FOOD SAFETY BEHAVIOUR IN THE HOME: DEVELOPMENT, APPLICATION AND EVALUATION OF A SOCIAL MARKETING FOOD SAFETY EDUCATION INITIATIVE.

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ABSTRACT

Foodborne disease is recognised as an important public health problem, with the domestic kitchen thought to be a point of origin for many cases. Foodborne pathogens associated with a range of raw foods can contaminate the kitchen unless appropriate food safety control measures are implemented. Consumer food safety education is therefore required to improve food safety practices during food preparation, and thus reduce the risk of foodborne disease.

Quantitative and qualitative research methods have been used to evaluate consumer attitudes towards food safety in the domestic kitchen and food safety education. Additionally, food safety behaviours have been assessed using an advanced observational technique incorporating CCTV and risk based scoring. This provided a quantitative assessment of the frequency, consistency and reproducibility of food safety malpractices, and enabled an evaluation of food safety intervention effectiveness.

Observations showed that food safety behaviours were variable and in many cases unsafe, indicating the need for food safety education. Overall, general consumer attitudes towards food safety in the domestic kitchen and food safety education were positive, although differences in respondent demographics highlighted the need for targeted educational efforts. Research findings informed development of a social marketing initiative that aimed to improve specific food safety behaviours. Observation results showed that the majority of consumers implemented unsafe cross contamination behaviours, so improvement of such actions was determined as the behavioural objective of the initiative. An evaluation of behaviours before and after intervention suggested that a 'one-off' social marketing strategy resulted in an initial behavioural improvement, which was not wholly maintained after 4-6 weeks. Results indicate that application of social marketing to food safety education may help to improve consumer food safety behaviours and reduce the risk of foodborne disease.

Cumulatively, this thesis has improved our understanding of consumer food safety behaviour, and provided important data to inform the development of future food safety education initiatives that intend to raise awareness of food safety issues, and bring about behavioural change.

PUBLICATIONS AND CONFERENCE CONTRIBUTIONS

IN SUPPORT OF THIS THESIS

Papers / chapters.

Redmond, E.C. and Griffith, C.J. (2003) Consumer food-handling in the home: a review of food safety studies. *Journal of Food Protection*. 66, (1), p130-161.

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Griffith, C.J. and Redmond, E.C. (2003) Consumer use of food products: a food safety perspective. In Lelieveld, Mostert, Holah, White. (eds). *Food Processing*. Woodhead Publishing Ltd. Cambridge. In press.

Griffith, C. J. and Redmond, E.C. (2001) Evaluating hygiene behaviour in the domestic setting and the impact of hygiene education. *Journal of Infection*. 43, p70-74.

Reports.

Redmond, E. C., Griffith, C. J., Slader, J. and Humphrey, T.J. (2001) The Evaluation and Application of Information on Consumer Hazard and Risk to Food Safety Education. (CSA 5107). Food Standards Agency. London.

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Griffith, C. J., Peters, A.C., Lewis, A., Davidson, C., Redmond, E.C. and Davies, C. (1999) The Application of Notation Analysis to Assess the Potential for Cross Contamination in Domestic Food Preparation. Department of Health. (DH215). London.

Conference contributions.

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Redmond, E.C., Griffith, C.J., Slader, J. and Humphrey, T.J. (2002) Assessment of risks associated with consumer food handling practices using real-time microbiological analysis. IAFP Conference, 89th Annual Meeting, San Diego, California. June 30th – July 3rd. Poster presentation.

Redmond, E.C., Griffith, C.J. and Peters, A.C. (2000) A risk based evaluation of traditional and social marketing methods of food hygiene education. IAFP Conference, 87th Annual Meeting. August 6-9th. Atlanta, Georgia. Poster presentation.

Redmond, E.C., Griffith, C.J. and Peters, A.C. (2000) Use of social marketing in the prevention of specific cross contamination actions in the domestic environment. Proceedings of the 2nd NSF International Conference on Food safety: Preventing foodborne illness through science and education. 11-13th October. Savannah, Georgia.

Redmond, E.C., Griffith, C.J. and Peters, A.C. (2000) Risk based observational assessment of consumer food safety behavior and implications for food safety education. Proceedings of the 2nd NSF International Conference on Food safety: Preventing foodborne illness through science and education. 11-13th October. Savannah, Georgia.

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DEDICATION

For my parents.

Thank you for all your love and support, and giving me the motivation to keep going!

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ABBREVIATIONS

ACMSF	Advisory Committee in the Microbiological Safety of Food.
ADA	American Dietetic Association.
ANOVA	Analysis of Variance.
ANZFA	Australian New Zealand Food Authority.
APC	Aerobic Plate Count.
BBC	British Broadcasting Co-operation.
CCTV	Closed Circuit Television.
CDNANZ	Communicable Disease Network, Australia and New Zealand.
CDSC	Communicable Disease Surveillance Centers.
CFDRA	Campden Food and Drink Research Association.
CFIA	Canadian Food Inspection Agency.
CFSAN	Centre for Food Safety and Applied Nutrition.
CH	Contaminated hand.
CMO	Chief Medical Officer
CRCE	Cardiff Research Centre Estimates.
CU	Contaminated utensil.
CV	Coefficient of Variation.
DEFRA	Department for Environment, Food and Rural Affairs.
DHHS	Department of Health and Human Services.
DHSS	Department of Health and Social Sciences.
DoH	Department of Health.
EHD	Environmental Health Department.
EHO	Environmental Health Officer.
EPT	End-Point-Temperature.
ERS	Economic Research Service.
FAO	Food and Agriculture Organisation of the United Nations.
FDA	Food and Drug Administration.
FDF	Food and Drink Federation.
FOR	Food Operations Risk.
FSA	Food Standards Agency.
FSAI	Food Safety Authority of Ireland.
FSES	Food Safety Education Staff.
FSIS	Food Safety Inspection Service.
FSR	Food Safety Risk.
GP	General Practitioner.
H	Hand.
HACCP	Hazard Analysis Critical Control Point.
HAPA	Health Action Process Approach.
HAS	Health Services Agency.
HBM	Health Belief Model.
HEA	Health Education Authority.
ICMSF	International Commission for the Microbiological Safety of Food.

ICRT	International Consumer Research and Testing.
IEHO	Institute of Environmental Health Officers.
IFH	International Scientific Forum on Home Hygiene.
IID	Infectious Intestinal Disease.
KAP	Knowledge, Attitudes, Practice.
LA	Local Authorities.
MAFF	Ministry of Agriculture, Fisheries and Food.
NACMCF	National Advisory Commission for Microbiological Criteria of Foods.
NCC	National Consumer Council.
NFSD	Novartis Foundation for Sustainable Development.
NG.	No Growth.
NHS	National Health Service.
NIHSSB	Northern Ireland Health and Social Services Board.
OAP	Old Age Pensioner.
ONS	Office for National Statistics.
PHLS	Public Health laboratory Service.
PHS	Public Health Service.
POST	Parliamentary Office of Science and Technology.
RC	Raw chicken.
RCP	Raw chicken packaging.
RE	Raw egg.
RES	Raw egg shells.
RM	Raw meat
RMP	Raw meat packaging.
RTE	Ready-to-eat.
RUHBC	Research Unit in Health and Behaviour Change.
SAE	Stamped Addressed Envelope.
SD	Standard Deviation.
SEG	Socio-economic Group.
SMI	Social Marketing Institute.
SPSS	Statistical Package for the Social Sciences.
TPB	Theory of Planned Behaviour.
TRA	Theory of Reasoned Action.
TTM	Transtheoretical Model.
U	Unclean utensil.
USDA	United States Department of Agriculture.
USDHHS	United States Department of Health and Human Services.
USEPA	United States Environmental and Protection Agency.
USF	University of South Florida.
UWIC	University of Wales Institute, Cardiff.
VAS	Visual Analogue Scale.
VTEC	Vero cytotoxin-producing *Escherichia coli*.
WHO	World Health Organisation.
WWW	World Wide Web.

DEFINITIONS

Case.	A person who has been ill following consumption of food, or consumption of water considered to be contaminated on the basis of epidemiological evidence or laboratory analysis, or who is part of an outbreak of food poisoning (Sockett *et al.* 1993).
Sporadic case.	A person with symptoms who has no known association with another case (Sockett *et al.* 1993).
Outbreak.	An incident in which two or more people, thought to have common exposure, experience a similar illness or proven infection, at least one of them being ill (Evans *et al.* 1998)
General outbreak.	An outbreak that affects members of more than one household, or residents of an institution (Evans *et al.* 1998).
Incident.	Refers to either an outbreak or a sporadic case (Sockett *et al.* 1993).
Formally notified case.	An individual statutorily notified to the proper officer by the attending doctor following a clinical diagnosis of food poisoning (Sockett *et al.* 1993).
Otherwise ascertained cases.	Suspected cases of food poisoning which came to the notice of the local authority, but which were not formally notified (Sockett *et al.* 1993).
Observational technique.	Observation of meal preparations in the model domestic kitchen using CCTV and risk based scoring.
Indirect contamination.	Passage of pathogens via an intermediary vehicle to a previously uncontaminated or cooked food. The main vehicles are hands, equipment, utensils, surfaces and cloths (Worsfold and Griffith, 1996a).
Potentially contaminated.	A material / food / surface that in its natural state is not contaminated with pathogenic micro-organisms, however, as a result of other actions / activities during domestic food preparation may become contaminated has been referred to as being.
Adequate hand-washing and hand drying.	Immediate thorough hand-washing after touching raw chicken using hand hot water and soap / detergent, followed by effective drying using a clean, hand towel or disposable paper towel (no contamination of the kitchen before washing and no touching of the tap before washing, and no contamination of kitchen items within kitchen before washing) (Griffith *et al.*1999a).
Inadequate hand-washing and hand drying.	Failure to implement adequate hand-washing and hand drying (as stated above).
Adequate washing and drying of equipment and utensils.	Adequate washing / drying of utensils (particularly after preparation of raw meat, raw chicken or raw egg) includes applying an abrasive scrubbing action with hot water, detergent and a clean cloth followed by rinsing and drying using an clean T-towel or disposable paper towel (Griffith *et al.* 1999a).
Inadequate washing and drying of equipment and utensils.	Failure to implement adequate washing and drying of equipment and utensils (as stated above).
Thorough cooking.	Heating of food products to reach 75°C for 30 seconds or equivalent (DoH and MAFF, 1996).
Adequate cooling.	Cooling of heated food products to <10°C within 90 minutes of removal from the heat (Sprenger, 1995).
Clean hand towel or T-towel.	A T-towel or hand towel that is considered to be 'clean' when it has *not* been previously in contact with potentially contaminated hands that have either not been washed or inadequately washed, or has been used to wipe a kitchen work surface.
Unclean utensil.	A utensil that has been used to taste meal or returned to a work surface each time before stirring.
Unclean hands.	Hands that are visually dirty and / or carry a risk of contamination with pathogens (i.e. have previously been in contact with other objects or surfaces that could have been contaminated).
Potentially contaminated hands.	Hands that have been unwashed and / or dried or inadequately washed and / or dried after direct or indirect contact with RC / RM and / or RCP, RMP and / or RE / RES.
Potentially contaminated utensils.	A utensil that has been unwashed / dried or inadequately washed and / or dried after direct or indirect contact with RC / RM and / or RCP, RMP and / or RE / RES.
Social marketing.	'Social marketing is the application of commercial marketing technologies to the analysis, planning, execution and evaluation of programs designed to influence the voluntary behaviour of target audiences in order to improve their personal welfare and that of society' (Andreason, 1995).

CHAPTER 1.0

INTRODUCTION.

In modern society prevention of disease and improvement of human health is of paramount importance, not only for governments and industries but also for consumers. The health of the population is affected by many factors, not least of which is the food supply (Forsythe, 1996). Many foods that are bought into the home and prepared for consumption are frequently contaminated with naturally occurring pathogenic micro-organisms (Ellard, 1999). Such pathogens cannot be seen, smelled, tasted or identified by touch (Roberts *et al.* 1995a) but when consumed can cause illnesses resulting from bacterial foodborne disease of varying severity, including death. Thus, food safety issues are of major importance to world health (WHO, 2000a) and indeed, food safety is an issue which affects every man, woman and child in the UK (FSA, 2000a).

Illnesses resulting from consumption of contaminated food have become one of the most widespread public health problems in the contemporary world (Notermans *et al.* 1995). National and international reported incidence of foodborne disease has increased substantially during the past 15 years. The full extent of the social and economic impact of foodborne illnesses to society is difficult to measure, however, cumulatively financial and social costs emphasise the need for effective strategies for food hygiene education.

The majority of food poisoning cases in the UK are thought to be sporadic (FSA, 2000b) and many are self-preventable. The domestic kitchen may be a significant point of origin for many of these cases. Indeed, data from Europe, North America, Australia and New Zealand have indicated that a substantial proportion of foodborne disease is attributable to food preparation malpractices implemented in the home (Redmond and Griffith, 2003a). The consumer is the least studied link in the food chain, yet is considered to be the '*final line of defence*' (Gilbert, 1983) for prevention against food poisoning. Consumers prepare and handle food in the domestic environment on a daily basis, so research and consumer education regarding the risk of food safety malpractices in the home is an essential element of preventing food poisoning (Kaferstein, 1997). In a recent strategy document, the Food Standards Agency (FSA) stated that the most significant reduction in the number of cases of foodborne disease over the next five years is likely to come from focussing attention on food preparation, particularly in the domestic setting (FSA, 2001a).

The importance of adequate consumer food-handling practices has been increasingly acknowledged in recent years (FSA, 2000a; Griffith *et al.* 1998; POST, 1997; Scott, 1996). As a consequence of this, an increasing amount of research regarding consumer food safety behaviour in the home has been undertaken, the majority of which has suggested that consumer food safety practices in the home are inadequate and increase the potential risk for foodborne disease. Many surveys have determined consumer knowledge and self-reported practices of food-handling behaviours implemented in the home, yet there is a lack of data available detailing consumer attitudes. It is considered that such data is needed (in addition to knowledge and self-reported practice) to attempt to understand why some food safety behaviours are performed and others are not. Research has also shown that discrepancies exist between reported food safety knowledge, self-reported practices and observed food-handling practices. It is considered that use of the observational technique provides more accurate data denoting failure and implementation of safe food-handling actions (Anderson, 2002; Griffith *et al.* 2001). Thus, further work is required to observe, assess and quantify consumer food-handling behaviours that are implemented in the domestic environment. Determination of the reproducibility and consistency of food-handling actions is also required to obtain a more accurate picture of how consumers handle foods in terms of food safety.

Effective food safety education is required to improve consumers' food safety behaviour in the domestic environment. However, relatively little is actually known about how consumers perceive food safety educational sources and materials, in terms of general attitudes towards information, receptivity to advice and perceived credibility of providers of information. Traditional intervention approaches have mainly been 'expert driven' and consisted of the provision of knowledge based educational materials. Such approaches have been based on the assumption that consumers will make informed and correct decisions about their own food-handling practices. However, although knowledge of the consequences of unsafe food-handling practices can enhance consumer motivation to change behaviour (Bruhn, 1997) such educational methods may not always bring about the desired behavioural change (Nichols *et al.* 1988).

A greater level of importance is now given to social and environmental variables when attempting to improve health-related behaviours (Bennett and Murphy, 1999). Knowledge of cognitive antecedents that influence consumers food preparation behaviours (Levy, 2002) and identification of perceptions of food safety interventions are also essential for the development of effective communication strategies to provide risk raising awareness of important hygiene issues. The consumer orientated approach of social marketing provides a framework for such strategies to be developed and applied by adopting traditional marketing technologies to target tailored communication material towards the needs and wants of specific consumer audiences. Previous research has suggested that different groups of consumers respond to food safety information in different ways (WHO, 2000b) and targeted interventions can be more effective for bringing about desirable behavioural change (Andreason, 1995).

Although evaluation is considered to be a critical part of the developmental and summative processes of health education initiatives, effective evaluation of the effectiveness of food safety education attempts have been ineffective or largely disregarded. Measurement of consumer knowledge and self-reported behaviour (using survey instruments) has been undertaken in instances to determine the effectiveness of other health-related educational initiatives that have aimed to bring about *behavioural* change. However, given the discrepancies that exist between knowledge, self-reported practice and actual behaviour (Redmond and Griffith, 2003a), use of such an approach may provide inaccurate and unreliable findings. Indeed, McKenzie-Mohr and Smith (1999) stated that a primary concern when evaluating the effectiveness of interventions designed to bring about behavioural change should always be to determine change of the actual targeted behaviour using a direct measurement approach. The purpose of the majority of consumer food safety education initiatives is to ultimately bring about improvement of food safety behaviours, therefore it is considered that the use of the observation technique for evaluation of food safety interventions would provide valuable information in terms of effectiveness.

Cumulatively, previous literature has denoted a definitive need for a decrease of the incidence of foodborne disease. In the UK, the FSA has indicated that the most significant reduction of the number of cases of foodborne disease is likely to come from improvement of food safety practices during food preparation (FSA, 2001a). However, before it is possible to design effective food safety interventions that intend to bring about improvement of food safety behaviours during food preparation, there is a need to ascertain what food safety behaviours are and are not being implemented in the domestic kitchen, and why this is so. Thus, there is a need to determine attitudes and perceptions towards specific food safety behaviours and overall food safety in the domestic kitchen to identify potential impediments to the implementation of safe practices. Similarly, to increase potential effectiveness of food safety interventions, an assessment of attitudes and perceptions towards food safety education sources, organisations and spokespersons is required. In addition, to maximise potential effectiveness of food safety education attempts, targeted approaches to food safety education designed to bring about behavioural change is advocated. Furthermore, there is a need for the development of a direct and objective means to evaluate the effectiveness of food safety educational interventions.

The following thesis analyses consumer food safety behaviours and uses a social marketing approach for development and application of a small-scale consumer food safety education initiative. The effectiveness of the initiative was evaluated using observation of food safety behaviours. Structurally, this thesis consists of nine chapters and a brief summary of each of the chapters is provided below.

- Chapter 2.0 reviews previous and current literature detailing information relating to the current incidence, causes, sources and influences of foodborne disease, as well as methods and sources used for food safety education. An evaluation of such information provides an introduction into the field of domestic food safety and highlights the need for more effective consumer food safety education.

- Chapter 3.0 presents a survey detailing consumer attitudes towards food safety behaviours in the home and perceptions of food safety risks, control and responsibility. The findings improve our understanding of why some food safety behaviours are implemented and others are not. In addition, the findings have been utilsed in Chapter 7.0 for the development of a social marketing based food safety education initiative.

- Chapter 4.0 presents a survey detailing attitudes and perceptions towards aspects of food safety education. Findings have been utilsed in Chapter 7.0 for the development of a social marketing based food safety education initiative.

- Chapter 5.0 reports upon the design, development and piloting of the observational technique for studying consumer food safety behaviours in a model domestic kitchen. Observational checklists and a generic risk based scoring system have been devised to record and quantify observed food safety behaviours. Development of the observational technique both facilitated a better understanding of consumers' food safety behaviours (see Chapter 6.0) and contributes important data to aid development of food safety education strategies (see Chapter 7.0). In addition, the observational technique provides a method for evaluating the effectiveness of food safety interventions (see Chapter 8.0).

- Chapter 6.0 examines the reliability and reproducibility of the observational technique for assessment of consumer food safety behaviours in the model domestic kitchen. Evaluation of such factors validated the observational technique developed in Chapter 5.0 as a reliable method for evaluation of the effectiveness of food safety education interventions (see Chapter 8.0).

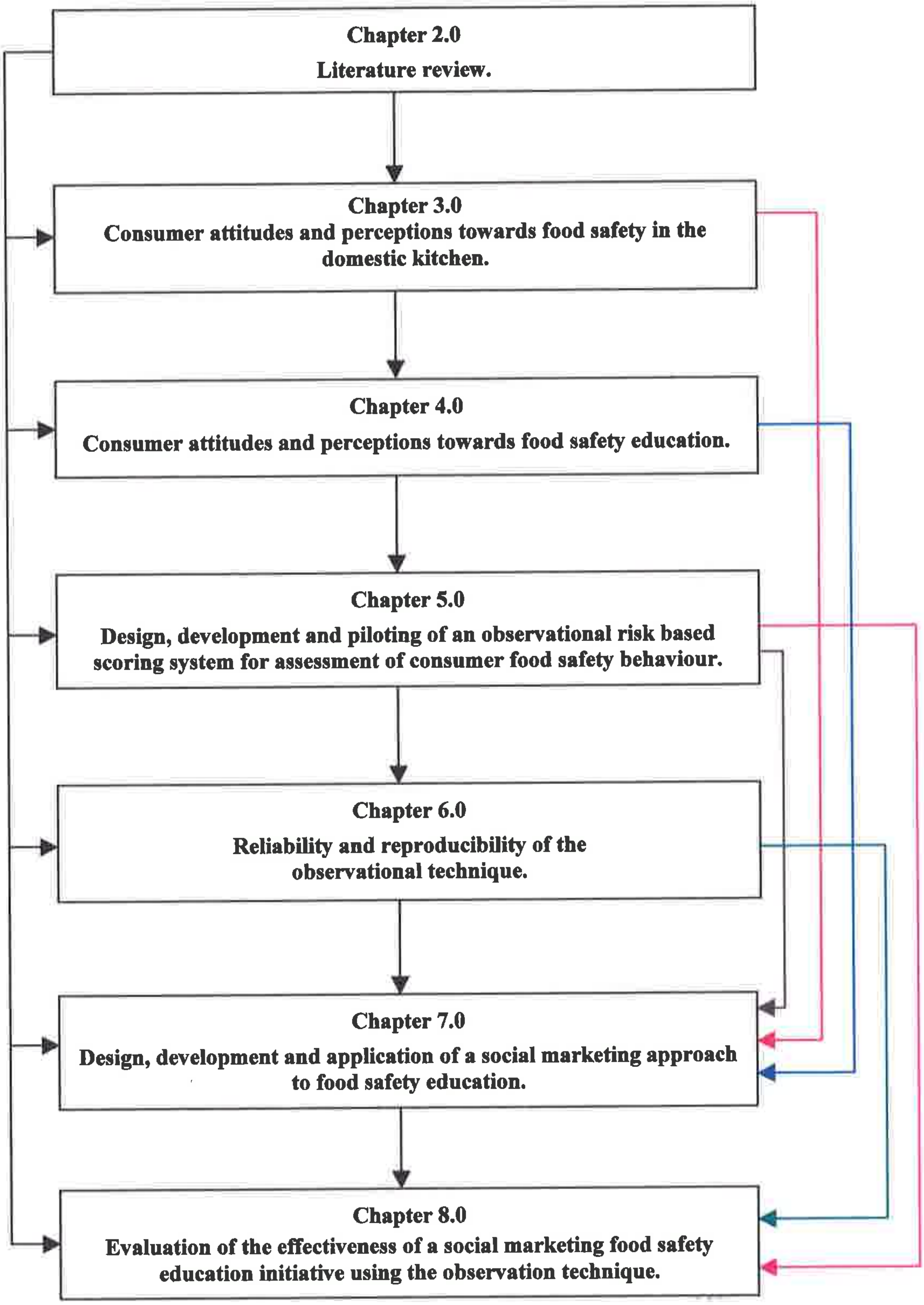
- Chapter 7.0 describes the design, development and application of the social marketing approach to food safety education. Quantitative findings from Chapters 3.0 and 4.0 detailing consumers' attitudes and perceptions of food safety behaviours and food safety education were used to aid the development process, as well as qualitative data from focus groups. In addition, observational data from Chapter 5.0 was used for determination of behavioural objectives. This chapter formulates a food safety education strategy based on the social marketing approach, which is then implemented as a small-scale initiative for a targeted group of consumers within a geographical community in Cardiff.

- Chapter 8.0 utilises the observational technique developed in Chapter 5.0 and validated in Chapter 6.0 to evaluate the social marketing food safety educational initiative developed in Chapter 7.0. Food safety behaviours of consumers from the 'test' community were evaluated before, immediately after and 4-6 weeks after intervention. Results were evaluated and compared to food safety behaviours of consumers from a control community who received no food safety education material.

- Chapter 9.0 forms a synoptic chapter bringing together the conclusions from all of the chapters included in this thesis. In addition recommendations are made for further research.

A plan of this thesis showing the inter-relationships between each of the chapters is illustrated in Figure 1.1. It can be seen that the literature review provided an introduction for each of the chapters. Data denoting attitudes and perceptions towards food safety in the domestic kitchen (Chapter 3.0) and towards food safety education (Chapter 4.0) and observed food safety malpractices implemented during domestic food preparation (Chapter 5.0) was required and utilised to inform the development of the social marketing food safety education strategy in Chapter 7.0. To evaluate the effectiveness of the social marketing food safety educational initiative developed in Chapter 7.0 and implemented in Chapter 8.0, a direct, quantitative method for assessment of actual food safety behavioural change was required. Thus, an observational risk based scoring system was designed, developed and piloted in Chapter 5.0 to obtain first-hand, quantified observation data detailing actual food safety behaviours during domestic food preparation. The reliability and representativeness of data collected using the observational technique was determined in Chapter 6.0. Development and validation of such a technique facilitated evaluation of the effectiveness of the social marketing food safety education initiative by assessment of behavioural change (Chapter 8.0).

Figure 1.1 Plan of thesis and inter-relationships between chapters.



CHAPTER 2.0

LITERATURE REVIEW.

2.1 INTRODUCTION.

The following chapter reviews previous and current literature relating to the current incidence, causes, sources and factors influencing foodborne disease, as well as methods and sources used for food safety education. The evaluation of such information provides an introduction to the field of domestic food safety and illustrates the need for more effective approaches for consumer food safety education.

2.2 EXPLANATION OF TERMS.

Universally accepted definitions of foodborne disease, foodborne illness and food poisoning provide substantial confusion and debate among food safety professionals in terms of correct meaning and use (Roberts, 2002). Frequently, such terms are used interchangeably within official reports, publications and research notes. It has been reported that foodborne infection and food poisoning / intoxications are considered to be categories of foodborne illness (Hall, 2002) and foodborne disease is a composite term used to describe all foodborne illnesses and food poisoning (Clark, 2002). The following discussion highlights the differences between published definitions, and attempts to ascertain the most suitable and defined terms of reference for use in this thesis.

Prior to 1992, no formal definition for the term 'food poisoning' existed. This was largely due to the absence of a definition of the term in the Public Health (Control of Diseases) Act, 1984. Therefore, before 1992, food poisoning was unofficially defined as '*a notifiable illness characterised by acute diarrhoea or vomiting caused by the consumption of food contaminated with pathogenic micro-organisms and / or their toxins*' (ACMSF, 1990; 1991). Absence of a formal definition created confusion among General Practitioners (GPs) regarding which cases of illnesses should be reported as food poisoning (Wall *et al.* 1996). Thus, to alleviate confusion government ministers asked the Advisory Committee for Microbiological Safety of Food (ACMSF) to propose a definition for use throughout the UK (Wall *et al.* 1996). The proposed definition for 'food poisoning' was published by the Chief Medical Officer in 1992 (CMO, 1992) and later adopted by the

World Health Organisation (Schmidt, 1995) to define the term 'foodborne disease'. This definition is as follows: *'any disease of an infectious or toxic nature caused by or thought to be caused by the consumption of food or water'* (CMO, 1992; Schmidt, 1995). This definition includes all food and waterborne illness regardless of the presenting symptoms and signs. It thus includes not only acute illnesses characterised by diarrhoea and / or vomiting, but also illnesses presenting manifestations not related to the gastrointestinal tract. The Parliamentary Office of Science and Technology (POST) (1997) have summarised such illnesses from food and water as being caused by the following agents: bacterial infections (e.g. *Salmonella* and *Campylobacter*); preformed bacterial toxins (e.g. botulism); other biological toxins (e.g. paralytic shellfish, scombrotoxin poisoning); viral infections (e.g. small, round, structured viruses); other parasitic infections (e.g. protozoa) and toxic chemicals (e.g. heavy metals).

However, the FSA (2000b) considered the above definition too broad and therefore inappropriate, given the reference to include illness due to chemical contamination of food, for example from insecticides, cleaning agents and heavy metals. Thus, during discussion of Agency strategies and targets the FSA has used the term 'foodborne disease' in reference to the following definition: *'a disease due to consumption of food contaminated with micro-organisms or their toxins'* (FSA, 2000b). This definition not only excludes chemical contamination of food but also waterborne diseases and diseases resulting from parasitic infections – unlike the definition suggested by the CMO.

The following thesis includes a review, analysis and discussion of published literature and consumer based research. The term 'food poisoning' is considered to be familiar to consumers and the terms 'food poisoning' and 'foodborne disease' are frequently used interchangeably in published journals and reports. In view of this both terms will be used interchangeably in this thesis, although terms used by authors will be used when referring to, or quoting work from outside of this study.

The question of which pathogens are associated with food poisoning is often unclear (Eley, 1996). Therefore the following explanation details micro-organisms associated with food poisoning / foodborne disease that are appropriate to the terms used in this thesis. There are two main categories of bacterial food poisoning – infective bacterial food poisoning and toxic bacterial food poisoning (Eley, 1996).

- Infective bacterial pathogens that cause food poisoning by an actual infection of the intestine. Usually these bacteria have to be present in large numbers (10^5-10^7 organisms/g food) as a result of being heavily contaminated or having been stored in conditions that promoted growth of large bacterial populations (Eley, 1996). However, it is now known that these organisms can cause disease with a relatively low infective dose (Eley, 1996). For example, the infective dose for causing *Campylobacter* infection can be as low as 500 cells (Robinson, 1981). Examples of infective bacterial pathogens that frequently cause food poisoning include *Salmonella* spp. and *Campylobacter* spp.

- Toxic bacterial food poisoning may be due to consumption of preformed toxins in foods and those that form a toxin in the intestine (Eley, 1996). Examples of toxic bacterial pathogens that often cause food poisoning include *Staphylococcus aureus*, *Bacillus cereus* and *Clostridium perfringens.* Strains of *Escherichia coli* are known to cause both toxic and infective bacterial food poisoning.

2.3 INCIDENCE OF FOODBORNE DISEASE.

Illness resulting from foodborne disease has become one of the most widespread public health problems in the contemporary world (Jermini, 1999; Motarjemi and Kaferstein, 1997). Internationally, it is considered that foodborne disease associated with microbial pathogens, biotoxins and chemical contaminants in food presents a serious threat to the health of millions of individuals (WHO, 2000d).

2.3.1 International incidence of foodborne disease.

Most countries with systems for reporting cases of foodborne diseases, have documented significant increases over the past few decades in the incidence of diseases caused by micro-organisms associated with food (FAO/WHO, 2002). Although every single person is at risk from foodborne disease, it is estimated that 30% of the industrialised population may suffer from foodborne illness each year (WHO, 2000e). Incidence data for England, USA, Australia and New Zealand is presented in Table 2.1. A direct comparison of incidence data is not possible due to differences in national surveillance systems, however, it is suggested that Australia, New Zealand, UK and USA appear to have a similar experience of incidence of foodborne disease (CDNANZ, 1997).

Data denoting food poisoning incidence from European countries tripled during the 1980's and 1990's (Maurice, 1995) and surveillance has indicated a steady increase of foodborne infections and intoxication's during the early 1990's (Schmidt, 1995). In 1995 it was estimated that 130 million Europeans were annually affected by episodes of foodborne disease (WHO, 2000f) and American data has indicated that food-related illnesses may cause approximately 76 million illnesses, 325,000 hospitalisations and 5000 deaths each year (Mead *et al.* 1999). These figures represent incidence of known and unknown agents attributable to foodborne transmission. Australian reports have further reiterated the significance of foodborne disease indicating an estimated incidence of 4.2 million cases per year (CDNANZ, 1997). Similarly, in New Zealand the estimated annual number of cases of foodborne disease is 119,000, including 400 hospital admissions and 2 deaths, such figures are reported to be increasing (Lake *et al.* 2000). Data in Table 2.1 indicate that New Zealand and USA have higher rates of foodborne disease than Australia and England.

Typically, meal patterns in Western society are based on consumption of three meals per day. Calculated figures (see Table 2.1) from foodborne disease estimates suggest that between 1-7% meals consumed each year cause foodborne disease and it is estimated that there may be 232,000 new cases of foodborne disease in Australia, England and Wales, New Zealand and USA every day. All reports of estimated foodborne disease statistics referred to in Table 2.1 acknowledged the difficulty of accurate surveillance. This is largely due to the formal notification and reporting of a small proportion of actual cases (see section 2.3.3). Estimated figures have been calculated using statistics from the approximate frequency of GP visits as a result of foodborne illness and actual formally notified cases of food poisoning (Lake *et al.* 2000; Mead *et al.* 1999; Wheeler *et al.* 1999).

Table 2.1 Estimated incidence of foodborne disease in selected countries[1].

	Australia	England	New Zealand	USA
Estimated number of annual cases of foodborne disease.	4.2 million[a]	4.5 million [b]	119,000[c]	76 million[d]
Estimated number of new cases of foodborne disease every day (estimated number of cases / 365).	11,500	12,300	326	208,000
Rate of foodborne disease expressed as a number of cases per 100 persons of the population, per year (estimated number of annual cases of foodborne disease / population x 100).	23	9	33	27
Estimated number of meals eaten every year (population x 3 meals per day).	55.5 million	150 million	11.4 million	859 million
% meals eaten each year which cause foodborne disease (estimated number of cases of foodborne disease /number of meals eaten each year x 100).	7%	3%	1%	1%

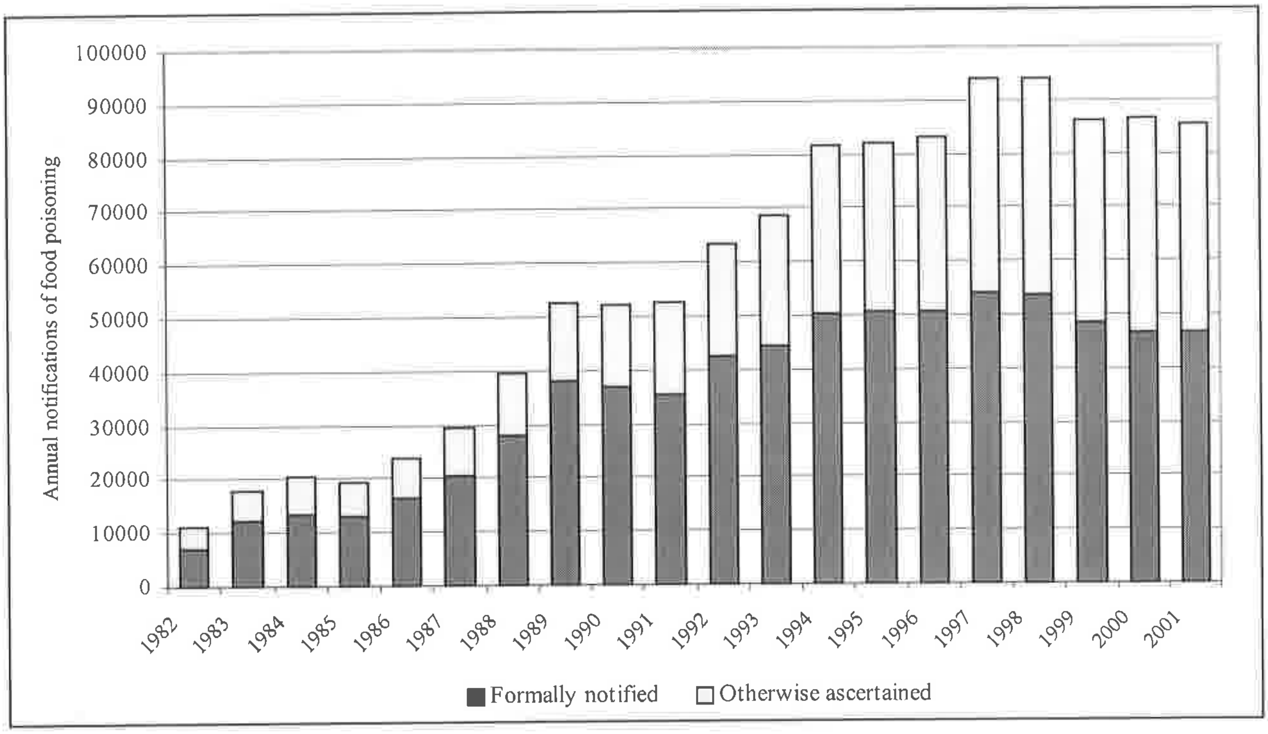
[a]ANZFA, 1999; [b]DoH and MAFF, 2000; [c]Lake *et al.* 2000; [d]Mead *et al.* 1999.

[1] Population data used for calculations; USA (U.S. Census Bureau, 2000), England (National Statistics, 2000), Australia and New Zealand (Australian Bureau of Statistics, 2000).

2.3.2 National Incidence.

The overall number of reported cases of food poisoning in England and Wales has increased nearly five-fold since the early 1980's (Maurice, 1995), with incidence of formally notified and otherwise ascertained cases of food poisoning increasing from 11,256 cases in 1982 to 93,932 cases in 1998 (PHLS, 2002a) (see Figure 2.1). Incidence peaked and remained more or less constant at ~94,000 reported cases between 1997-1998. However, between 1998-1999 an 8% reduction in incidence was recorded (PHLS, 2002a). This was the first time in 15 years that there has been a fall in reported food poisoning cases (Mursell, 2000). Since 1999, notified incidence of food poisoning has reduced by a further 1%, and 85,468 cases of food poisoning were formally notified / otherwise ascertained in 2001 (PHLS, 2002a). Factors that may have influenced the upward trend of incidence of foodborne disease in England and Wales are discussed in section 2.3.4.

Figure 2.1 Annual notifications of food poisoning, England and Wales 1982-2001 (PHLS, 2002a).



A large UK study reporting intestinal infectious diseases (IID's) was completed in 1999 to attempt to establish a more accurate incidence, reporting and aetiology of IID's in the community (IID Executive Committee, 2000; Wheeler *et al.* 1999). The term IID is used to describe gastrointestinal symptoms (diarrhoea, vomiting and abdominal pain) due to micro-organisms or their toxins, (FSA, 2001c) however, only a proportion of such cases are foodborne (FSA, 2001a; Hilton, 2002). The study found that IID's cause substantial morbidity and mortality in England and Wales with an estimated 9.4 million cases each year, including 35,000 hospital admissions and over 300 deaths (Wheeler *et al.* 1999). Using this data it has been suggested that 4.5 million people a year are estimated to suffer from foodborne disease (DoH and MAFF, 2000; FSA, 2000c).

2.3.3 Under-reporting of foodborne disease.

Under-ascertainment of foodborne disease incidence is an international problem. The true incidence is difficult to obtain due to under-reporting of cases of illness (Lake *et al.* 2000). Although foodborne illnesses can be severe and fatal, milder cases are often not detected through routine surveillance (Mead *et al.* 1999). Given that most foodborne illnesses only cause discomfort for a short period of time, medical attention is frequently not sought (Anderson, 2000; IID Executive Committee, 2000; Mead *et al.* 1999; Scott, 1996). Therefore, the small proportion of more severe food poisoning cases that are reported may only represent the *'tip of the iceberg'* (Maurice, 1995). Illustrating such under-reporting, the FSA in the UK found that 80% of people who suffered what they considered to be food poisoning failed to report it to anyone (FSA, 2001b). Similarly in other industrialised countries only relatively small percentages of people suffering from suspected foodborne illnesses have been reported to consult a health worker, for example 5% in Netherlands, 6% in Sweden and 13% in New Zealand (Motarjemi and Kaferstein, 1997).

The majority (>95%) of cases of foodborne disease are believed to be sporadic (FSA, 2000b; Olsen *et al.* 2000). These cases, as well as small outbreaks may have originated from the home and typically involve individuals or a small number of people, therefore they less likely to be identified by public health authorities (Knabel, 1995; Worsfold and Griffith, 1997a). The World Health Organisation (1997) has indicated that estimated incidence of foodborne disease may be as much as 300-350 times more frequent than reported. However, more recent data suggests that the overall reported incidence of foodborne diseases represent between 1-10% of the actual incidence (ANZFA, 1999; FAO/WHO, 2002). In the UK the substantial under-reporting of specific pathogens has been determined and it is suggested that only 5% *Salmonella* cases and 0.04% *Campylobacter* cases are actually reported (IID Executive Committee, 2000).

Research has suggested that the degree of under-reporting of foodborne disease as a whole, and for different pathogens varies from year to year (ACMSF, 1991). Nevertheless, given that the absolute number of cases of foodborne disease is not known, laboratory reports of major pathogens such as *Campylobacter*, *Salmonella*, *E.coli* 0157, *Clostridium perfringens* as well as listeriosis are considered to be a reliable way of measuring trends (FSA, 2001c).

2.3.4 Foodborne disease incidence trends.

As previously mentioned, overall incidence of food poisoning in UK, USA and Europe has increased during the past 20 years (CDNANZ, 1997). The extent of this overall increase has been difficult to measure accurately (ACMSF, 1991) and therefore the legitimacy of increased reported figures has been challenged. There is not one single cause for the upward trend (ACMSF, 1991) and reasons for the increased incidence in industrialised countries are believed to be complex (Desmarchelier, 1996).

In the UK, until 1997, officially reported food poisoning incidence figures undoubtedly showed an increase in the number of food poisoning cases each year (POST, 1997). It is argued that circulation of the new definition of food poisoning (Wall *et al.* 1996) to all GPs in 1992 may have influenced more frequent notifications. However, it is considered to be difficult to explain all of the increase through such effects, especially as most of the increase since 1992 has been from 'otherwise ascertained' cases, which are outside of the patient-doctor route (POST, 1997). An additional factor that may have influenced increased incidence of foodborne disease is that widespread publicity of food safety has improved public awareness of foodborne illness (Levy, 1997), and so GPs are more likely to be consulted due to illness and therefore additional cases may be reported. However, statutory notifications and laboratory reporting methods of data collection remained unchanged whilst the upward trend in incidence began (POST, 1997). Indeed, trends in reported food poisoning and laboratory reported salmonellosis have corresponded, despite being obtained through different mechanisms (Sockett *et al.* 1993). In addition there have been increases in different pathogen serotypes. For example, *Salmonella enteritidis* was the most prevalent serotype of *Salmonella* in 1980's and 90's (Cox, 1995; Humphrey, 1990) but recent reports have indicated that *Salmonella typhimurium* incidence has increased significantly in recent years (PHLS, 2000). Changes in food consumption patterns have also facilitated the emergence of foodborne disease patterns (Altekruse and Swerdlow, 1996). Thus, overall the upward trend of foodborne disease incidence in England and Wales considered is a 'real' increase (POST, 1997; Wall *et al.* 1996).

2.3.5 Costs of foodborne disease.

The widespread incidence of foodborne disease generates a substantial burden on society and the full extent of the social and economic impact of such illnesses is difficult to measure. Significant costs are incurred by the public sector, industry, to the infected individual and family, and entire communities may be affected (Kaferstein, 1997; Sockett and Roberts, 1991). The magnitude of potential costs can be directly related to the severity of ill health (Henson, 1996). Reports have indicated that the bacterial pathogens that incur the highest total estimated costs include *Campylobacter*, *Salmonella* and *Staphylococcus* (Roberts, 1989). Indeed, it has been estimated that in the USA a reduction of *Campylobacter* incidence alone could save up to $5.6 billion in tangible costs annually (Buzby and Roberts, 1997a).

International and national monetary costs of foodborne disease can be seen in Table 2.2. In addition to this information, recent data from Wales has suggested that 23,000 cases of salmonellosis in Wales were estimated to have cost an overall £40-50 million (Jermini, 1999). It is difficult to make direct comparisons between costs of foodborne disease from different countries as sources of information are not only from different years, but also collected using different methods. For example, some estimates account for tangible costs, others account for tangible and intangible costs. Nevertheless, it can be seen that substantial financial costs are incurred from foodborne disease. It is reported that the majority of economic estimates made are dependent on incidence estimates, so financial costs that have been discussed in this section may have been underestimated (Archer and Kvenberg, 1985).

Table 2.2 International and national monetary costs of foodborne disease (*tangible costs only, **tangible and intangible costs).

	Australia**	Canada**	England*	New Zealand**	USA*
Estimated cost per case.	A$630[1]	C$1100[2]	£606[3]	NZ$462[4]	US$1240[5]
Estimated annual cost.	A$2.6 billion[1]	C$1.2 billion[2]	£645 million[3]	NZ$88.8 million[4]	US$6.5-33 billion[6,7]

[1]ANZFA, 1999, [2]Todd, 1989a, [3]IID Executive Committee, 2000; [4]Scott *et al.* 2000; [5]Todd, 1989b, [6]Buzby and Roberts, 1997b, [7]Buzby *et al.* 1996.

Methods for determination of monetary costs of foodborne disease in Table 2.2.

- Australian data has accounted for tangible and intangible costs (ANZFA, 1999) and costs for New Zealand were based on direct and non direct medical costs such as lost productivity and intangible loss of life (Scott *et al.* 2000).

- Estimated costs for Canada have been calculated from the economic impact of 68 incidents of foodborne disease caused by 13 different etiologic agents. Costs of illness from mishandled food preparation, processed food and value of deaths were totaled for each disease to give an overall estimate (1985C$) (Todd, 1989a).

- The estimated annual cost for England was based upon NHS costs (37%), individual costs (8%) and employment costs (56%) determined for the IID study in England. This cost was based upon 9.4 million annual cases of IID, and given as foodborne disease accounts of a proportion of IID cases the overall estimated costs is likely to be an overestimate. The estimated costs per case from the same study and based upon the cost of a case of *Salmonella* presented to a GP (IID Executive Committee, 2000).

- Expense for individual cases of foodborne disease in USA was based upon the average cost of illness resulting from a bacterial source of infection (1989 US$) (Todd, 1989b). Estimated annual cost for these illnesses in USA was calculated from actual medical costs and productivity costs from the six most commonly reported bacterial foodborne pathogens. Full valuations of other costs to individuals, industry or public sectors are not included in these valuations (Buzby *et al.* 1996; Buzby and Roberts, 1997b).

2.3.5.1 Tangible costs of foodborne disease.

Tangible costs resulting from foodborne disease include those that can be easily measured in monetary terms and namely affect the public sector, medical profession, food industry, and sick individual(s). Financial costs are not only associated with investigation, surveillance, treatment and prevention of spread of infection, but may also affect the whole food chain (Sockett, 1991). Industry is affected by lost productivity through sickness related absence from work (Sockett *et al.* 1993), product recalls / withdrawals, immediate loss of sales and bad publicity resulting in loss of consumer confidence (ANZFA, 1999; Sockett, 1993). The public sector is affected due to the expense of medical costs, health care, hospitalisations and other treatment related costs. Local authorities (LA), Communicable Disease Surveillance Centers (CDSC), Department of Health and Social Services (DHSS) and laboratories all also incur expense as part of investigative and surveillance processes. In addition, costs are also incurred to facilitate preventative strategies and health education initiatives to attempt to decrease incidence of foodborne disease. Financial costs affecting individuals and families include lost working time, travel costs, averting behaviour costs (Roberts, 1989) and direct and attributable costs of the actual illness.

2.3.5.2 Intangible costs of foodborne disease.

The financial estimates presented in Table 2.2 undervalue the true societal costs incurred as a result of foodborne disease. Health consequences of foodborne illnesses are varied (Kaferstein, 1997), foodborne pathogens can cause mild, self-limiting gastrointestinal illnesses, severe acute illnesses (Buzby and Roberts, 1997a) and even potentially fatal conditions. It has been estimated that secondary long-term sequalae or life threatening complications develop in 2-3% of acute cases of foodborne illnesses (Archer and Kvenberg, 1985; Bunning *et al.* 1997; Buzby and Roberts, 1997b). A financial value for psychological costs, endurance of pain and suffering of unpleasant symptoms or loss of leisure time and disruption to normal activity attributable to experiencing food poisoning is difficult to measure (Buzby *et al.* 1996). However, estimated costs of loss of life have been included in estimated annual costs of foodborne disease for Canada, Australia and New Zealand (see Table 2.2).

The totality of tangible and intangible costs emphasise the need for strategies to reduce the incidence of foodborne disease, reduce financial costs as well as prevent the discomfort or potentially life threatening risks of foodborne illnesses. Such illnesses may be preventable and the social and economic costs are potentially avoidable (Sockett and Roberts, 1991).

2.4 EPIDEMIOLOGY OF FOODBORNE DISEASE.

2.4.1 Factors influencing foodborne disease.

Epidemiology of foodborne disease has changed significantly during the last few decades (Desmarchelier, 1996) and this has been due to a variety of factors (Smith and Fratamico, 1995; WHO, 2000b). The population structure has changed, which has resulted in a larger proportion of individuals that are more 'at risk' and vulnerable to infection. Consumers' lifestyles, food purchasing, preparation and consumption behaviours have also changed, resulting in the development of new methods of food production and preservation which allow greater survival and potential for proliferation of foodborne pathogens, such as *Salmonella enteritidis*, *Campylobacter jejuni* and *Escherichia coli* 0157 (Altekruse and Swerdlow, 1996).

2.4.1.1 Populations at risk from foodborne disease.

Vulnerable populations that are more susceptible to bacterial pathogenic infection include the elderly (Smith 1998), young and immuno-compromised and pregnant (Smith, 1999). In the last few decades, reports have indicated that the proportions of 'at risk' individuals in the population have increased (Desmarchelier, 1996), and continue to increase (Oosterom, 1998), thus adding to the public impact of foodborne illnesses (CDNANZ, 1997). Although the aged and infirm have always been vulnerable, the population on average is getting older (Altekruse and Swerdlow, 1996; BBC, 2002; Zink, 1997). In addition there are more immuno-compromised people in the community than in the past (Desmarchelier, 1996). In the United States, it has been reported that 20% of the population are categorised having an increased susceptibility to foodborne disease (Smith, 1999). As the population structure changes, new concerns arise about aspects of food safety (Buzby, 1995).

Susceptibility to foodborne disease increases at both extremes of age due to underdeveloped or partially lost protection to infection (WHO, 1995). High-risk individuals considered to be susceptible to foodborne illnesses, are more likely to become infected with lower infectious doses of pathogens (WHO, 1996) and also more likely to develop secondary sequalae complications (Buzby, 1995). Research from USA (Samuel *et al.* 2000) has indicated that susceptible populations with an increased risk of foodborne disease continue to consume foods such as inadequately cooked runny eggs and pink beef-burgers, this raises the concern for the implications of risks associated with foodborne disease.

2.4.1.2 Consumer food preparation and consumption patterns.

In recent years consumer food consumption patterns have changed and it is suggested that this has had a significant influence upon the increasing incidence of foodborne disease (CDNANZ, 1997). Food preparation and consumption habits have been affected by lifestyle changes such as the increased number of women in the workforce, and a consequent reduction in time for food preparation (Fearne and Laurelle, 1996) and emphasis for convenience foods (Jamieson, 1990). These changes have resulted in a fundamental alteration of 'kitchen culture' (Fearne and Laurelle, 1996). Although it has been suggested that traditional cooking skills may have declined (Lang and Baker, 1993; Rees, 1992; Stitt *et al.* 1995), recent information from The National Food Survey (DEFRA, 2001) and Keynote Food Market Reports (Fenn, 2001) indicate that many consumers still purchase raw foods that require preparation for serving of 'home-made foods'. In addition, it is considered that increased interest in home cooking for entertaining purposes has become more widespread (Jamieson, 1990).

Heightened levels of health consciousness has increased consumer demand for food products that are convenient, healthy, fresh (less processed and less packaged), 'all natural' with no preservatives and without a perceived negative (without high salt, high fat and high sugar) (Zink, 1997). Consumer purchasing behaviour has changed and has led to fewer, less frequent shopping trips (POST, 1997), therefore creating a demand for perishable products to have an extended shelf life. Consumer demand for convenient fresh foods with an extended shelf life has forced the food industry to develop and utilise different preservation techniques such as refrigeration and Modified Atmosphere Packaging. The new generation of minimally processed foods may pose a greater risk of food poisoning to consumers if abused (Wolf and Lechovic, 1989) and so it is important that consumers store foods under appropriate conditions to minimise the risk of foodborne disease.

Meat, poultry and associated products are an established part of most British diets. Overall, it is reported that 86% consumers purchase raw meat / raw meat products per week (DEFRA, 2001), and recent market trends indicate that more than half of consumers serve meat or poultry products at least once a week (Fenn, 2001). The National Food Survey (2000) has indicated that consumers from England and Wales purchase between 197-218g uncooked poultry, and 240-251g of carcass meat (i.e. raw red meat) each week (DEFRA, 2001). In addition, chicken has been determined the most popular meat in the meat / meat products market in terms of volume sales (Barker, 2001). Concurring with such data, it is reported that purchases of uncooked poultry and turkey are 27% higher than 20 years ago (MAFF, 2000). It has been suggested that an increase in the consumption of fresh chicken has been associated with the increase in human infection of campylobacteriosis (Galbraith, 1990; Ralston, 1995).

Despite food scares in the early 1990's, eggs remain to be an important part of British diets. In England and Wales between 1.68 –1.63 eggs are consumed per person, per week, and it is reported that 42% households purchase eggs on a weekly basis (DEFRA, 2001).

2.4.2 Incidence of foodborne pathogens associated with foodborne disease.

In England and Wales (1993-1998) the most commonly identified cause of foodborne disease was *Campylobacter*, whereas the predominant causative organism in reported foodborne outbreaks was *Salmonella* (Tirado and Schmidt, 2000). During this time *Salmonella* accounted for 55% reported outbreaks and *Campylobacter* caused 3% of reported outbreaks (Tirado and Schmidt, 2000). Clinical features of both organisms differ and facilitate different epidemiological modes of infection. *Campylobacter* is known to be a primary cause of sporadic cases of food poisoning (Rodrigues *et al.* 2000) and caused 56,420 cases of illness (66% of all UK cases) in 2001 (PHLS, 2002b). *Salmonella*, however, is more frequently associated with reported outbreaks and caused 16,465 cases of illness (19% of all UK cases) in 2001 (PHLS, 2002c). Other foodborne pathogens that were causative agents of outbreaks of food poisoning between 1993-1998 in England and Wales include *Clostridium perfringens* (13% of outbreaks), *Bacillus cereus* (2% of outbreaks), *Escherichia coli* 0157:H7 (2% of outbreaks) and *Staphylococcus aureus* (1% of outbreaks) (Tirado and Schmidt, 2000).

Pathogen incidence data from the United States has followed a similar pattern to the UK whereby campylobacteriosis and salmonellosis are the most frequently reported foodborne illnesses (Mead *et al.* 1999). In the USA, (1993-1998) prevalence of outbreaks of foodborne illness from bacterial agents indicated, as in England and Wales, *Salmonella* was responsible for 55% outbreaks and *Campylobacter* was responsible for only 3% outbreaks of known etiology (Olsen *et al.* 2000). As with data from England and Wales, it has been estimated in the USA, that 47% cases were attributed to *Campylobacter* and 27% cases attributed to *Salmonella* (Mead *et al.* 1999). In the USA, other pathogens to cause foodborne illness outbreaks included *E.coli* (13%), *Clostridium perfringens* (8%), *Staphylococcus* (6%), *Bacillus cereus* (2%) and *Listeria monocytogenes* (0.5%) (Olsen *et al.* 2000).

In the UK, the FSA has set itself a target of reducing foodborne disease by 20% by April, 2006 (FSA, 2001c; Hilton, 2002). The Agency intends to measure the foodborne disease target on the basis of UK laboratory reports of the major bacterial causes of foodborne disease, namely *Campylobacter jejuni*, *Salmonella* spp., *Escherchia coli* 0157, *Clostridium perfringens* and *Listeria monocytogenes* (FSA, 2001a). It is considered that the most significant reduction of the number of cases of foodborne disease over the next five years is likely to come from focusing attention on food preparation in domestic and catering settings (FSA, 2001c). Therefore, the aforementioned pathogens are of principal significance in this thesis. In addition, the pathogens *Staphylococcus aureus* and *Bacillus cereus* are of interest to the realms of this study. Such pathogens may be particularly under-reported due to the typical short duration of illness, and so are important considerations for consumer food safety.

2.4.2.1 Salmonella spp.

In England and Wales, *Salmonella* incidence peaked in 1997 causing 32,596 cases of illness (PHLS, 2002c). However, since then, incidence has decreased by 49%. *Salmonella enteritidis* PT4 has been reported to be the most prevalent serotype of *Salmonella* infection in UK during the 1990's (Evans *et al.* 1998), USA (Olsen *et al.* 2000) and in Europe (FAO/WHO, 2002) accounting for between 55% and 77% of reported foodborne outbreaks. Annual reports of *Salmonella* incidence have shown a seasonal distribution, peaking in summer months (Cowden *et al.* 1995).

Salmonella is a non-spore-forming organism and multiplies in food in temperatures ranging from just above 5°C to 47°C, with an optimum growth temperature of 37°C (Varnam and Evans, 1991). Illness is usually caused from ingestion of 10^7–10^9/g cells, however, outbreaks have also been known to be caused by relatively low numbers of cells (Jay, 1996) and the minimum infective dose is known to be variable (Harrison *et al.* 2001a).

2.4.2.2 Campylobacter spp.

Most infections caused by *Campylobacter* are thought to be sporadic (Leman, 2001; Skirrow, 1991; Tam, 2001) and the most commonly reported species of campylobacters in the UK are *Campylobacter jejuni* and *Campylobacter coli* (Pearson and Healing, 1992). Significant microbiological properties of campylobacters affect survival and consequent potential for infection. Optimal growth of *Campylobacter jejuni* is obtained in a microaerophillic atmosphere (5% oxygen) (NACMCF, 1995) and bacterial numbers are reported to decline on exposure to the atmosphere (ACMSF, 1993a), in addition, campylobacters are sensitive to drying. The organisms are inactivated at 48°C so would not be expected to survive typical meat cooking procedures. The thermophillic nature of campylobacters does not allow growth of the organism at room or refrigeration temperatures (ACMSF, 1993a). It is reported that *Campylobacter jejuni* has a variable infective dose (Harrison *et al.* 2001b) which is known to be less than 500 cells (ACMSF, 1993a), thus, sporadic cases of *Campylobacter* may result from cross contamination of only a small number of organisms in the kitchen (Rodrigues *et al.* 2000).

2.4.2.3 Escherichia coli **0157:H7.**

Escherichia coli 0157:H7 was first recognised in 1982 following foodborne outbreaks associated with consumption of undercooked hamburger from a fast food restaurant in USA (Altekruse *et al.* 1997; Turney *et al.* 1994). Since then, further *E.coli* 0157:H7 outbreaks have been implicated in USA, UK, Canada, and Europe (ACMSF, 1995). The reported occurrence of this pathogen has increased considerably in the past two decades and in 2001, 768 isolations of vero cytotoxin-producing *E.coli* 0157:H7 in England and Wales were obtained (PHLS, 2002d). Typical mesophile characteristics allow *E.coli* 0157:H7 to grow from 7-10°C up to 50°C, and also to survive refrigeration and frozen storage for extended periods of time (Adams and Moss, 2000). The majority of *E.coli* 0157:H7 cases are sporadic (Smith and Fratamico, 1995) and the infectious dose is reported to be low (Reid, 1992), indeed, illness may occur after the ingestion of <100 organisms (ACMSF, 1995). Clinical features of illnesses resulting from ingestion of this pathogen are varied and can be particularly severe. Between 2-7% of cases develop haemolytic uraemic syndrome which is a form of renal failure which has a reported fatality rate of between 3-17% (PHLS Working Group on VTEC, 1995).

2.4.2.4 Listeria monocytogenes.

Listeria monocytogenes is known to be the principle disease causing pathogen of the *Listeria* species (Seeliger, 1991). Most cases of *Listeria* are sporadic (Newton *et al.* 1992) and in 2001 there were 136 cases of *Listeria monocytogenes* reported in England and Wales (PHLS, 2002e). Incidence has remained relatively constant over the past 20 years, except for during the late 1980s when incidence increased to 278 annual cases (PHLS, 2002e). *Listeria monocytogenes* is known to grow at refrigeration temperatures and also to survive for long periods of time in the environment, on foods, in food processing plants and household refrigerators (FDA, CFSAN, USDA, FSIS, 1999). Listeriosis can lead to a severe human illness within vulnerable populations and it has been reported that foods containing small numbers (<100cfu/g) of *Listeria monocytogenes* can cause such an illness (Desmarchelier, 1998). Illnesses from *Listeria monocytogenes* have been estimated to result in 91% hospitalisations and 20% deaths (Mead *et al.* 1999). Thus, microbiological guidelines recommend zero tolerance for refrigerated foods with a long shelf life (Gilbert *et al.* 2000).

2.4.2.5 Staphylococcus aureus, Bacillus cereus and *Clostridium perfringens.*

The three main types of toxic bacterial food poisoning organisms include *Staphylococcus aureus, Bacillus cereus* and *Clostridium perfringens.* Approximately 40% adults carry *Staphylococcus aureus* in the nose and throat and 15% on the skin, especially the hands (Sprenger, 1995). Therefore, personal hygiene is a particularly important control measure for prevention of this form of foodborne disease. Recovery from illness from *Staphylococcus aureus* is usually complete within 1-2 days (Adams and Moss, 2000) and thus, reported cases may constitute a small percentage of actual cases (Doan and Davidson, 1999). Therefore, the majority of cases of *Staphylococcus aureus* are thought to be unreported (see section 2.3.3). Foodborne outbreaks associated with *Clostridium perfringens* are largely associated with the preparation, holding and serving of large quantities of food (Wolf and Lechovic, 1989) thus, control measures to prevent this type of food poisoning are largely concerned with adequate cooling and storage practices. *Clostridium perfringens* is capable of reproducing every 10 minutes when at the optimum temperature and under favourable conditions (Sprenger, 1995). Illness occurs after ingestion of large numbers of the vegetative organism and production of a toxin in the gut. *Bacillus cereus* is capable of causing two distinct forms of food poisoning (Adams and Moss, 2000). The emetic syndrome is classically associated with survival of heat resistant spores in rice. If heated rice is subject to temperature abuse, vegetative cells proliferate in the food, producing a heat stable enterotoxin which causes illness if consumed (Eley, 1996). The diarrhoeal syndrome is characterised by illness caused by toxin production in the gut.

2.4.3 Food vehicles associated with foodborne disease.

Microbiological and epidemiological investigations are used to identify food vehicles associated with incidents of foodborne disease. For many cases of food poisoning a food vehicle is never identified, this is largely due to under-reporting and retrospective analyses of food poisoning cases (ACMSF, 1996). However, when food vehicles are identified, more often than not, one or more specific foods are suspected to be sources of infection in foodborne outbreaks (Evans *et al.* 1998). Overall, foods most frequently implicated as vehicles of infection in England and Wales (1993-1998), Europe (1993-1998) and USA (1993-1997) have included poultry and red meat (and associated products) and eggs, and dishes containing eggs (Olsen *et al.* 2000; Tirado and Schmidt, 2000).

Data from England and Wales have indicated that 20% poultry and associated products, 20% raw and / or lightly cooked eggs (including desserts) and 15% red meat and associated products were food vehicles implicated in reported foodborne outbreaks (where a suspect food was recorded) between 1995-1996 (Evans *et al.* 1998). More recent data from England and Wales (1993-1998) has indicated that overall, 20% reported foodborne illness was associated with poultry, 18% with meat / products and 10% with eggs (Tirado and Schmidt, 2000). Thus, corresponding with the reduction in *Salmonella* infections, food poisoning attributed to eggs may have decreased in the past few years (see section 2.4.4.3).

Internationally, foods reported to most frequently cause cases of illness in USA have been red meats, followed by chicken and turkey (Olsen *et al.* 2000). Australian data detailing specific food vehicles implicated in foodborne outbreaks between 1980-1995 indicate that the most frequently implicated foods were meat, seafood and salad / vegetables (CDNANZ, 1997). In addition to the most frequently implicated foods, numerous outbreaks in the UK (Cowden *et al.* 1995; Evans *et al.* 1998), USA (Olsen *et al.* 2000) and Europe (FAO/WHO, 2002; Schmidt, 1995; Tirado and Schmidt, 2000) have been associated with consumption of cooked meats, egg-based desserts, rice, home-made beef-burgers / hamburgers and meat based salads. A detailed analysis of food vehicles associated with reported incidents of foodborne disease can be found in Appendix 2.1.

2.4.4 Prevalence of pathogens in foods associated with foodborne disease.

Many surveys have examined the extent that foods implicated in incidents of foodborne disease are contaminated with pathogens. Contamination rates of *Campylobacter* spp. in raw poultry, *Salmonella* spp. in raw poultry and red meat and eggs, *Escherichia coli* 0157:H7 in red meats, particularly beef and *Listeria* spp. in 'ready-to-eat' (RTE) cooked meats and pre-packaged salads have been most commonly investigated. An analysis of research detailing contamination rates of pathogens in foods has been undertaken and a summary of findings can be found in Appendix 2.1.

2.4.4.1 Poultry / poultry products.

Poultry is acknowledged by many sources as being an important potential reservoir of foodborne pathogens, particularly from *Campylobacter* and *Salmonella* species (ACMSF, 1996; Kessel *et al.* 2001). Indeed, epidemiological investigations have demonstrated a correlation between consumption and handling of poultry meat and the occurrence of *Campylobacter* enteritidis (Harrison *et al.* 2001b). Internationally, contamination of *Salmonella* in whole raw chickens and chicken pieces has ranged between 6% and 58%, and contamination with *Campylobacter* has ranged between 28% and 83%. Additional studies have illustrated isolation rates of *Campylobacter jejuni* and / or *Campylobacter coli* from retail broiler chickens as ranging from up to 98% contamination (Flynn *et al.* 1994). In the UK, contamination of raw chicken appears to be more prevalent from *Campylobacter* than *Salmonella* as data indicates that 63-83% fresh chicken portions have been found to be contaminated with *Campylobacter* spp. and 4-28% contaminated with *Salmonella* spp.. Corresponding with British data, European findings (ICRT, 1994, Geilhausen *et al.* 1996) also indicate that *Campylobacter* spp. is more prevalent in chicken carcasses / products than *Salmonella* spp., particularly in fresh / chilled samples. However, chicken samples in Belgium were found to be more frequently contaminated with *Salmonella* spp. than *Campylobacter* spp. (Uyttendaele *et al.* 1999). Findings from nineteen microbiological surveys determining *Campylobacter* and *Salmonella* contamination of raw chicken can be found in Appendix 2.2.

Contamination rates for *Campylobacter* spp. and *Salmonella* spp. in frozen and fresh / chilled chicken samples have been compared. A larger percentage of *Campylobacter* (Hood *et al.* 1988; ICRT, 1994; Rayes *et al.* 1983) and *Salmonella* (ICRT, 1994; Wilson *et al.* 1996) isolates have been obtained from fresh / chilled poultry as opposed to frozen poultry. For example, 80% of fresh chicken portions were found to contain *Campylobacter* spp., compared with a 19% contamination rate for frozen samples (ICRT, 1994). However, contrary to these findings, a UK study found contamination rates for *Salmonella* spp. were higher in frozen samples (ACMSF, 1996). Although the skin has been found to be an important source of *Campylobacter* spp. contamination in poultry (Flynn *et al.* 1994) a European survey found that products with and without skin were equally as contaminated (ICRT, 1994). Dawkins *et al.* (1984) reported that campylobacters can be recovered up to three times more frequently from the inside than the outside of whole birds. Further research has investigated the contamination of whole raw chicken packaging (RCP) and results have shown that 34% has been found to be contaminated with *Campylobacter* and 11% contaminated with *Salmonella* (Harrison *et al.* 2001b).

Surveys of raw poultry products have also detected other pathogenic bacteria from samples, for example, 38-56% of supermarket raw chicken products have been found to be contaminated with *Listeria* spp. (Farber *et al.* 1989; Genigeorgis *et al.* 1989). A microbiological analysis of fresh turkey meat has resulted in isolation of *Clostridium perfringens*, *Staphylococcus aureus*, *Escherichia coli* and *Yersinia* (see Appendix 2.1)

2.4.4.2. Red meat / red meat products.

Raw red meat including beef, lamb, pork and associated products has been found to be contaminated with *Salmonella* spp., *Campylobacter* spp., *Listeria* spp. (including *Listeria monocytogenes*) and *Escherichia coli* (including *Escherichia coli* 0157:H7), *Yersinia enterocolitica*, *Staphylococcus aureus* and *Bacillus cereus* (see Appendix 2.1). The mincing process of raw beef allows any organisms that may be present on the surface of raw meat to be distributed throughout the product. Therefore, minced products, such as sausages and beef-burgers pose a greater hazard than intact joints of meat (ACMSF, 1995) particularly if inadequately heated before consumption. In the UK, surveys found that 13% of raw minced beef and 22% raw beef-burgers to be contaminated with *Escherichia coli* 0157:H7 (Willshaw *et al.* 1993). Similarly, in USA, 23% raw beef, 18% raw pork, 48% raw lamb and 63% of raw veal were contaminated with *Escherichia coli* 0157:H7 (Samadpour *et al.* 1994). Although levels of this pathogen detected from foods were low, only small numbers are required to cause a potentially serious illness (ACMSF, 1995).

2.4.4.3. Eggs.

In the late 1980's and early 1990's there was substantial concern that eggs could be a possible source of salmonellosis in humans (ACMSF, 1993b). Thus, examinations of the prevalence of *Salmonella* in eggs were undertaken and findings concluded that 0.6% egg contents (from a naturally infected flock of chickens) were contaminated with low levels of *Salmonella enteritidis* (Humphrey *et al.* 1991). A similar study by the PHLS in 1991 surveyed *Salmonella* contamination in British eggs on retail sale and *Salmonella enteritidis* was isolated from 0.7% of 7045 six egg packs (ACMSF, 1993b). Therefore in 1993, the overall prevalence of *Salmonella* spp. in British eggs was estimated as 1:650, and the rate of contamination of *Salmonella enteritidis* was 1:880 (ACMSF, 1993b). However, it is noted that such data was obtained ~10 years ago and since then it has been suggested that *Salmonella* levels in eggs have reduced considerably (FSA, 2001d). Research has shown a 53% reduction of laboratory confirmed cases of human salmonellosis and it is believed that the reduction of contamination levels has been due to the widespread vaccination of egg laying flocks against *Salmonella enteritidis* combined with improved flock hygiene measures (ACMSF, 2001). Supporting this belief, recent data from Northern Ireland has suggested that only 0.4% of 2090 egg packs were contaminated with *Salmonella* (Wilson *et al.* 1998).

2.4.4.4 Vegetables and RTE foods.

Soil harbours a considerable number of microbial contaminants such as *Bacillus* spp. (Adams and Moss, 2000), *Clostridium perfringens* (Sprenger, 1995), *Listeria* spp. (Dowe *et al.* 1997) and can be potentially contaminated with *Escherichia coli* from faecal contamination from animals. Therefore, raw foodstuffs, particularly fruits and vegetables grown close to the soil may be contaminated with various foodborne pathogens (Beuchat, 1998). Pathogens that have been isolated from raw vegetables include *Salmonella* spp., *Staphylococcus* spp., *Escherichia coli* 0157:H7, *Listeria monocytogenes*, *Campylobacter* spp., *Bacillus cereus* and *Yersinia enterocolitica* (Beuchat, 1998) (see Appendix 2.1).

Increased cases of foodborne disease cases associated with cooked and ready-to-serve processed food products has prompted research to assess the occurrence of pathogens in pre-packaged salads and cooked meats. Such foods have been found to contain low levels of other *Listeria* spp., *Staphylococcus aureus*, *Escherichia coli*, *Clostridium perfringens* and *Salmonella* spp. (FSA, 2000d) (see Appendix 2.1). Presence of pathogens in such foods indicates a need for strict temperature control to minimise any proliferation of organisms. Research has shown that salad vegetables and cooked meats may support the growth of pathogenic micro-organisms such as *Listeria monocytogenes* at refrigeration temperatures (Snyder, 1999a). In addition, changes in packaging technology have been associated with improved survival of pathogenic bacteria (Abdul-Raouf *et al.* 1993).

2.4.5 Contributory factors associated with foodborne disease.

Pathogens frequently enter the food preparation environment via contaminated raw foods (Bryan, 1978), therefore, it is imperative that consumers implement appropriate and effective control measures to prevent or minimise opportunities for product contamination and microbial growth. Bryan, (1988) has identified four determinants that must be present for an incident of foodborne disease to occur: the pathogen must reach the food; the pathogen must survive in the food until ingested; the pathogen must (in some cases) multiply to reach infectious levels or produce toxins; the person ingesting the food must be susceptible to the levels ingested.

Intrinsic characteristics such as pH, redox potential, nutrient content, and water activity can influence the activity of micro-organisms present in contaminated foods (Jay, 1996). These characteristics, plus an extrinsic sequence of events may enable a sufficient number of organisms to survive and / or proliferate in ingested food and subsequently cause illness (Bryan, 1988). These actions affecting microbial activity within food are collectively known as contributory factors.

There are difficulties in identifying factors responsible for contributing to foodborne disease outbreaks (Schmidt, 1995). Epidemiological investigations often rely on retrospective analysis and may be hindered by failure to recall or report actions associated with the incriminated food(s). Indeed, it has been reported that evidence of factors that contribute to outbreaks (Ryan *et al.* 1996) and almost all sporadic cases (Dawkins *et* *al.* 1984) are usually not identified. For example in Europe (1992-1994) contributory factors were identified for only 36% outbreaks (Schmidt, 1995).

It is difficult to directly compare the results detailing contributory factors of foodborne disease from different years and international sources because of differences in classification of food-handling actions and reporting procedures. Nevertheless, a summarised analysis of identified contributory factors associated with incidents of food poisoning can be found in Appendix 2.3. The most frequently reported contributory factor for England and Wales has been determined as inadequate heat treatment (Tirado and Schmidt, 2000), for USA, improper holding temperatures (Olsen *et al.* 2000), for Europe, temperature misuse (FAO/WHO, 2002) and Australia, inadequate cooking (CDNANZ, 1997). The reporting of cross contamination as a contributory factor is limited from European, Australian and American data. A sequential set of events is required for cross contamination to occur and so it is difficult to detect during routine inspections or retrospective epidemiological investigations, thus it is believed that cross contamination is probably underestimated in surveillance statistics (Bryan, 1988). Frequently, multiple factors are cited as contributory factors for many foodborne outbreaks (Bryan, 1988; Ryan *et al.* 1996). For example, an outbreak of *Salmonella newport*, which affected 79 adults resulted from the consumption of undercooked eggs which were served after 14hrs storage at ambient temperature (Aseffa *et al.* 1994).

2.4.5.1 Cross contamination.

Despite the difficulties of associating specific cross contamination actions with incidence of foodborne disease, cross contamination of bacterial pathogens is thought to be a major contributory factor for foodborne illnesses (Chen *et al.* 2001). Throughout England / Wales and Europe, cross contamination has been attributed to between 16-39% reported foodborne outbreaks of food poisoning (see Appendix 2.3). Intermediary vectors associated with frequent cross contamination actions include hands (see section 2.4.5.2), cloths, equipment, hand and food contact surfaces (ACMSF, 1990). Indirect contamination using an intermediary vehicle is believed to be the more common route for contamination (Acuff *et al.* 1986) as opposed to direct contamination from raw food stuffs. Due to associated microbiological risks, it is recommended that cross contamination between raw and cooked foods should be avoided at all stages of food preparation (DoH, 1993a). Food safety risks associated with cross contamination are considered to be high (Bryan, 1988), especially when raw meat and poultry directly or indirectly contaminate food that is not cooked prior to consumption e.g. salad vegetables, cooked meats (POST, 1997). Contamination such as this to RTE foods constitutes a direct health risk to consumers (De Boer and Hahne, 1990).

The spread of foodborne pathogens from raw meat and poultry (and products) are the most likely sources of cross contamination in the kitchen. Microbiological studies of the kitchen environment have indicated that many surfaces exhibit some degree of microbial contamination, suggesting that cross contamination of pathogens such as *Campylobacter* and *Salmonella* from raw meat / poultry / eggs has occurred during normal usage of the kitchen (Cogan *et al.* 1999; Dawkins *et al.* 1984; De Boer and Hahne, 1990; Humphrey *et al.* 1994; Josephson *et al.* 1997; Slader *et al.* 2001). Bacterial contamination of the domestic environment will be discussed in section 2.6.2.

It has been reported that there is a statistically significant association between handling and preparation of raw chicken and illness caused by *Campylobacter jejuni* (Hopkins and Scott, 1983). Microbiological analyses of inadequate food-handling techniques implemented during food preparation has found that *Campylobacter* and *Salmonella* can be easily transferred from raw chicken products to cutting boards, plates and utensils (Chen *et al.* 2001; Cogan *et al.* 1999; De Boer and Hahne, 1990; De Wit *et al.* 1979; Hutchinson *et al.* 1983; Redmond *et al.* 2001). Such organisms have also been isolated from raw vegetables and cooked chicken products which had been placed onto plates or cutting boards that had not been decontaminated after contact with raw chicken (De Boer and Hahne, 1990; Redmond *et al.* 2002; Zhao *et al.* 1998). Indeed, an investigation of an outbreak of *Campylobacter jejuni* in USA determined that infections were most likely to be acquired from eating lettuce cross contaminated from raw chicken (Graves *et al.* 1998). In addition, Brown *et al.* (1988) determined that cross contamination, as a result of handling raw and cooked food consecutively was a possible cause of another *Campylobacter jejuni* outbreak.

Few workers have quantified microbiological risks of cross contamination actions. Chen *et al.* (2001) determined that up to 54% of bacterial cells from a cutting board contaminated with bacteria from a piece of raw chicken could be transferred to lettuce that was subsequently prepared on the same (unwashed) cutting board. In addition, an 81% risk of pathogenic transfer of organisms such as *Campylobacter* has been determined when RTE foods such as salad vegetables are prepared using unwashed / inadequately washed utensils (Redmond *et al.* 2001). De Boer and Hahne (1990) determined substantially lower contamination rates for *Campylobacter* (9-10%) and *Salmonella* (5-6%) from raw vegetables / cooked chicken which had been in contact with plates on which raw chicken had been placed. Such differences in contamination rates may be due to variation of initial contamination rates of raw chickens used for experimentation and differences in microbiological isolation methods. Nevertheless, a direct risk to health is illustrated by the implementation of inappropriate food preparation actions described.

De Wit *et al.* (1979) suggested that to prevent cross contamination in the kitchen, raw and cooked foods have to be handled separately. However, the strict separation of raw poultry, raw meat and RTE foods is not always possible in the domestic kitchen. Many kitchens may not have the space to adequately separate raw and cooked preparation areas (Varnam and Evans, 1991), furthermore, the risk of cross contamination is reported to increase when large amounts of food are prepared in the domestic kitchen (Ryan *et al.* 1996). To prevent and reduce risks of cross contamination, implementation of preventative measures involving washing, drying and cleaning procedures have been found to be effective for decontamination processes. Such procedures have been detailed in 'Recommendations for selection of suitable hygiene procedures for use in the domestic environment' (IFH, 1998a).

Effective cleaning of contaminated surfaces is required to minimise the risk of cross contamination in the domestic kitchen. Bacterial contamination of kitchen cloths and towels will be discussed in section 2.6.2. Scott and Bloomfield, (1990a) found that when contaminated cloths or surfaces came into contact with fingers, equipment and surfaces, organisms were transferred in sufficient numbers to represent a potential hazard if subsequent contact was made with food. Effectiveness of cleaning and disinfection methods has been investigated and findings have been inconsistent. Several workers, for example, Coates *et al.* (1987), Dawkins *et al.* (1984), Redmond *et al.* (2001) and Zhao *et al.* (1998) have suggested that ordinary cleaning practices including the use of hot water and detergent, (combined with adequate drying) can remove pathogens such as *Campylobacter jejuni* during cleaning of equipment / utensils in the domestic kitchen after preparation of foods such as raw chicken. However, other studies have found that the addition of hypochlorite disinfectant to cleaning procedures involving hot water and detergent resulted in significant decreases in contamination rates (Borneff *et al.* 1988; Cogan *et al.* 1999; Josephson *et al.* 1997; Rusin *et al.*1998).

2.4.5.2 Hand washing and hand drying.

The role of hands in the transmission of disease is well established (Emery, 1990), and effective hand-washing and hand drying is considered to be an important control measure for preventing the transmission of foodborne diseases in food-handling environments (Paulson *et al.* 1999). Contamination of food via the hands may be through direct contact of the food with hands that are contaminated, or indirectly through poor practice such as handling and contaminating equipment that is subsequently used for food preparation (Taylor and Holah, 2000). Hand-washing compliance and hand-washing effectiveness are crucial issues to address with respect to food safety (Michaels, 1999).

Handling raw foods of animal origin results in the greatest source of food pathogens on the hands (Taylor and Holah, 2000). Transient contaminants on the skin should be removed by washing and drying to eliminate the risk of cross contamination (Brown *et al.* 1988). Research has shown that *Salmonella* spp. can survive on fingertips for several hours after contamination and only 100 organisms on fingertips have been found to be sufficient to enable microbial transfer to samples of cooked meat (Pether and Gilbert, 1971). In addition, after handling raw chicken, 73-100% hands have been found to be contaminated with bacteria such as *Campylobacter* (Chen *et al.* 2001; De Boer and Hahne, 1990; Redmond *et al.* 2001) and 18% contaminated with *Salmonella* (De Boer and Hahne, 1990). Furthermore, Humphrey *et al.* (1994) determined that *Salmonella enteritidis* PT4 could be recovered from fingers following the practice of breaking a shell egg. Thus, adequate hand decontamination is required to prevent cross contamination where the hands are intermediary vectors. Additional research has suggested that *Campylobacter* and *Salmonella* can survive on hands for enough time after initial contamination to further cross contaminate the pathogens around the kitchen environment (Coates *et al.* 1987; Pether and Gilbert, 1971). De Wit *et al.* (1979) has estimated that 82% of sink tap handles are contaminated after food preparation of raw chicken. However, transfer rates for contamination of a tap handle from a contaminated hand have been determined as between 6-12% (Chen *et al.* 2001; Redmond *et al.* 2001). Although these rates are relatively low, up to 72% of the bacterial load from a contaminated tap handle has been found to be transferred to a 'clean' hand (Chen *et al.* 2001). Such results suggest that refraining from touching the tap handle with contaminated hands is necessary to prevent the risk of cross contamination.

Numerous studies have researched the effectiveness of hand-washing and hand drying efficacy (Michaels *et al.* 2001a; Miller *et al.* 1994). Results have indicated that a quick rinse or wash of hands may not assure complete removal of pathogens such as *Campylobacter jejuni* after handling contaminated foods (Acuff *et al.* 1986). In addition to this, research has shown that when hands are wet, touch-contact associated with bacterial transfer is facilitated (Patrick *et al.* 1997). Coates *et al.* (1987) found that hand-washing using soap and water, followed by drying using a paper towel was effective for removing a heavy inoculum of campylobacters from fingertips. It is recommended that good hand-washing practice includes the use of warm water (45°C) and a bactericidal detergent, in addition, the use of hand towels on more than one occasion is considered to be unacceptable hand drying practice (Food Safety and Hygiene Working Group, 1997). The hand drying process is considered to be of critical importance to maximise reduction of transient and resident bacteria (Michaels *et al.* 2001b). It has been found that if hands are shaken dry, campylobacters were likely to remain, especially if only water had been used for washing (Coates *et al.* 1987). Indeed, hand drying can provide an additional 90% reduction in transient bacterial flora (Michaels and Ayers, 2000a). Thus, it is imperative for consumers to not only wash their hands adequately, but also to dry hands adequately as well.

2.4.5.3 Temperature control: thawing and heating.

Inadequate heating has been determined as a contributory factor for up to 50% reported foodborne outbreaks in England and Wales (1995-1996) (Evans *et al.* 1998). Indeed, cooking is considered to be the most important control step in food preparation (Food Safety and Hygiene Working Group, 1997). The time and temperature association for heating should be such to ensure that heat penetration to the centre of the foodstuffs occurs and results in destruction of vegetative, non-sporeforming organisms (DoH, 1993a). To achieve bacteriological safety, the core cooking time-temperature recommended by the Department of Health is 75°C for 30 seconds, or equivalent (DoH and MAFF, 1996).

For many years meat colour was considered to be an acceptable visual determinant of heating adequacy. However, research conducted in USA has found that colour of meat is not a reliable indicator that the meat has reached a temperature high enough to destroy pathogens such as *E.coli* 0157:H7 (FSIS, USDA, 1998a; Snyder, 1998). Thus, it has been recommended that food thermometers should be used to determine end of cooking times of meat and meat products (USDA, FSIS, 2000). In addition to meat, heating adequacy of eggs has been investigated, particularly regarding survival of *Salmonella*. Research findings have indicated that strains of *Salmonella*, including *Salmonella enteritidis* survived forms of cooking when some of the yolk remained liquid, particularly when fried 'sunny-side-up', scrambled and boiled (Humphrey *et al.* 1989). Nevertheless, research findings have also shown that minimal cooking procedures can destroy *Campylobacter jejuni* (Acuff *et al.* 1986).

The practice of adequate thawing of food, particularly for joints of meat, is essential before cooking. It is recommended that food should be thawed at the bottom of the refrigerator (USDHHS, PHS, FDA, 1999). However, recent research has concluded that poultry carcasses can be thawed safely within 14 hours at ambient temperature on the counter, even resulting in a decline in the overall bacterial population (Jimenez *et al.* 2000; Snyder, 1999b). However, this method of thawing has been reported to allow organisms to multiply on the surface of frozen food as it defrosts, while the centre remains frozen (Sprenger, 1995). Consumers must realise the importance of proper defrosting of foods, particularly joints of meat and poultry. Cooking a joint of meat or poultry that has been insufficiently defrosted may result in a product that may appear to be well done, but the heat energy used to defrost the centre of the meat may be insufficient to bring about adequately high enough temperatures for safe cooking. Thereby, enabling a greater chance of survival for organisms such as *Salmonella* spp. (Roberts, 1985) and increasing the risk of foodborne disease.

2.4.5.4 Temperature control: cooling.

Practices such as post-cooking cooling need to be controlled sufficiently to prevent the risk of multiplication of surviving bacteria. Fast cooling reduces the time that a food spends at critical temperatures and hence reduces bacterial growth (Farber and Hughes, 1995). The Food Safety (Temperature Control) Regulations, 1995, require food to be cooled quickly after heating or preparation, however no limits are specified. Nevertheless, it has been recommended that food should cooled to below 10°C in less than 90 minutes (Sprenger, 1995) followed by storage below 5°C (Food Safety and Hygiene Working Group, 1997).

Inadequate cooling has been associated with 11-53% reported foodborne disease outbreaks (see Appendix 2.3), therefore consumers need to implement appropriate food safety behaviours to achieve adequate cooling of foods to reduce the potential risks of foodborne disease. To achieve adequate cooling procedures it has been suggested that foods should be divided into smaller quantities (USDHHS, PHS, FDA, 1999) and placed into a shallow container (Farber and Hughes, 1995) not exceeding 50mm in depth (DoH, 1993a) that allow maximum heat transfer through container walls (USDHHS, PHS, FDA, 1999). Foods that have been stored in large or deep containers in refrigerators have been frequently implicated as contributing to cases of foodborne disease (Bryan, 1988). Additional food safety practices that are needed to facilitate rapid cooling include stirring of foods during cooling (HSA, EHD, 1997), loosely covering or leaving foods uncovered during the cooling period to facilitate heat transfer from the surface of the food (USDHHS, PHS, FDA, 1999). In addition the use of cold water / ice is considered to increase cooling procedures (Ryno and Leftwich, 1981; USDHHS, PHS, FDA, 1999). Cooling of cooked whole chicken and turkey carcasses has been investigated and results have shown that when meat was not removed from the carcass before cooling and subsequent storage, the internal temperature (during refrigeration) remained for 10 hours or longer, thus allowing the multiplication of foodborne pathogens (Bryan and McKinley, 1974). However, removal of chicken and turkey meat from carcasses followed by cutting up immediately after cooling has been shown to significantly decrease cooling times (Bryan and McKinley, 1974; Lewis *et al.* 1953).

2.4.5.5 Temperature control: storage.

Storage of food products above refrigeration temperature and below the recommended hot holding temperature of 63°C (DoH, 1995) encourages proliferation of bacterial cells, germination of spores and possible toxin production to potentially dangerous levels. Inadequate temperature control during storage is frequently implicated as a cause of foodborne illness (Knabel, 1995). Indeed, in recent years inadequate temperature control during storage of foods has been associated with 28-46% reported foodborne disease outbreaks in England and Wales (see Appendix 2.3). Thus, it is important that consumers implement correct storage practices of foods in the home to reduce the risk of foodborne disease.

Experimental findings have illustrated the ease with which transferred organisms can grow on RTE foodstuffs held at ambient temperature (Bradford *et al.* 1997). In addition, *Escherichia coli* 0157:H7 has been found to survive or grow on salad vegetables at temperatures simulating temperature abuse (Abdul-Raouf *et al.* 1993; Richert *et al.* 2000) and it has been reported that *Salmonella* can grow on exterior and interior surfaces of tomatoes at ambient temperature (Zhuang *et al.* 1995), thus increasing the risk of infective food poisoning. Reports have suggested that the rate at which egg contents change to permit the growth of *Salmonella enteritidis* is related to storage temperature, and thus, fluctuating temperatures between 18-30°C for prolonged periods of time (representing inadequate storage temperatures) allows a rapid growth of *Salmonella enteritidis* (Humphrey and Whitehead, 1993). Measures can be taken however to reduce the relative risks that eggs and egg products present. To ensure that the growth of *Salmonella* is prevented, it is recommended for consumers to store raw shell eggs in the refrigerator (ACMSF, 1993a). Toxin-type food poisoning can occur from the variably heat resistant spores of (e.g.) *Bacillus cereus*, commonly found in rice, which can survive cooking processes and subsequently germinate when stored at ambient temperatures. Prevention of this, and similar types of food poisoning is largely dependant upon effective temperature control (Roberts, 1982).

The microbial lag phase and generation time of a bacterial population in food increases as refrigeration temperature decreases (IFT, 1998). The recommended requirement from the Food Safety (Temperature Control) Regulations 1995 for storage of refrigerated foods is less than 8°C (DoH, 1995) and it is recommended that refrigerators should be set to keep food at 5°C or cooler (Food Safety and Hygiene Working Group, 1997). However, pathogens such as *Listeria* spp. and *Yersinia* spp. have been found capable of growing at 5°C and below, and it has been found that *Staphylococcus aureus, Bacillus cereus* and *Salmonella* spp. are capable of growth at temperatures slightly above 5°C (IFT, 1998). Indeed, *Listeria* spp. in prepackaged salads held at 4°C for four days showed a two-fold increase in numbers, thereby indicating that the organism can survive and multiply during refrigerated storage of the product (Sizmur and Walker, 1988). Similarly, other research has shown that *Escherichia coli* 0157:H7 can survive on vegetable produce stored at 4°C (Richert *et al.* 2000). Further research has suggested that the optimum temperature range for chilled storage of meat is between –1°C and +2°C (Krockel and Hechelmann, 1999).

An analysis of incidence of foodborne disease suggests that there are substantial microbiological risks associated with foods that are prepared and eaten by consumers on a regular basis. Many of the foods that are brought into the domestic kitchen for preparation may be contaminated with harmful pathogens such as *Campylobacter* spp., *Salmonella* spp., *Escherichia coli*, *Listeria monocytogenes*, *Staphylococcus aureus*, *Bacillus cereus* and *Clostridium perfringens* and implementation of safe food-handling behaviours is considered to be imperative to reduce the risk of foodborne disease. The most frequently implicated food vehicles associated with foodborne disease include poultry (and poultry products), red meat (and red meat products) and eggs (and egg products) and some vegetables. Consumer purchasing of poultry has increased in recent years and preparation of raw poultry in the domestic kitchen provides opportunities for consumers' to cross contaminate harmful pathogens in the kitchen environment. Raw poultry is an important source of *Campylobacter* and *Salmonella* and such pathogens are the most commonly identified causes of foodborne disease in England, Wales and USA. Thus, implementation of safe food-handling behaviours is considered to be essential during food preparation to minimise the risk of cross contamination and potential for foodborne disease. The most frequently reported contributory factors associated with foodborne disease in the UK, Europe, USA, and Australia were determined as inadequate cooking, improper holding temperatures and temperature misuse. In addition to this, cross contamination is believed to be an important contributory factor that causes many sporadic cases of foodborne disease. Overall, epidemiological findings suggest that consumers are presented with many microbiological risks that need to be controlled during domestic food preparation. Failure to implement appropriate control measures may result in the risk of foodborne disease, thus highlighting the need for consumer food safety education.

2.5 RESPONSIBILITY FOR FOOD SAFETY.

The prevention of foodborne disease involves co-operation of all stages of the food chain (ICMSF, 1988; WHO, 1997), no one stage has sole blame or responsibility (ACMSF, 1991). Effective food safety strategies require a dual approach for minimising the risks of pathogenic contamination (Gilbert, 1983; Griffith *et al.* 1995; Todd, 1989b) integrating education and regulation (Kaferstein, 1997). Food safety can be affected by events at any stage of the food chain (Howells *et al.* 1990). Responsibility for provision of safe food involves careful food-handling from farmers, food processors, transporters, importers, restaurants, supermarket retailers and institutional food providers, governments (USEPA, USDA, DHHS, 1997) and ultimately the consumer, who has been described as the *'final line of defence'* (ACMSF, 1991; Gilbert, 1983). In a statement of general objectives and practices of the new UK Food Standards Agency it is stated:

> *'Just as those who produce and sell food are responsible for its safety, consumers have a role to play in ensuring that the food we eat is handled safely'* (FSA, 2000a).

The ACMSF (1990) have stated that due to widespread presence of micro-organisms in the environment, animals and man, it would be unrealistic to expect that all food at all stages of the food chain to be totally free of pathogens. Nevertheless, it is considered to be important that food produced for the consumer is of the highest microbiological quality possible (ACMSF, 1990). However, an improvement of food safety practices at all levels of food processing and preparation is necessary to reduce the currently high incidence of food poisoning (Phillips and George, 1994).

2.5.1 Responsibilities of the Government.

Food safety is an issue for which regulatory authorities in almost any country adopt a formal responsibility (Jouve, 1998). Disease notifications, laboratory surveillance, outbreak investigation and research are all required for effective epidemiological data collection (Guzewich *et al.* 1997). This information enables trends, implicated foods and contributory factors that may be attributed to incidents of foodborne disease to be identified. Accurate surveillance of foodborne disease is fundamental to the planning of food safety education programmes and the development of prevention strategies (Kaferstein *et al.* 1997). In addition, research, risk assessment and surveillance provide a basis to inform policy development and decision making by the food industry and the Government in the area of food safety (ACMSF, 1991). The regulatory role of the Government is important because it includes the development of legislation and its enforcement (Kaferstein, 1997). It is then the responsibility of Environmental Health Officers (EHOs) to enforce legislation and check that food hygiene standards are maintained in catering premises and retail establishments, thereby ensuring that food produced is acceptable for consumption (Sprenger, 1995).

In the UK, the role of the FSA has assumed responsibilities that were previously in the remit of Ministry of Agriculture, Fisheries and Food (MAFF) and The Department of Health (DoH). The FSA, which was established in April 2000, is a UK body accountable to Parliament, The Scottish Parliament and to the National Assembly of Wales and the responsible authorities of Northern Ireland (ADAS Consulting Ltd, 2000). Its primary aims include protecting public health and the interests of consumers in relation to food (FSA, 2000a). The Agency is considered to be responsible for formulation and implementation of policies on all aspects of food safety and standards (ADAS Consulting Group, 2000). Furthermore, protection of the consumer through effective enforcement is of primary importance (FSA, 2000e). Interests of consumers will be protected by three core values: a) to put the consumer first, b) to be open and accessible and c) to be an independent voice (FSA, 2000e; FSA, 2000f).

Reflecting the recognition of responsibility for food safety, governments' have set up national food safety initiatives accounting for all stages of the food chain with overall aims of reducing foodborne disease. In the UK, the 'Farm to Fork' approach has been introduced to examine food safety and standards (FSA, 2000e) and enable identification of the need for the implementation of preventative measures at key stages of the food chain, from the agricultural supply sector through to consumers (ADAS Consulting Group, 2000). In the USA, the 'From Farm to Table' initiative was set up in 1997 with the overall goal of reducing the incidence of foodborne illness to the greatest extent feasible (USEPA, USDA, PHHS, 1997). Similarly, in Australia a 'Paddock to Plate' approach has been launched, to coordinate activities across the full spectrum of the food chain (CDNANZ, 1997).

2.5.2 Responsibilities of the food industry.

The food industry consists of a series of processes that transform basic agricultural raw materials into a more acceptable or more convenient forms for consumer consumption (Strak *et al.* 1995). The food industry begins with agricultural methods of production and / or rearing of animals on farms, followed by the manufacture and distribution of processed foodstuffs, proceeded by wholesale, retailing and final preparation of foods in catering establishments.

Provision of food will always present some biological risk (Griffith, 2000a) and it is the responsibility of the food industry to provide food of a minimum risk for the consumer (Jermini, 1999). In the food industry, retail and particularly catering establishments have the responsibility of being providers of food during the last steps before purchase or consumption by the consumer (Griffith, 2000a). In order to ensure that this responsibility is met, provision of proper premises and proper hygiene training is required, as well as implementation of food safety measures. This may be achieved by implementation of Hazard Analysis Critical Control Point (HACCP) which is a specific prevention strategy that has been developed to allow structured, systematic identification and control of food safety hazards for quality control (ICMSF, 1988). The law requires a proprietor of a food business to ensure that key features of the HACCP approach are implemented (Regulation 4 (3) of the Food Safety -General Food Hygiene- Regulations 1995), and a hazard analysis is required to evaluate all procedures concerned with production, distribution and use of raw materials (Food Safety and Hygiene Working Group, 1997). Application of HACCP and risk assessment techniques provides information to base preventative actions and control measures (Bryan, 1996) to prevent, eliminate or reduce hazards, such as pathogens, to acceptable levels (Kliebenstein, 1995). Therefore, potential food safety problems are minimised (Buchanan *et al.* 1995) and production of safe food is ensured (NACMCF, 1992).

2.5.3 Responsibilities of consumers.

Consumers are the important final link in the food chain to assure safe food consumption and prevent foodborne illness (The Pennington Group, 1997; Zhang and Penner, 1999). Multiple food safety responsibilities are required by consumers because they not only purchase and receive products but also process and provide foods for themselves and for others (CDNANZ, 1997). Therefore consumers' have responsibilities as purchasers, storers, providers and processors of food and need to be conscious of the nature and safety of food products (CDNANZ, 1997). Thus, food-handling practices employed by consumers in the domestic kitchen influence the risk of pathogen multiplication, cross contamination to other products, or destruction by thorough cooking procedures (Roberts *et al.* 1995a). Given that 92% women and 61% men prepare meals (if not every day) at least once or twice a week (Nicolaas, 1995) it is extremely important that food is handled in a manner that does not increase the risks of foodborne disease. A great deal of research has been carried out on manufacturing, processing and distribution processes in the food industry, however, the consumer remains the least studied, yet crucial link of the food chain.

2.6 THE DOMESTIC ENVIRONMENT.

2.6.1 The domestic environment as a location for getting foodborne disease.

Foodborne pathogens (see section 2.4.2) associated with a range of raw foods (see sections 2.4.3 and 2.4.4) are regularly bought into the domestic kitchen and transmission of such pathogens due to implementation of unsafe food-handling behaviours (see section 2.4.5) within the household is seen to be inevitable (Jones, 1998). Thus, the domestic kitchen has been described as the 'front line in the battle against foodborne disease' (CFIA, 1998). Foodborne illnesses are most often caused by faults during the handling and preparation of food (Archer, 1986; Desmarchelier, 1996) and it is reported that a substantial amount of food poisoning occurs in the home (POST, 1997). Catering premises are subject to food legislation specifying design, layout, construction and size requirements and food handlers frequently have had food safety training. However, the domestic environment may have inadequate facilities for equivalently safe food preparation, consumers have no formal training and there is no regulations regarding the implementation of appropriate food safety behaviours (Griffith and Worsfold, 1994a). Thus, it is possible to see how foodborne outbreaks may originate when food is prepared and served in private dwellings (Ryan *et al.* 1996).

Reported incidence of foodborne disease associated with the domestic environment in the UK, Europe, USA, Canada, Australia and New Zealand is variable and is based upon reported *outbreaks*. Scott (1996) noted that outbreaks of foodborne illness occurring in private homes are less likely to be reported than those in commercial and public premises, however, it has been estimated that private homes in the UK have accounted for more outbreaks of foodborne illness than the sum of all other reported locations (IFH, 1998b; Scott, 1996). Indeed, infections attributed to the private home are believed to be three times more frequent than attributed to canteens (Borneff *et al.* 1988). Thus, given the substantial under-reporting of foodborne disease (see section 2.3.3) and the fact that the majority of cases of foodborne disease are thought to be sporadic (FSA, 2000b) the actual proportion of foodborne disease cases that occur in the home is likely to be much larger than initially realised. Nevertheless, data from England, Wales, USA and Canada suggest between 12-20% reported foodborne outbreaks have been attributed to the home. Data from Australia and New Zealand suggest between 20-50% foodborne illness has been attributed to the home and data for some European countries suggest that up to 95% of reported foodborne disease outbreaks in have been associated with food prepared or consumed in the home. Overall, in Europe, FAO/WHO (2002) have stated that the '*private home is the single location where most foodborne outbreaks occur*'. Summarised data from international and national studies reporting on the incidence of foodborne disease attributed to the home can be found in Appendix 2.4a and 2.4b.

The largest proportions of reported foodborne disease outbreaks associated with the private home have been caused by *Salmonella* (Tirado and Schmidt, 2000). However, as incidence of *Campylobacter* is largely sporadic it is suggested that more cases of *Campylobacter* infection may be attributed to the home than *Salmonella*. Experts have indicated that cases of home based foodborne illness may become more prevalent in the future due to consumers lacking time or familiarity with food safety issues (Kurtzweil, 1996).

2.6.2 Bacterial contamination in the domestic environment.

The importance of the home as a location for acquiring foodborne disease has prompted the assessment of levels of bacterial contamination within the domestic environment. Surveys have evaluated the microbial content of the domestic kitchen (Cox *et al.* 1989; Spiers *et al.* 1995) and domestic environment (Beumer *et* *al.* 1996; Finch *et al.* 1978; Ojima *et al.* 2002; Scott *et al.* 1981; Scott *et al.* 1982). Other surveys have quantified bacterial pathogens in the home and determined the effectiveness of cleaning agents and methods (Cogan *et al.* 1999; Josephson *et al.* 1997; Rusin *et al.* 1998). Few surveys have evaluated microbial contamination in the domestic kitchen after food preparation (Cogan *et al.* 1999; Gorman *et al.* 2002; Worsfold and Griffith, 1996a). Most studies have concluded that the domestic environment is an important source of foodborne infections (ACMSF, 1990) and hygiene behaviour and / or cleaning practices need to be improved to reduce levels of contamination in the domestic environment (Beumer *et al.* 1996; Cogan *et al.* 1999; Mendes *et al.* 1978; Scott *et al.* 1982).

Research results have shown that the majority of domestic environments studied were contaminated with pathogenic and non-pathogenic micro-organisms. Interestingly, two studies found bacterial contamination levels in kitchens to be higher than in bathrooms (Ojima *et al.* 2002; Rusin *et al.* 1998). Finch *et al.* (1978) reported that the normal domestic environment appeared to support a fairly wide range of bacterial species and Josephson *et al.* (1997) concluded that normal kitchens can be easily contaminated with a variety of bacterial contaminants including faecal coliforms, *Enterobacteriaceae* (such as *Escherichia coli*), *Campylobacter* spp. and *Salmonella* spp.. *Campylobacter* spp. has also been detected from commercial and domestic kitchens after food preparation (Cogan *et al.* 1999; Dawkins *et al.* 1984). *Listeria* spp. (including *Listeria monocytogenes*) have been isolated from 20% domestic kitchens (Cox *et al.* 1989), and from 47% kitchens and bathrooms (Beumer *et al.* 1996) and both studies expressed concern for the implications of human exposure to these pathogens in the domestic environment. Other organisms that have been detected in the domestic environment include *Staphylococcus* spp. (Josephson *et al.* 1997; Spiers *et al.* 1995; Finch *et al.* 1978), *Bacillus* spp. and *Micrococcus* spp. (Finch *et al.* 1978; Scott *et al.* 1982; Speirs *et al.* 1995), and *Streptococcus* spp. (Scott *et al.* 1982). Furthermore, it has been reported that potentially pathogenic *Escherichia coli, Klebseiella pnneumoniae,* and *Enterobacter cloacae* were the most frequently detected species in the home (Scott *et al.* 1982).

The type and density of bacterial contamination has been found to be influenced by the physical nature of the site sampled (Gorman *et al.* 2002; Scott *et al.* 1981). Contaminants detected from the majority of studies were reported as being more commonly isolated from wet to moist locations (Cox *et al.* 1989; Josephson *et al.* 1997; Scott *et al.* 1982; Speirs *et al.* 1995) where survival and proliferation of organisms is favoured. Scott *et al.* (1982) reiterated these findings and stated that detection of *Enterobacteriaceae* predominately occurred from wet sites. The most common locations found to be more heavily contaminated with micro-organisms in the domestic kitchen were dishcloths, cleaning cloths, sponges, sink environments and towels (Beumer *et al.* 1996; Cox *et al.* 1989; Finch *et al.* 1978; Josephson *et al.* 1997; Rusin *et al.* 1998; Scott *et al.* 1982; Speirs *et al.* 1995). Kitchen sponges and dishcloths are considered to be particularly conducive environments for growth and survival of bacteria due to being continuously moist and supplied with nutrients in the form of food scraps and organic matter (Doyle *et al.* 2000). Other locations that were found to be contaminated included those frequently touched such as tap handles and fridge handles (Mendes *et al.* 1978; Rusin *et al.* 1998). The frequent contamination of dishcloths and other wet samples with large numbers of organisms including *Enterobacteriaceae* suggest that these locations may not just harbour the bacteria, but also spread them round the kitchen during use (Doyle *et al.* 2000; Scott *et al.* 1982). Thus, it is suggested that consumers use disposable paper towels for cleaning of surfaces in the kitchen, as opposed to dishcloths.

The potential spread and persistence of contaminants in the domestic environment has been recognised in several studies (Dawkins *et al.* 1984; Humphrey *et al.* 2001; Scott *et al.* 1982; Slader *et al.* 2001; Spiers *et al.* 1995). Indeed, during food preparation, pathogens such as *Campylobacter*, *Salmonella*, *Escherichia coli* and *Staphylococcus aureus* are disseminated from infected foods such as raw chicken to hand and food contact surfaces in the domestic kitchen (Gorman *et al.* 2002), thus increasing the potential risk for food poisoning.

Cumulatively data suggest that the domestic environment is a ubiquitous source of pathogenic micro-organisms. It is possible for consumers to prevent pathogenic contamination of the domestic environment during food preparation, by implementing appropriate food safety behaviours to prevent direct and indirect cross contamination occurring from foods such as raw poultry, raw meat and / or raw eggs. Such behaviours include immediate and adequate hand-washing and hand drying after handling raw poultry, meat and / or eggs and implementation of effective cleaning procedures, particularly including the use of disposable paper towels.

2.7 CONSUMER FOOD SAFETY.

Acknowledgement of the importance of adequate consumer food safety practices has been widely reported (FSA, 2000b; Griffith *et al.* 1998; POST, 1997; Scott, 1996). A considerable amount of food preparation and food-handling occurs in the domestic kitchen, so research and consumer education regarding the risk of food safety malpractices is an essential element of preventing foodborne disease (Kaferstein, 1997). A key to the design of effective educational initiatives is an understanding of factors that influence an individual's behaviour (Middlestadt *et al.* 1996). Health-related behaviours, such as those related to food safety, are considered to be influenced by a number of cultural, socio-economic and environmental factors, as well as cognitive intrinsic factors such as knowledge, attitudes, beliefs and values (WHO, 2000b). Such cognitive antecedents are focussed upon as being the most important determinants that provide a rationale or motivation for the behaviour (Connor and Norman, 1999; Levy, 2002). The more that is known about the factors underlying performance or non performance of a health-related practice, the more successful the design of interventions can be for influencing that practice (Strand, 1999).

2.7.1 Sources of information about consumer food safety behaviour.

Information relating to domestic safety behaviour comes from two main sources, analysis of food poisoning outbreaks and consumer based research studies (Griffith and Worsfold, 1994a). Epidemiological studies provide quantitative data regarding contributory food-handling malpractices that have resulted in outbreaks of foodborne disease. However, retrospective analysis of foodborne disease provides limited information about consumer food safety behaviour. The accuracy and availability of data is limited due to difficulties of recalling exact food consumption details and handling practices that may have occurred some time before the illness is reported. Internationally, numerous consumer based research studies have taken place to evaluate food safety practices of consumers. Different approaches have been adopted including questionnaire and interview surveys, focus group discussions and observational studies.

2.7.2 Consumer food safety studies.

The purpose of conducting consumer food safety studies has been to ascertain how consumers' handle food in their homes, determine consumers' knowledge of food safety, and examine why some safe food-handling practices are or are not implemented. General knowledge of food safety and hygiene has been determined by several workers (Meer and Misner, 2000; Shiferaw *et al.* 2000; Spriegal, 1991; Unklesbury *et al.* 1998), and other workers sought to obtain an understanding and awareness of specific food safety issues (Beddows, 1983; FDA/FSIS, 2000; Griffith *et al.* 2001; NCC, 1991; Woodburn and Van de Riet, 1985). Many studies have assessed self-reported practices of consumers (Albrecht, 1995; Bruhn and Schultz, 1999; Fein *et al.* 1995; Jones and Weimer, 1977; Meer and Misner, 2000; Williamson *et al.* 1992), whereas others assessed actual food-handling behaviours (Audits International, 2000; Jay *et al.* 1999a: Worsfold and Griffith, 1997a; Worsfold, 1994). Some studies have investigated general attitudes towards aspects of food safety (FSA, 2000g; FSA, 2001e; FSA, 2002a; Jones and Weimer, 1977), and food standards in the UK (FSA, 2001e; FSA, 2002a) and a few investigations have used the constructs of psychological theories to attempt to understand the relationships between knowledge, attitudes, intention and behaviour of food safety practices (Griffith *et al.* 2001; Mullan, 1997). The overall aim of the majority of studies undertaken was to provide information for the development of effective communication strategies to promote safe food-handling (Albrecht, 1995; FDA/FSIS, 2000; Sammarco and Ripabelli, 1997; Walker, 1996; Williamson *et al.* 1992).

2.7.3 When consumer food safety studies were carried out.

Over the past 26 years at least 77 consumer food safety studies have been carried out. The earliest study obtained was undertaken in the late 1970's and the most recent in 2002 (see Table 2.3). Few surveys were carried out during the 1980's when although safe food production was a priority, the importance of the consumers' role in the food chain was not so widely appreciated. During the 1980's and early 1990's international incidence of foodborne disease increased considerably and a variety of media 'food scares' brought food safety issues to the attention of the consumer. As a consequence of these factors it was recognised that there was significant potential for the domestic kitchen to be a significant origin of foodborne disease. This prompted more interest in 'the consumer' and the consumers' role in production of safe food. Consequently, many different organisations, research institutions and government agencies investigated aspects of safe food preparation in the domestic kitchen. In the early 1990's, several studies and reports emphasised that very little was known about the knowledge, attitudes and behaviours of consumers regarding safe food-handling practices and microbial contamination (ACMSF, 1991; Griffith and Worsfold, 1994a). Between 1990 - 1999 more than 55 studies were completed, the majority (80%) of which were undertaken between 1995 - 1999. Since 2000, there have been a further 18 studies undertaken. Reflecting the upward trend of cases of illness resulting from foodborne disease, there has been an increased collection of data detailing consumers' food preparation practices from all over the world.

Table 2.3. Number of consumer food safety studies conducted between 1975-2002 (*n*=77).

Years	No. of studies completed *n* (%)
1977 – 1979	1 (1%)
1980 – 1984	1 (1%)
1985 – 1989	2 (3%)
1990 – 1994	11 (14%)
1995 – 1999	44 (57%)
2000 – 2002	18 (24%)

2.7.4 Origins of consumer food safety studies.

Data presented in Table 2.4 shows the origins of consumer food safety studies under discussion. The majority of studies were undertaken in the USA (48%). More than half of the studies were carried out in UK and Northern Ireland (40%), Australia and New Zealand (8%), Europe (2%) and Canada (1%).

Table 2.4. Table showing origins of consumer safety studies (*n*=77).

Location.	Total no. studies completed. *n* (%)
USA	37 (48%)
UK and Northern Ireland	31 (40%)
New Zealand	4 (5%)
Australia	2 (3%)
Canada	1 (1%)
Italy	1 (1%)
Southern Ireland	1 (1%)

2.7.5 Research methods used.

Research methods used for data collection of consumer food safety studies include self-completion questionnaires and interviews, (collectively known as surveys), focus groups and observational studies. Data shown in Table 2.5 denotes proportions of studies undertaken according to research methods used. Interviewing was found to be the most common methodology for obtaining information on consumer food safety, accounting for 56% of studies, followed by self-completion questionnaires which accounted for 29% of studies. Research using focus groups accounted for 6% of studies and use of the direct observation technique accounted for 9% of studies.

Table 2.5. Methods of data collection for reviewed consumer food safety studies (*n*=77).

Method of Data Collection.		Frequency of use by specific methodology. *n* (% of total studies).	Overall frequency of use *n* (% of total studies).
Self-completion questionnaires.	Postal	9 (12%)	**22 (29%)**
	Self-administered	11 (14%)	
	Online	2 (3%)	
Interviews.	Telephone	19 (25%)	**43 (56%)**
	Face-to-face	24 (31%)	
Focus groups.		-	**5 (6%)**
Observational studies.		-	**7 (9%)**

2.7.6 Content analysis of consumer food safety surveys (n=65)

Social surveys involve a quantitative method for collecting information from a population sample usually by personal interviews or by self-completion questionnaires. Such survey methods have been used for the assessment of knowledge of food-handling practices, foods at risk for transmitting infection, recognition of foodborne pathogens, self-reports of food safety behaviours, determination of food safety perceptions and measurement of psychological influences towards food safety behaviours.

To obtain a better understanding of the reasons why individuals perform food safety behaviours, different types of questions have been asked in interviews and questionnaires. Questions to identify attitudes and knowledge of food safety behaviours have been included in a considerable proportion of surveys, as have self-reported practices (see Table 2.6). Cognitive factors determine whether an individual practices health behaviours or not and are relevant to aspects of health promotion as they mediate the effects of other factors such as social and demographic variables when attempting to change health behaviours (Connor and Norman, 1996). For the majority of consumer food safety research studies it has not been possible to make direct observations of actual food preparation practices, therefore, asking questions based on self-report of practices has been used as an alternative.

A breakdown of the types of questions included in all of the consumer food safety surveys analysed can be found in Table 2.6. A content analysis of 65 food safety surveys (questionnaires and interviews) found that 13 (20%) surveys only included questions based on self-reported practices, only 1 (1%) survey was found to be solely based on determination of consumer attitudes and 2 (3%) surveys were only knowledge based. The majority of all surveys (45%) undertaken investigated self-reported practices with attitudes and knowledge of food safety, 25% surveys examined self-reported practice with knowledge, and 20% were solely based on self-reported practices.

Table 2.6. Inclusion of self-reported practices, attitudes and knowledge in consumer food safety surveys (n=65).

	Self-reported practice.	Attitude.	Knowledge.	Occurrence in food safety surveys n (% of total)
✓ = included in analysed consumer food safety surveys.	✓	✓	✓	29 (45)
	✗	✓	✓	2 (3)
	✓	✗	✓	16 (25)
✗ = not included in analysed consumer food safety surveys.	✓	✓	✗	2 (3)
	✓	✗	✗	13 (20)
	✗	✓	✗	1 (1)
	✗	✗	✓	2 (3)
Occurrence in food safety surveys	60 (92)	34 (52)	49 (75)	

2.7.6.1 Knowledge.

Determination of knowledge is relatively straightforward and information gained is likely to be an accurate description of what issue is sought. In some surveys preceding a food safety education initiative it is necessary to determine the baseline level of knowledge consumers possess regarding behaviours targeted by the initiative to assure a suitable level of education is provided. Indeed, it has been have stated *'food safety education can accomplish a great deal if basic knowledge about human behaviour is taken into account when health education programmes are planned'* (WHO, 1988, p10). Furthermore, determination of consumer knowledge has been used to evaluate effectiveness of health promotion initiatives after they have taken place (Macdonald, 1998).

Research detailing health-related behaviours has suggested that individuals sometimes make rational decisions about such behaviours when they are aware of and have some knowledge of the associated health problems (McIntosh *et al.* 1994). However, the acquisition of knowledge alone does not automatically produce the corresponding behaviour, nor will it lead to corresponding behaviour changes (Ackerley, 1994). Indeed, it is known that possession of knowledge of food safety practices does not always translate into correct implementation of food safety behaviours (Jay *et al.* 1999b; Meer and Misner, 2000; Worsfold and Griffith, 1997a). Nevertheless, the possession of knowledge allows consumers to make informed choices regarding their actions when they are motivated to do so. The accuracy and extent of a persons' knowledge can therefore be of major significance regarding corresponding behaviours.

Assessment of consumer knowledge featured in 75% of surveys carried out in the past 26 years. An analysis of consumer food safety surveys indicated that consumer knowledge of specific food safety practices may have improved since the 1980's (CFIA, 1998; Raab and Woodburn, 1997). Nevertheless, the level of consumer knowledge determined in food safety surveys has been varied, although the majority of surveys analysed concluded that consumer knowledge of food safety is inadequate and requires improvement. Poor knowledge may lead to implementation of common faults during food preparation that contribute to foodborne disease (Kerslake, 1995). Generally, consumers have been found to possess insufficient knowledge to ensure that food preparation in the home is performed so that the risk of illness is minimised (Jay *et al.* 1999b). Many surveys have identified gaps in or a lack of such knowledge (ADA Conagra, 1999; Albrecht, 1995; AMI, 1996; Bloomfield and Neal, 1997; Hodges, 1993; Jay *et al.* 1999b; Sammarco and Ripabelli, 1997; Woodburn and VanDeRiet, 1985; Woodburn and Raab, 1997). A recent survey carried out by Albrecht (1995) found that consumers did not clearly understand or report implementation of safe food-handling practices however, another survey has indicated that 80% of consumers considered themselves to be adequately informed regarding food safety (Bruhn and Schultz, 1999). Further research found that when consumers were asked why they failed to implement appropriate food preparation behaviours, responses showed that 40% consumers did not know or were consciously aware that they were carrying out malpractices (Audits International, 2000).

An analysis of consumer food safety surveys has been undertaken to determine consumer knowledge of key, composite food safety behaviours. Data indicates that in recent years, between 75-100% of consumers recognised hand-washing to be a necessary food safety action, although one survey indicated that only 45% of consumers knew that improper hand-washing could result in food poisoning (ADA Conagra, 1999). Results suggest that up to 36% of UK consumers and up to 22% of American consumers do not recognise the importance of using separate or adequately cleaned utensils for preparation of RTE foods after preparation of raw meat and poultry. Consumer knowledge determined for temperature control of foods has been varied. Knowledge of the implications of undercooking appears to be known by the majority of consumers. For example, 67-89% of consumers have reported to know that undercooking is associated with the risks of food poisoning. However, it has also been reported that only 15-20% of consumers know what the internal temperature of a piece of meat should be when it is considered to be safe to eat. Knowledge of cooling principles has been largely understudied, however, the few results obtained have suggested that many consumers are unaware of food safety risks associated with inadequate cooling. Furthermore, knowledge of storage temperatures showed that 93% of consumers did not know the correct refrigerator temperature and 25-31% of consumers did not know that storage of food at room temperature may increase the potential for microbial growth and thus increase the risk of food poisoning. Descriptive findings detailing consumer knowledge of important food safety behaviours can be found in Appendix 2.5.

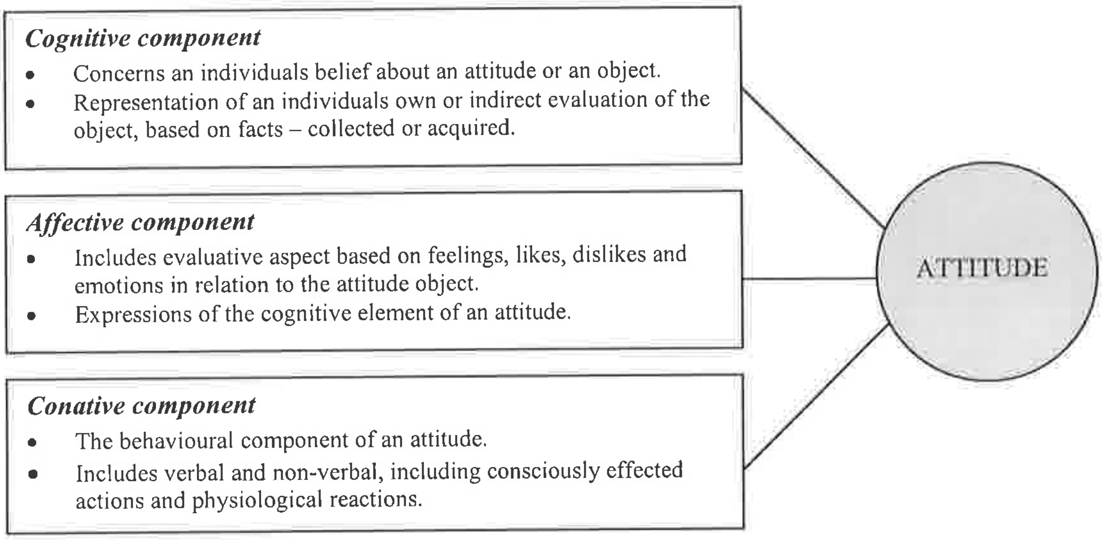
2.7.6.2. Attitudes.

Consumer attitudes are considered to be central to understanding actual behaviours (Downie *et al.* 1998). A substantial amount of ambiguity and disagreement exists regarding attitude definition, how attitudes are formed and changed, and what role, if any attitudes have in influencing or determining behaviour (Fishbein and Ajzen, 1975). However, an attitude is typically viewed as being an underlying variable that is assumed to guide or influence behaviour (Fishbein and Ajzen, 1975). One definition suggested is:

> *'an attitude is a learned predisposition to think, feel and act in a particular way towards a given object or class of objects'* (Ribeaux and Poppleton, 1978, p138).

This definition not only describes the three aspects of an attitude (cognitive, affective and conative components) (see Figure 2.2) but it also gives an indication of attitude structure and also suggests that attitudes are seen to be related to behaviour (Downie *et al.* 1998). This multi-component structure of an attitude has been adopted almost universally (Ajzen and Fishbein, 1980) and is also described by other workers (Fishbein and Ajzen, 1975; Gross, 1999; Schiffman and Kanuk, 1991; Stroebe and Stroebe, 1995).

Figure 2.2 The multi-component model of an attitude (based on Ribeaux and Poppleton definition), (Downie *et al.* 1998).



It has been stated that a belief is a component part of an attitude (Bennett and Murphy, 1999; Downie *et al.*1998; Stroebe and Stroebe, 1995), thus, for purposes of this thesis attitudes and beliefs will be categorised as stated in the above definition.

The association between attitudes and behaviour has been discussed by numerous social psychologists and findings between the attitude-behaviour relationship have not proved to be simple (Stroebe and Stroebe, 1995). In the past, social scientists assumed that attitudes could be used to explain human actions, as attitudes were viewed as behavioural dispositions (Azjen and Fishbein, 1980). A large number of studies have examined the relationship between the two variables, however results have been inconclusive and doubts have been raised regarding the association between attitudes and behaviour. The first sociologist to present evidence that suggested there was no correspondence between attitudes and associated behaviours was La Piere (1943), and this particular study has been cited on many occasions. A review of several aspects of the attitude-behaviour relationship has provided little evidence to support that underlying attitudes do influence behaviours (Wicker, 1969). This review indicated that correlations between measures of individual attitudes and direct measures of associated behaviour were particularly low. Other workers have also discussed the disparity between attitudes and behaviour (Augoustinos and Walker, 1996; Azjen and Fishbein, 1980; Azjen and Timko, 1986; Fishbein and Ajzen, 1975; Shepherd, 1995; Shepherd *et al.* 1995; Stroebe ad Stroebe, 1995). Despite such findings, the basic assumption that human behaviour is determined by attitudes continues to persist (Fishbein and Ajzen, 1975) and attitudes still form an important subject for psychological and behavioural research (Bennett and Murphy, 1999).

As the attitude-behaviour association has proved to be less than straightforward, various social cognition models and behavioural theories to have been developed in an attempt to understand the associations between cognitive variables and behaviour (see section 2.8.3.2). Attitudes are important components in these models as they, along with other cognitions, are considered to shape behaviour, differentiate between individuals and are open to change, thus represent a route for influencing performance of health behaviours (Connor and Norman, 1999). It is therefore important to determine attitudes towards behaviour for development of effective health education strategies. Research determining consumer attitudes and behaviour related to food safety has been lacking. However, such research is required to facilitate a better understanding of food safety behaviours and to aid the development of food safety education initiatives (see Chapter 3.0).

2.7.6.3 Self-reported practices.

Self-reported practices are personal accounts of actions, which may or may not reflect actual behaviours. Data from self-report questions may provide valid information of awareness or indirect knowledge about 'correct' behaviours rather than 'actual' behaviours, so may not give an accurate representation of what a respondent's true behaviour actually is. Social scientists have suggested that a respondent may claim to carry out the perceived 'correct' behaviours opposed to behaviours perceived to be undesirable, thereby providing a response to represent a positive image (Bowling, 2000). This concept is known as 'social desirability bias' and is reported to occur more frequently in questionnaires and telephone interviews than face-to-face interviews (Oppenheim, 1998). An evaluation of self-reported data that has been subject to social desirability bias could result in misleading findings (Curtis *et al.* 1993) and indeed, some consumer food safety surveys have acknowledged the limitations of interpreting self-reported data (Altekruse *et al.* 1999; Yang *et al.* 1998).

The majority (92%) of consumer food safety interviews and questionnaires analysed (n=65) have included questions based on self-reported practices. Self-reported responses from several surveys have suggested that reported malpractice's and misunderstandings of safe food-handling occur with respect to all factors that are known to contribute to food poisoning. An overall assessment of interview responses from an American survey found that 98% of food preparers reported at least one unsafe practice (Woodburn and Van De Riet, 1985). A more recent survey carried out by Altekruse *et al.* (1996) indicated that unsafe food hygiene practices were reported by one third of respondents. It was apparent that questions relating to hand-washing and use of separate or washed utensils for preparation of raw and cooked foods during food preparation were issues investigated most frequently.

An analysis of self-reported practices determined in consumer food safety surveys has been undertaken for key composite food safety behaviours. Results have found that between 62-100% of consumers have reported to always or usually wash their hands after handling raw meat and poultry and 87-92% of consumers have reported to always or usually wash their hands with soap and water before handling food. Data denoting self-reported actions related to cross contamination of pathogens from raw meat and poultry to RTE foods during food preparation show discrepancies in findings. For example, although 77-80% of consumers have reported that they never use the same plate for raw and cooked meat, up to 76% of consumers have reported they always / usually use separate utensils (e.g.) chopping board for preparation of raw meat and cooked foods. Thus illustrating responses that may have been subject to social desirability bias. Self-reported cooking practices indicated that the majority (85-98%) of consumers assessed adequate heating using subjective measurements and only 12-24% reported to use a meat / food thermometer to check the 'doneness' of meats. The majority of consumers who responded to food safety surveys have indicated they implement inappropriate cooling practices, largely based on leaving foods at room temperature for lengths of time that would allow growth of micro-organisms that could potentially cause foodborne disease if consumed. Reported storage practices mainly concerned refrigerated storage of foods. Results indicated that although 91% of consumers reported to keep raw meat, fish and poultry separate from other foods, 12-48% of consumers reported to store their raw meat and poultry on the top or middle shelf of the fridge, thereby increasing the potential for cross contamination of pathogens to foods that may be stored on shelves below. Detailed findings denoting consumers' self-reported practices of key food safety behaviours from consumer food safety surveys can be found in Appendix 2.6.

2.7.6.4 Discrepancies between consumer food safety knowledge and self-reported practices.

Research has shown that consumer food safety knowledge has failed to correlate with self-reported practices concerning important food safety behaviours (Albrecht, 1995; Altekruse *et al.* 1996; Meer and Misner, 2000; Williamson *et al.* 1992). Albrecht (1995) found that a number of respondents knew about the concepts of proper food-handling, but did not report to put those concepts into practice. Similarly, Altekruse *et al.* (1996) revealed that between 20-27% of consumers demonstrated they knew of safe food-handling behaviours to reduce the risk of food poisoning, yet failed to report a corresponding safe practice. The same disparities were not observed for adequate cooking of meat and poultry, where more consumers reported to serve adequately cooked meat than knew adequate cooking of meat reduces the risk of food poisoning (Altekruse *et al.* 1996). Overall, surveys determining knowledge and self-reported practice have found that knowledge of a term or concept, does not always correlate with the appropriate self-reported, safe food preparation practice (Williamson *et al.* 1992). Other consumer food safety studies that have made inferences regarding this disparity that has been determined in consumer food safety research including ADA Conagra, (1999), Griffith *et al.* (1998), Raab and Woodburn, (1997) and Worsfold and Griffith, (1997a). Detailed findings from consumer food safety surveys that have compared knowledge and self-reported practices can be found in Appendix 2.7.

2.7.7 Focus group data.

The use of focus groups as a means for obtaining consumer food safety information is a relatively under-utilised research method, although has been increasingly adopted. This research method is based on carefully planned group discussions designed to obtain attitudes and perceptions on a defined area of interest (Kruegar, 1998). Focus groups are known to be particularly effective for providing information about *why* people think or feel in the way that they do, and group interaction provides a greater insight into why certain opinions are held (Kruegar, 1994). To date, only 6% of consumer food safety studies have used focus groups to ascertain information about consumer food safety.

In the UK, focus groups have been used to investigate public attitudes towards food safety and elicit expectation of the Government (FSA, 2000g). In the USA, group discussions were used to determine perceptions about the use of thermometers when cooking meat and poultry products to aid development of an effective consumer food safety education campaign (Koeppl, 1998). Findings from the UK focus groups suggested that few people have food safety issues on their minds when they go shopping, and substantial scepticism was ascertained regarding the UK food supply, food producers and food scares (FSA, 2000g). Perceptions of specific food safety behaviours, the home as a point of source for incidence of foodborne disease and perceptions of food safety education were not investigated. Focus groups undertaken in USA determined less positive self-reported behaviour than previous quantitative consumer food safety research. In addition, further insight was obtained regarding implementation of food preparation practices related to cooking of foods. For example, in group discussions, consumers described how they usually assessed end of cooking, by '*wiggling the leg, if its loose, it's done*' and '*the smell tells you its close to being done*' (Koeppl, 1998). Thus, richer information about consumer food safety behaviours may be obtained using informal group discussions / focus groups opposed to using the more frequently utilised quantitative survey methods.

2.7.8 Observation data.

Observation is a method used for understanding complex behavioural situations more accurately (Bowling, 2000). Observation does not depend on second hand reported accounts of behaviour from respondents who may have put their own interpretation on events (Saunders *et al.* 2000). Seven consumer food safety studies identified have used observational techniques to obtain data detailing actual food safety behaviours. Various methods of observation have been used to collect information about consumers actual food safety behaviours in their own homes, such as personal direct observation or observation using video recordings. Four observational studies have been undertaken in USA (Anderson *et al.* 2000; Audits International, 1998; Audits International, 1999; Audits International, 2000), one in Australia (Jay *et al.* 1999a) and two in the UK (Mullan, 1997; Worsfold, 1994). Although providing useful and valuable data, such food safety studies have been subject to a variety of limitations. To date, none of the studies have assessed the reliability of observational methods used and all observations have taken place in uncontrolled consumer home kitchens. As an alternative, a controlled, naturalistic environment that could facilitate replicate meal preparations could be used to determine consistency of food safety malpractices implemented over time, as well as provide a means for evaluating intervention effectiveness. A variety of methods for recording food safety malpractices have been used, although to date, none have accounted for frequency of all malpractices or provided an objective measurement of food safety malpractices that accounts for associated microbiological risks of implementation. Issues related to observation of consumer food preparation behaviours have been discussed in more detail in Chapter 5.0.

Overall, findings from observational studies have provided more accurate information detailing actual consumer food safety behaviours, as opposed to second hand reports obtained from surveys. All of the studies found that the majority of consumers implement many food safety malpractices including behaviours that may result in temperature abuse and behaviours that may result in cross contamination of harmful pathogenic micro-organisms from raw meat and raw poultry within the domestic kitchen. Thus, many consumers' food preparation behaviours in the domestic kitchen may increase the potential risks of foodborne disease.

2.7.8.1 Discrepancies between knowledge, self-reported practices and observed behaviour.

Assessments of food safety knowledge and observed food safety behaviours have featured in several American studies (Anderson *et al.* 2000; Audits International, 1999), and in an Australian study (Jay *et al.* 1999a). Each of the studies demonstrated that possession of knowledge did not correlate with actual food-handling performance. For example, although nearly all American consumers rated eating a lettuce moistened with raw poultry dripping as a 'risky' food-handling behaviour, observations of food preparation practices showed 98% of the same consumers cross contaminate RTE foods with raw meat and raw egg (Anderson *et al.* 2000). Nevertheless, lack of knowledge did not mean that a violation was imminent, for example, although only 7% of consumers knew adequate temperatures for foods to be cooked, yet >80% of consumers were observed to cook their foods to proper temperatures (Audits International, 1999). Australian data also revealed that there was significant variance between stated answers (given on a questionnaire) and observed (via video monitoring) food-handling and hygiene practices (Jay *et al.* 1999a). Nineteen percent of consumers who claimed to have soap available in the kitchen, did not, and similarly, almost half of consumers did not use a detergent or cleaner for cleaning kitchen surfaces even though having previously stated the contrary (Jay *et al.* 1999a). Due to such discrepancies between knowledge and actual behaviour workers have concluded that knowledge is a poor indicator of actual behaviour and when it comes to food safety, it is difficult to measure what the general population does by what they know (Audits International, 1999). See Appendix 2.8 for data denoting intra-study comparisons between knowledge and observed behaviours.

A comparison between self-reported practices and actual observed behaviour has been researched by Anderson *et al.* (2000). Results summarised in Appendix 2.9, show that substantially larger proportions of consumers reported to implement safe food-handling behaviours than actually performed them. For example, although nearly all respondents (87%) reported to wash their hands before food preparation, observational findings showed that less than half (45%) actually did so. Thus suggesting that self-reports of food safety practices may not be a reliable indication of actual behaviour.

Intra-study comparisons between observed food safety malpractices, knowledge and self-reported practices indicate that discrepancies exist between what consumers know, what they say that they do and what they actually do. In addition, findings show that observed food safety behaviours are considerably worse than self-reported practice and reports of knowledge. Thus, results suggest that observations of food preparations in the domestic kitchen provide more accurate and reliable representation of consumer food safety behaviours than measures of knowledge and self-reported practice.

Inter-study comparisons of consumer knowledge, attitudes, self-reported practices and actual behaviour from international consumer food safety studies reiterate findings from the *intra*-study analyses. Thus, discrepancies between cognitive antecedents that may influence food safety behaviours and actual food safety behaviours are highlighted. For example, 82-100% of consumers knew that hand-washing was necessary before handling RTE foods and after raw foods such as raw meat and poultry, 95-100% consumers expressed a positive attitude towards hand-washing, 62-92% reported to implement acceptable hand-washing behaviours. However, between 75-100% of consumers failed to implement acceptable hand-washing and hand drying behaviours when necessary during food preparation. On the whole, the *inter*-study comparison of findings showed that the majority of consumers demonstrated knowledge, expressed a positive attitude and self-reported acceptable food safety practices. However, observation findings showed that the majority of consumers also failed to implement corresponding food safety behaviours to prevent cross contamination of pathogens in the domestic kitchen and practices to prevent the risk of undercooking. Insufficient data was available to make *inter*-study comparisons between knowledge, attitudes, self-reported practices and actual behaviour for behaviours associated with cooling and storage of foods. Further research is required to determine consumer attitudes towards food safety behaviours, particularly for cooling and storage practices. In addition, quantifiable observational data detailing specific food safety behaviours, particularly with regards to the frequency of observed practices, is required to realise the extent that food safety malpractices are implemented during domestic food preparation. Summarised findings from the *inter*-study comparison of knowledge, attitudes, self-reported practices and observed food safety behaviours for important composite food safety malpractices can be found in Appendix 2.10.

2.7.9 Gaps in research of consumer food safety.

An analysis of consumer food safety studies to date shows that a substantial amount of research has been conducted to identify consumer knowledge and self-reported behaviour of food-handling practices in the home. However, it is apparent that there is a lack of data available detailing consumer attitudes towards food safety in the domestic kitchen. Thus, there is a need for research to identify consumer attitudes towards specific food safety behaviours to attempt to increase understanding of why some food safety behaviours are performed and others are not. In addition to this, given the discrepancies identified between knowledge, self-reported practice and observed food-handling practices, further work is required to assess and quantify the frequency of consumer food safety behaviours. To date, published research detailing observed food safety practices have occurred in consumers' home kitchens. However, assessment of actual food safety behaviours in a controlled, yet naturalistic model environment would enable direct comparisons of food safety performance between different groups of consumers and the potential for evaluation of the effectiveness of food safety interventions.

2.8 CONSUMER FOOD SAFETY EDUCATION.

An improvement in consumer food safety behaviour is likely to reduce the risk and incidence of foodborne disease. A reduction of foodborne disease in the general population depends on positively altering the behaviour of food-handlers (Howes *et al.* 1996). Food control authorities cannot intervene in every household (WHO, 2000b), therefore educational initiatives are required to reduce incidence of foodborne illness within the food safety continuum from 'farm to table' (Meer and Misner, 2000).

To effectively decrease food poisoning incidence, educational strategies are required to reduce prevalence of behaviours associated with foodborne illness, increase consumer awareness of risks, and motivate consumers to change unsafe behaviours (Yang *et al.* 1998). It has been suggested that the use of information related to the food habits and beliefs of consumers is essential if the disease control messages are to effect behavioural change (Ehiri and Morris, 1996). To maximise the effectiveness of food safety educational initiatives, strategies should be based on knowledge of consumer attitudes towards food safety behaviours, actual food safety behaviours and an understanding of receptivity for advice and preference for sources and message types.

2.8.1 National and International consumer food safety education strategies.

As described in section 2.5.1, national and international food safety initiatives have been set up to account for all stages of the food chain including the consumer. For a list of current and previous national and international consumer food safety initiatives identified see Table 2.7. In addition, the following organisations in the UK are known to provide food safety interventions for consumers: The Food Safety Advisory Centre, Foodlink, The British Egg Information Service, The Chilled Food Association, The British Chicken Information Service, The Meat and Livestock Commission, Sainsburys (particularly for promotion of Microban®) and other supermarkets, Domestos Food Safety Advisory Board, Milton sterilisers and local Environmental Health Departments. It is also noted that a vast amount of consumer food safety advice for consumers is available on the Internet from smaller, less known organisations, University research groups, extension services and government organisations. The effectiveness and reach of such materials has not been ascertained.

Table 2.7 National and International food safety education initiatives.

Year	Country	Food Safety Initiative	Implemented by whom
2002	UK	Food Hygiene Campaign (for caterers and consumers based on the 4C's)	FSA
1991-1995	UK	Foodsense leaflets	MAFF
1993-2002	UK	National Food Safety Week	Food link
1998-2002	USA	Food Safety Education Month	USDA, FDA
1999-2002	USA	Fight BAC!^{TM} Campaign (for targeted consumers based upon the '4 simple steps for food safety'	Partnership for Food Safety Education.

To achieve the FSA target for foodborne disease reduction (FSA, 2001c; Hilton, 2002) a national food hygiene campaign has been implemented in the UK. The campaign is based upon increasing awareness and understanding of 'The 4 C's' (cleanliness, cooking, chilling and cross contamination) (Boville, 2002). To date, a variety of media based interventions have been developed, for example a `Preventing food poisoning' leaflet has been designed for all consumers and catering establishments (Boville, 2002).

In 1999, The Fight BAC! National Food Safety Initiative was set up to provide targeted information for consumers in USA. The Fight BAC! Campaign is a product of the Partnership for Food Safety Education which is a unique public-private partnership of government and consumer groups dedicated to increasing awareness of food safety and reducing the incidence of foodborne illness (Partnership for Food Safety Education, 2001). The Campaign is based on four food safety messages ('*Clean'* -wash hands and surfaces often, '*Separate'* – don't cross contaminate, '*Chill'* – refrigerate properly and '*Cook'* – cook to proper temperatures) (USDA, FSIS, FSES, 2001) and BAC! a big, green bacterium character has served as the focal point to the campaign (Partnership for Food Safety Education, 2001). A recent addition to the Fight BAC! initiative has been the introduction of 'Thermy' a cartoon thermometer. Such a character has been used to support the Fight BAC! message of '*Cook*' based on studies that have indicated there is significant risks of foodborne illness when the colour is used to judge when a food has been cooked to a safe temperature (USDA, FSIS, FSES, 2001). Intervention materials have not only been targeted at specific food safety behaviours but also for specific groups of consumers and have included a wide range of media formats, some of which have been interactive.

2.8.2 General sources of food safety education.

2.8.2.1 The Mass Media.

Consumers are exposed to many sources for food safety information namely encompassed within the realms of the mass media. As the media permeate everyday life, reaching the majority of the population by one or several of modes of communication (RUHBC, 1995), its potential for influencing public attitudes and behaviours is well recognised (Chipman *et al.* 1996). It is considered that the impact of the mass media on food hygiene may be greater than in other areas of health education (Griffith *et al.* 1994). Indeed, the mass media has been shown to be an important source of information for food and nutrition (Griffith *et al.* 1994; Moore *et al.* 1992). Two key features of the mass media include the large audience but no interpersonal communication between the originator of the message and the audience (Tones and Tilford, 1996).

The role of the mass media for informing consumers about food safety risks is of critical importance (Beardsworth, 1990) and the media have a responsibility to ensure that advice they provide is accurate and adequate (Griffith *et al.* 1994). Although media coverage of food safety issues in recent years has heightened consumer awareness of microbiological safety (Ollinger-Snyder and Matthews, 1994), it has also increased consumer concern and confusion (Wheelock, 1989). Chipman *et al.* (1996) acknowledged that the considerable challenge that exists to create messages that are perceived to be objective and unsensational, yet maintain the interests of viewers and readers. Indeed, the media have been responsible for sensationalising so called 'food scares' whereby consumers' initial anxieties regarding the issue are commonly amplified (Beardsworth, 1990). For example, in response to the *Salmonella* in eggs 'scare' in 1988, consumers' risk perceptions increased not only to the same level of the actual risk, but also to a level far greater than the actual risk (Mitchell and Greatorex, 1990). In addition to this, adverse media coverage has resulted in consumer confusion because conflicting information has been received from different sources (Wheelock, 1989). It is concerning to realise that many consumers have obtained information about food safety from such 'food scares' (NCC, 1991). Consumers need to receive consistent food safety information to not only prevent panic instigated by careless communications (Scroggins, 1993) but also to promote safe food-handling behaviours in a manner that is accurate and credible.

2.8.2.2 Leaflets, posters, videos and television as sources of food safety information.

Channels and sources generally used in public communication efforts include a variety of formats such as television, radio, posters, leaflets, newspapers, cookery books, magazines and reminder aids. Although limited research has been conducted to evaluate the effectiveness of different intervention types, it has been reported that the potential effectiveness of different media does vary considerably, despite having common characteristics (Tones and Tilford, 1996).

The production and distribution of leaflets is considered to be a mainstay of health education and promotion activities (Fraser and Smith, 1997) however, the effectiveness of communication using written information in the form of leaflets has been widely debated. Some workers have reported that leaflets alone have resulted in an increase of knowledge for the short and long term (Paul and Redman, 1997), and other research has indicated that printed leaflets can bring about positive attitude change (Harvey *et al.* 2000). Other studies have reported the contrary, for example, after leaflets had been personally given to patients by GPs, recall of such leaflets was less than 50% (Tones and Tilford, 1996). Thus suggesting that the leaflet had little or no impact on a large proportion of persons that it was given to. In addition it has been questioned whether leaflets given to or picked up by consumers are actually read (Bennett and Murphy, 1999). After implementing evaluative research with nutrition based leaflets, Nichols *et al.* (1988) concluded that mass distribution of leaflets may not be an effective method of health education. Nevertheless, there is evidence to suggest the appropriate use of leaflets can be effective in *helping* people make changes (Fraser and Smith, 1997) yet no available data suggests that leaflets alone can bring about actual behavioural change. It is believed that the real value of leaflets lies in their combined use with other strategies, especially those concerning interpersonal support (Griffith *et al.* 1994; Tones and Tilford, 1996). Furthermore, it is considered that significant changes in recall, knowledge and behaviour are most likely when a leaflet comes from a reliable source and is used in conjunction with interpersonal communication and other educational resources in a familiar context (Bennett and Murphy, 1999).

Other sources of food safety information such as posters, newsletters, recipes and reminder aids have received less attention in terms of researched effectiveness than sources such as leaflets, however they remain to be utilised for health education purposes. Appraisals of the use of posters for health education have demonstrated a very low effectiveness when used without interpersonal support (Tones and Tilford, 1996). For example, a study by Cole and Holland (1986) reported that only 8% women could accurately remember seeing posters displayed on a health centre waiting room wall, suggesting that the posters had proven to have little or no effect. Research has shown that use of strategically placed reminders to aid hand-washing compliance in hospitals can have a modest but sustained effect (Naikoba and Haywood, 2001). It has been reported that women's magazines have a particularly strong influence as a source of information about food and nutrition (Moore *et al.* 1992). Furthermore, cookery books are considered to be a logical source of food safety information, as recipes could be a source of precise appropriate control measures (Griffith *et al.* 1994). Indeed, Griffith *et al.* (1994) reports that cookery books are a missed health education opportunity with respect to food safety.

Limited research has assessed the effectiveness of television and videos for improving food safety behaviours of consumers. A video is considered to offer great potential as a teaching aid because it avoids some of the limitations of written material such as reliance of reasonable standards of literacy (HEA, 1996). Evaluations of the use of a video, in terms of effectiveness and the importance of its role in health education, have demonstrated that a video can be used to good effect as part of a carefully designed educational strategy (Eiser and Eiser, 1996).

Hygiene messages projected onto TV cookery programmes have been found to be variable. A survey of such programmes revealed that 76% demonstrated good personal habits, however, other critical practices relating to effective temperature control or practices designed to eliminate cross contamination were poorly dealt with or not mentioned at all (Griffith *et al.* 1994). Interventions that depend on passive exposure to information generally have been found to have no effect (Eiser and Eiser, 1996), so in view of this the need for TV cooks to demonstrate good practice is questionable. However, if a TV cook not only fails to implement good practice, but also revels in bad practice then the opposite message concerning the value of food hygiene may be transmitted to consumers (Griffith *et al.* 1994). Overall, food safety information sources that are liked and considered similar to the consumer are more likely to play an important part in changing resistant attitudes and behaviour (Bennett and Murphy, 1999). Furthermore, it is suggested that messages from multiple sources should be utilised to convey information to the public (Bruhn and Schultz, 1999).

2.8.3 Approaches to food safety education.

2.8.3.1 Traditional approach to food safety education.

Traditional approaches to food safety education tend to have had a negative focus that addresses prevention rather than positive heath (Downie *et al.* 1998). In addition, conventional approaches to food safety education have been mainly 'expert driven' and largely based on the provision of educational materials. A common fault of public health programmes is to rely solely on clinical and epidemiological research as the basis for message development. Thus, the 'facts' about a specific health behaviour may be presented upon the assumption that exposure to such 'facts' will lead to the desired behaviour (Sutton *et al.* 1995). A problem common to food safety education is the assumption that food handlers are ignorant of hygiene principles (Ehiri and Morris, 1996). However, epidemiological evidence shows that most cases of foodborne disease result not only from ignorance of good practices, but also from a failure of apply learned techniques (Ehiri and Morris, 1994). On the whole, traditional food safety education interventions have aimed to provide knowledge and an increased awareness of food safety issues, on the assumption that consumers will make informed and correct decisions about their own food safety behaviours. Communication of these messages has mainly involved widespread distribution of knowledge based information using the mass media directed at large numbers of people (Freimuth *et al.* 2000). Although knowledge of the consequences of unsafe food-handling practices can enhance consumer motivation to change behaviour (Bruhn, 1997), a substantial amount of research has established that provision of knowledge does not necessarily translate into practice (Ackerley, 1994; Curtis *et al.* 1993; Nichols *et al.* 1988; Pinfold, 1999). The traditional approach to food safety education has had limited success and it is accepted that traditional methods have failed to meet the challenges of primary food safety problems (Ehiri and Morris, 1994). It has been suggested that the future of hygiene promotion should be based on the analysis of the specific needs of the target audience (Rennie, 1995a).

2.8.3.2 The use of psychological models in health education.

Increasingly the use of social cognition models and concepts taken from the models have been used as a basis for health education programmes (Rutter and Quine, 2002). Three models that have been commonly used to attempt to explain health-related behaviours and as a basis for health education include the KAP model, The Health Belief Model and The Theory of Reasoned Action / Planned Behaviour.

The Knowledge, Attitudes and Practice (KAP) model is considered to have been one of the most widely used models when developing health education programmes (Hamilton *et al.* 1980). The KAP model postulates that an individual's behaviour is dependent upon knowledge and attitudes, and thus suggests that the provision of information alone will lead directly to an understanding of the need for a change in attitude and consequently modification of a practice (Rennie, 1995a). However, research has shown that provision of knowledge alone will not lead to a change in behaviour (Ackerley, 1994). Use of the KAP approach surmises that a greater importance is attributed to knowledge as a precursor for behavioural change and less importance is given to attitudinal effects and hence health education attempts using this approach have generally failed (Rennie, 1995a).

The Health Belief Model (HBM) has been applied extensively to issues related to preventative behaviour (Van der Pligt, 1994) and it has been recommended that consideration of HBM dimensions be part of health education programming (Janz and Becker, 1984). This model assumes that health behaviours are functions of four key beliefs, namely perceived susceptibility, perceived severity, perceived efficacy and perceived barriers to implementing the desired behaviour (Strand, 1999). For food safety behaviours to occur the HMB surmises that a person must feel threatened and have an incentive to take action, in addition percieve themselves competent to carry out that action (Schafer *et al.* 1993). Support for the prediction of health behaviours using the HBM has been contradictory (Ogden, 1996). Nevertheless, research of applications of the HBM have indicated that it can provide a helpful framework for interpreting non-compliance health behaviours (Maiman *et al.* 1977) despite this however, applications to food safety have been limited (Trenda and Hilliers, 1997).

The Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975) and Theory of Planned Behaviour (TPB) (Ajzen, 1991) are considered to be general models of decision making which have been used to attempt to predict behaviour (Bennett and Murphy, 1999). The basis of TRA is that the most immediate determinant of behaviour is behavioural intention, and behavioural intention is a function of the attitude towards the behaviour and consideration of relevant social norms (Connor and Norman, 1994). The extension of the TRA to the TPB included consideration of perceived behavioural control to also have a predictive influence on behaviour (Ajzen, 1991). Both models have been tested extensively and shown to be successful in predicting a wide range of health-related behaviours (Armitage and Connor, 2001). According to the more recent model (TPB), the effectiveness of strategies aimed at modifying health behaviour depends on the success of changing attitudes towards the specific behaviour, relevant subjective norms and perceived behavioural control (Stroebe and Stroebe, 1995).

Although behavioural theories such as the ones described above, appear to have direct implications for the development of health education programmes, it has been stated that '*the transition of theoretical postulates and empirical findings derived from mainly non-experimental studies of the theories into effective interventions is far from straight-forward*' (Sutton, 2002 p193). Nevertheless, it is considered that determination of individual cognitive influences' of food safety behaviours can be used for the development of educational initiatives (Schafer *et al.* 1993).

2.8.3.3 A contemporary approach to food safety education.

A contemporary approach to structured behavioural change for health education initiatives has been the application of social marketing to a variety of public health-related disciplines (Andreason, 1995). The key feature of social marketing that distinguishes it from traditional public health approaches is the consumer orientation or 'audience centred thinking' (Bryant and Salazar, 1998) applied to all stages of initiatives. Tabulated differences between traditional approaches to health education and the social marketing approach can be found in Table 2.8. Social marketing is a social change strategy that focuses on voluntary behavioural change to benefit the individual and society, rather than coercing consumers to adopt healthy behaviours. At the centre of all stages of social marketing initiatives are the target audiences' needs, wants, attitudes and perceptions of aspects influencing the behavioural objective. Such variables need to be attended to and acted upon in social marketing programme planning, delivery, management and evaluation (Lefebvre, 1995). Concepts and principles of social marketing will be described in greater detail in Chapters 7.0 and 8.0.

2.8.3.4 Requirements for development of future food safety education initiatives.

'Health education interventions must be planned with a full understanding of the factors contributing to the desired behaviours' (WHO, 1988, p10). Measurement of consumer knowledge, attitudes and behaviour can provide a basis for planning health promotion programmes (Westaway and Vijoen, 2000). Indeed, it is considered that it is only when existing attitudes and practices regarding food safety are known is it possible to plan effective strategies to encourage and strengthen desirable behaviours and discourage unsuitable ones (Foster and Kaferstein, 1985). Thus, there is the need to identify attitudes towards food safety in the domestic kitchen (see Chapter 3.0) and actual food safety behaviours implemented in domestic food preparation (see Chapters 5.0 and 6.0) to enable the development of informed food safety educational initiatives to improve domestic food safety behaviours. In addition, consumer attitudes and perceptions of health-related educational attempts are known to aid development of effectual initiatives that can result in behavioural change (WHO, 1991). Thus, attitudes and behaviours towards food safety education need to be identified prior to planning food safety education initiatives (see Chapters 4.0 and 7.0).

Table 2.8 A comparison of a traditional and social marketing approach to health education.

TRADITIONAL APPROACH.	SOCIAL MARKETING APPROACH.
'Top down planning approach': Authorities specify health behaviours and launch information campaigns to support these programmes.	**'Consumer orientated approach'**: Needs and wants of consumers are actively sought and acted upon in programme planning, management and evaluation.
Relies more on opinions of experts and 'best practice models' for guidance.	Experts look to the consumer for guidance and program planning.
Overall goal is to bring about behavioural change, use of persuasion and coercion tactics.	Overall goal is to bring about voluntary behavioural change, and to influence consumer behaviour (often by changing beliefs and attitudes).
Often based on increasing knowledge of the consumer through education.	Based on 'exchange theory' (exchange of time and effort for inherent benefits of the desired behaviour).
Aims to change behaviour of a larger, non targeted and segmented audience.	Aims to change behaviour of a smaller, targeted and segmented audience.
Audience is based on consumers greatest in need given greatest priority.	Target audience is segmented into consumers ready to change behaviour.
Epidemiological / census data usually used to identify neediest consumers.	Behavioural theories used to segment target audience.
All of the audience are usually offered the same promotional material and behavioural benefits and price.	Design of effective intervention strategies to reach subgroups of target audience based on perceived benefits / barriers, self-efficacy, social norms and values.
Interventions are circulated by mass distribution or placement in locations where there is the likelihood of reaching a large audience.	Promotional materials are placed in the target audience 'life point paths'.
Initiatives usually based on general themes not specific behavioural actions.	Entire initiatives based on specific behavioural objectives and determinants.
Less expensive, less time consuming and requires a smaller management team.	Considerable time and resources spent listening to consumers. Requires larger number of people to manage initiative.
Lack of success of the initiative attributes fault of the audience response.	Lack of success of a social marketing initiative attributes fault with the program strategies and message, not the consumer.
Terminal evaluation methods used.	Constant re-evaluation of each step of the initiative.

2.8.3.5 Importance of evaluation of health education initiatives.

Evaluation is critical for all health promotion and health education programmes (McEnzie and Jurs, 1993) and should not be seen as an end in itself, but as an integral part of all health education and promotion activities (Candeias, 1991). Indeed, evaluation is the process of assessing what has been achieved in a health education initiative as well as an appraisal of how achievements have been accomplished (Ewles and Simnett, 1992). It has been considered that a better quality of evaluation will lead to better forms of intervention (Hawe *et al.* 1995). However, a substantial amount of health education is not evaluated (Tones and Tilford, 1996).

Evaluations of health education and promotion initiatives need to be implemented before, during, and at the end of an initiative. Thus, different types of evaluation are required and termed 'process', 'impact' and 'outcome' evaluations, or 'formative' and 'summative' evaluations (McKenzie and Jurs, 1993). In both cases process and formative evaluations provide informed feedback during initiative planning, thus improving the process before implementation of the initiative. Such evaluation should include pre-testing of intervention materials and concepts to be utilised in the planned initiative. Pre-testing is important to ensure that the message and interventions are tailored to their particular defined target groups (Downie *et al.* 1998). Impact / outcome and summative evaluations determine the achievements of the initiative – whether stated goals and objectives have been met and identification of immediate effects (e.g.) change in behaviour or increase in knowledge (McKenzie and Jurs, 1993).

Qualitative and quantitative methods are used for evaluations of health education and promotion activities. Process and formative evaluations may include the use of expert panels, focus groups and in-depth interviews (Pirie, 1990). Indeed individuals drawn from the target audience may be asked to examine and interpret intervention messages and comment upon format and understandability. Traditionally, measurement of change in knowledge, attitudes and self-reported behaviour were used to evaluate effectiveness of initiatives (impact / outcome / summative evaluations). However, there are inherent biases when utilising survey instruments to evaluate the effectiveness of initiatives, for example social desirability bias and discrepancies between knowledge, self-reports and actual behaviour. If a health education initiative has aimed to improve awareness / knowledge of an issue then use of a quantitative survey is an acceptable method of evaluation, and certainly surveys can be useful tools to ascertain whether targeted consumers have seen interventions in a community or not. However, if an initiative aims to improve 'behaviour' an evaluation based on anything other than observed behaviour may be inaccurate and potentially misleading. Self-reported behaviour is sometimes sought to aid evaluation of health promotion initiatives. However, self-reported behavioural change may be a change that a respondent may perceive to have made or only what a respondent may be willing to report (Katz and Perberdy, 1997). Evaluation of food safety programmes should be a continuous process (FAO/WHO, 1984) however, in the UK evaluation of a nationwide consumer food safety initiatives appear to rely on analysis of epidemiological incidence data (FSA, 2001a) (see section 2.4.2) rather than the immediate and long term effect of interventions on consumers food-handling behaviours. Therefore quantitative methods to evaluate food safety behaviour is needed to evaluate the effectiveness of food safety education interventions (see Chapter 8.0).

2.9 AIMS AND OBJECTIVES.

2.9.1 Aims.

- Review factors that influence consumer food safety and consumer food safety education.
- Determine consumer attitudes and perceptions towards to food safety behaviours in the domestic kitchen and towards food safety education.
- Quantitatively assess consumer food safety behaviours using direct observation.
- Evaluate the effectiveness of a social marketing based food safety education initiative using direct observation.

2.9.2 Objectives.

- Use survey techniques to examine consumer attitudes and perceptions towards consumer food safety in the domestic kitchen and food safety education.
- Design, develop and pilot a discriminating risk based tool to quantitatively assess observed food safety behaviours in a model domestic environment.
- Assess the reproducibility of consumer food safety behaviours and determine the reliability of the observation technique as a tool for measurement of food safety behaviours.
- Examine the potential use of social marketing for development of a community food safety education initiative.
- Apply the principles and concepts of social marketing to food safety education and formulate a social marketing strategy for a targeted, community food safety education initiative.
- Design food safety interventions using the social marketing approach and implementation of the social marketing based food safety education initiative in a community in Cardiff.
- Use of observation and risk based scoring to evaluate the effectiveness of the social marketing initiative.

CHAPTER 3.0

CONSUMER ATTITUDES AND PERCEPTIONS TOWARDS FOOD SAFETY IN THE DOMESTIC KITCHEN.

3.1 INTRODUCTION.

Consumer attitudes are known to be an important determinant of behaviour. It is therefore important to identify attitudes towards health behaviours such as those related towards food safety to increase understanding of consumer food-handling practices and for development of educational initiatives. This chapter analyses attitudes towards food safety behaviours and perceptions of food safety risks, control and responsibility.

3.2 REVIEW OF LITERATURE.

Contrary to findings disassociating the attitude-behaviour relationship (see Chapter 2.0), it has been reported that attitudes towards food safety and related issues can influence behaviour directly (Saba and Di-Natale, 1999). Research conducted by Schafer *et al.* (1993) provided evidence to indicate a relationship between food safety beliefs and behaviour whereby perceptions of vulnerability to illness (resulting from consuming contaminated food) were associated with selected food safety behaviours. More recently, Westaway and Viljoen (2000) reported that a more positive attitude towards personal and domestic hygiene was associated with more frequent implementation of hygiene behaviours. Given that understanding attitudes contributes to a central part of effective health promotion (Downie *et al.* 1998) and attitudes towards food safety may be an important influence on performed behaviours, a detailed analysis of consumer attitudes towards food safety behaviour is required.

Attitude determination towards 'food safety' and food-related issues has been limited and issues related to microbial food safety have been largely neglected. Research detailing 'attitudes towards food safety' has frequently associated the term 'food safety' with pesticide residues (Misra and Huang, 1991), irradiation (Deruiter and Dwyer, 2002; Hunter, 2000), product recall, specific substances (Hammonds, 1985), biotechnology (Frewer *et al.* 1994a), genetically modified foods (Bredahl, 2001) and generalised aspects of food quality (Holm and Kildevang, 1996). Other research equating attitudes and food safety evaluated consumer confidence of food supplies (Jussaume and Higgins, 1998; Scroggins, 1993) and consumer perceptions of food safety related to regulatory issues (Brewer *et al.* 1994). More commonly, attitudes have been determined towards food choice (Shepherd, 1995), towards different foods (Fearne and Lavelle, 1996; Mitsostergios and Skiadas, 1994) and towards food consumption patterns (Verbeke and Vieine, 1999). Studies that may have inferences for microbial food safety and consumer hygiene includes those that have identified attitudes towards fresh meat consumption (Verbeke and Vieine, 1999; Woodward, 1988) and hospital hand hygiene (Zimakoff *et al.* 1999). On the whole, identification of consumer attitudes to microbial food safety has been generalised and largely addresses overall concern and acceptability of foods.

Attitudinal statements were included in just over half (52%) of identified food safety surveys (n=65). However, many of these surveys (>44%) only included one or two questions relating to psychologically defined 'attitudes' towards aspects of microbial food safety. Such questions were namely based on beliefs of causes of food poisoning, beliefs about favourable providers of information, perceptions of risky foods, perceptions of responsibility or determination of levels of concern towards aspects of food safety. Very few surveys (8%) carried out a detailed investigation of the role of cognitive elements that may influence important food safety behaviours and specific practices related to domestic food preparation. Therefore, there is a need for attitudes towards such aspects of food safety in the home to be investigated. It is anticipated that the quantitative findings from this chapter will, with qualitative findings from Chapters 7.0 provide a better understanding of consumer food safety behaviours in terms of why consumers perform or do not perform certain practices. Such information will also be useful for the development of food safety education initiatives.

Concepts of risk, control and responsibility are known to be present in many behavioural models used to aid health education processes. Risk perceptions are considered to form the basis of a heuristic framework that guides decisions about behaviour (Frewer *et al.* 1994b; Raab and Woodburn, 1997) and indeed, perceptions of food safety risks have been reported to influence the attitudes and behaviour of consumers (Yeung and Morris, 2001) and even 'control behaviour' (Scroggins, 1993). Controllability has been identified as an important determinant of the perceived risk associated with a hazard (Frewer *et al.* 1994b) and perceptions of risk and control are important influences for implementation of preventative behaviours. However, despite knowing that an understanding of how consumers perceive risks is required for effective communication of food safety risks (Groth III, 1991), consumer food safety research in this field has been limited. The importance and need for such research is further ratified by a widely reported acknowledgement that experts and the general public often differ in their perceptions of risk (Frewer *et al.* 1995a; MAFF, 1993; Mutsaers and Shepherd, 1995; WHO, 2000b).

The perception of personal vulnerability to disease is an important initiator for preventative behaviours (Bennett and Murphy, 1999). Weinstein (1980) has conducted a substantial amount of research that indicates that people underestimate their personal probability of encountering negative events. Findings denoting *'it wont happen to me'* judgements when assessing the likelihood of experiencing such events in the future may be interpreted in terms of unrealistic optimism and the illusion of control (McKenna, 1993). These concepts infer perceptions of personal invulnerability to a particular hazard, yet fail to extend this vulnerability to others (Frewer *et al.* 1994b). In addition to this, McKenna (1993) has suggested that perceptions of personal risks associated with a hazard are associated with the amount of control that an individual has over a potential hazard. Consumer perceptions of risk and control for food safety during domestic food preparation will be investigated in this chapter.

The implications of unrealistic optimism for health-related behaviours have created considerable concern. Indeed, it has been stated that *'optimistic biases in personal risk perceptions are important because they may seriously hinder efforts to promote risk-reducing behaviours'* (Weinstein, 1989, p1232). The illusion of relative invulnerability to hazards might mean that people are less likely to adopt health-promoting behaviours (Raats and Sparks, 1995). Thus, it has been suggested that unrealistic optimism reduces the effectiveness of campaigns designed to promote healthy or safe lifestyles (Hoorens, 1994). This may be because perceptions of invulnerability cause consumers to think interventions are meant for others rather than themselves. In order to change, people have to perceive that their current behaviour endangers their health and that taking action has a strong likelihood of reducing their risk (McIntosh *et al.* 1994). For intervention strategies to be effective it is important that aspects or perceived risk and control are identified and addressed accordingly.

Over optimistic biases in evaluating personal health risks are common (Bennett and Murphy, 1999) and have been associated with automobile accidents, crime and disease (Weinstein, 1980). In accordance with this notion, a number of workers have determined positive correlations between personal optimism, endangering behaviour and neglect of precaution (Hoorens, 1994). For example, it has been reported that subjects who were strongly optimistic concerning their chances of getting the flu were less willing to get inoculated (Hoorens, 1994). Similarly, and illnesses that elicited stronger unrealistic optimism have been associated with less worry and hence a less interest in taking precautions than illnesses that elicited weaker unrealistic optimism (Weinstein 1982; 1983).

Recognition of personal responsibility for food safety is considered to be a prerequisite for implementation of appropriate food safety behaviours during food preparation at home (Unklesbury *et al.* 1998). Failure to assume such responsibility may result in perceiving others to be responsible for the safety of food and therefore not implementing correct food-handling actions when necessary. Thus creating increased potential for implementation of malpractices and contamination in the domestic environment and increased risk of food poisoning.

Assessment of consumer attitudes to food safety in the domestic kitchen in this chapter will increase our knowledge as to why consumers continue to implement food-handling malpractices that present an increased risk of food poisoning. Findings will be discussed in view of previous research findings based on knowledge and self-reports of corresponding food safety behaviours, thus providing data for development of informed food safety education initiatives.

3.3 AIMS AND OBJECTIVES.

3.3.1 Aims.

- Evaluation of consumer attitudes towards food safety behaviours in the domestic kitchen
- Determination of consumer perceptions of risk of food poisoning.

3.3.2 Objectives.

- Determine consumer attitudes to food safety behaviours.
- Investigate influencing factors as to why consumers implement unsafe food-handling behaviours during food preparation in the domestic environment.
- Analyse consumer perceptions of risk, control and responsibility for themselves and for others.
- Ascertain consumer perceptions of the home as a location for acquiring food poisoning.

3.4 METHODS.

3.4.1 Introduction.

Quantitative methods of data collection can be used for determination of attitudes and perceptions. The present chapter uses a questionnaire to assess attitudes and perceptions of consumers food safety behaviours. Such a research method was considered to be most appropriate for obtaining data that could be generalisable to the population of Cardiff.

3.4.2 Questionnaire development.

This questionnaire, found in Appendix 3.1, was designed to obtain an understanding of consumer attitudes towards specific food safety behaviours, perceptions of risk, control and responsibility and perception of the home as a point of origin for acquiring food poisoning. To facilitate the development of the questionnaire, epidemiological literature was reviewed to determine contributory factors of foodborne disease, this information was obtained to determine food-handling behaviours that were to be the basis of attitudinal statements. Throughout this questionnaire, several attitude statements and questions based on aspects food preparation other than food safety, and out of scope of the current study, were included. Such statements and questions were designed to distract attention from the focus of food safety and to potentially reduce social desirability bias. Such questions have not been analysed for the purpose of this thesis.

The questionnaire was divided into three sections. The first section (Section A) included a total of 32 food safety orientated attitudinal statements. Statements were based upon important food safety issues and were designed to obtain data regarding attitudes towards aspects of cross contamination in the domestic kitchen, such as hand-washing and hand drying, preparation of raw and cooked foods and cleaning. In addition, statements were based upon aspects of temperature control such as cooking, cooling and storage. Attitude responses were given on a Likert-type rating scale and statements were placed in an order whereby some responses warranted a positive response and others warranted a negative response.

The second section (Section B) included five questions which aimed to identify rated perceptions of experiencing food poisoning after food preparation of self and others, perceptions of personal control and control of others and perceptions of personal responsibility for food safety. Such perceptions were assessed using a variation of a visual analogue scale (VAS) in the Likert-type style. The numeric scale in which the horizontal line of the VAS is bounded by numbers and adjectives at either end (e.g.) 'Very low risk and very high risk' (Bowling, 2000). Numerical values were displayed at regular intervals along the line (from 1 to 10) to help respondents intuitively understand the scale (Bowling, 2000). Respondents were required to circle a number along each line to indicate how strongly they felt about each of the given statements.

The final section (Section C) investigated perceptions of eleven ranked locations where respondents may expect to get food poisoning from. Respondents were required to state '1' in the relevant box where they would least expect to get food poisoning, through to '11' in the box where they would most expect to get food poisoning.

3.4.3. Pilot testing.

Pilot testing occurred using recommended procedures (Breakwell *et al.* 1995) using 10% of the sample during developmental stages. It was ensured that the piloting process critically assessed instructions, question layout, wording, sequence and scale. As a result of piloting procedures main amendments to each questionnaire included refinement of the wording of several attitude statements to alleviate ambiguities and a reduction in the length. The final version of this Questionnaire entitled 'Attitudes and Perceptions towards Food Preparation Behaviours' can be found in Appendix 3.1. It is noted that the administration of the questionnaire was also piloted and no amendments to the process were required.

3.4.4. Determination of validity and reliability.

Consideration for aspects of validity and reliability are important during questionnaire development, (Shaughnessy and Zechmeister, 1997) and thus increase research credibility (Coolican, 1999). Validity has been defined as '*the extent to which the procedure measures what it is intended to measure*' and reliability has been defined as '*the degree to which measurements are consistent*' (Heiman, 1999, p43). Measurements of forms of validity and reliability parameters were required for the questionnaire conducted in this chapter.

3.4.4.1 Validity.

- *Face validity* was assessed by visually checking that questions and attitude statements were related to the aims of the research.
- *Content validity* was determined by conducting an evaluation of the question components of the survey by academic researchers. It was ensured that questions and attitude statements were representative of the variables of interest, for example attitudes and perceptions of food safety behaviours.

- In accordance with *external validity,* it was considered that the of results this questionnaire could be generalised to the general population of Cardiff, South Wales. This assumption was made as the respondent sample was based on census data of the population of Cardiff.

3.4.4.2 Reliability.

Reliable tests are characterised by consistency (Shaughnessy and Zechmeister, 1997). To ensure reliability of this questionnaire, a variety of factors have been addressed. Questionnaire construction required careful consideration to maintain the avoidance of ambiguities, leading questions, value judgements, double-barreled questions (Breakwell *et al.* 1995). The inclusion of 'Barnum statements'[1] and questions that contained undefined terms were avoided (Shaughnessy and Zechmeister, 1997). Adherence to such factors should prevent individual interpretations and misunderstandings of questions. The use of fixed response questions reduced the variability of responses (Malhotra and Birks, 2000) and clear and standard instructions were included to reduce errors of measurement. Administration of this questionnaire occurred under standard, well-controlled and similar conditions to also increase reliability (Breakwell *et al.* 1995). The specific types of reliability considered during the research process are discussed below.

- Although it may have been interesting to consider issues related to questionnaire reproducibility in terms of *test-retest reliability,* such a concept was not relevant to the aims of this chapter and so was not carried out.
- Measures of *internal consistency / reliability* are based on a single administration of the measure (Streiner and Norman, 2001). Thus, a measure of Cronbachs alpha was determined to obtain an estimate of reliability based on all possible correlations between all of the items within a scale (Bowling, 2000). The measure gave an indication how consistent the results for different statements are within the questionnaire. A Cronbachs alpha coefficient of 0.7 was determined for responses to attitude statements in this questionnaire. For the internal consistency of a questionnaire to be acceptably reliable, Cronbachs alpha should be >0.7 and <0.9 (Streiner and Norman, 2001). Therefore, when rounded up, the response scale from this questionnaire was considered to have an acceptable internal consistency.

3.4.5 Sampling and data collection.

The questionnaire was self-administered to 100 respondents at UWIC who were participating in a concurrent food-related research project. Respondents were recruited using a local Market Research Agency (Research and Marketing, Cardiff Bay) using a standardised recruitment questionnaire (see Appendix 5.12) and

[1] A 'Barnum' statement is so global and vague that everyone would agree with, or select the same response for, for example, "Do you sometimes worry?" (Shaughnessy and Zechmeister, 1997).

telephone interviewing methods. Recruited respondents represented a cross-section of the population of Cardiff, based on 1991 Census data (ONS, 1997). Self-complete questionnaires were individually presented to respondents by the researcher followed by an explanation as to the purpose of the survey and how to answer the different question types. The respondent was left alone to complete the questionnaire, which took about 30 minutes to complete. The questionnaire was returned to the researcher before the respondent left UWIC.

3.4.6 Data analysis.

All questionnaire responses were inputted and stored on a Microsoft Access 1997 database (designed specifically for this project) (see section 5.4.8.1). Statistical analysis was carried out using SPSS (for Windows) Versions 9.0 and Microsoft Excel 1997.

3.4.6.1 Data assumptions.

For data analysis the following assumptions have been made:

- Socio-economic groups (AB, C1, C2, DE) are considered to have an ordinal level of measurement (Curwin and Slater, 1994) and age groups (16-24, 25-34, 35-44, 45-55, 56-64, 65+) have also been considered to be ordinal data. Sex of respondent has a nominal level of measurement.
- Responses to five point Likert-like scale attitude statements (Strongly Agree to Strongly Disagree) (Section A) were considered to be ordinal data and no assumption of equal intervals was made on the rating scale.
- Responses to scales based on a variation of VAS (in the Likert-type style) (Section B) were considered to be ranked, ordinal data. Similarly, ranked data (Section C) was also considered to be ordinal data.

3.4.6.2 Analysis of attitudes towards food safety behaviours.

⇒ *Analysis of overall scored attitudes towards food safety behaviours.*

- Attitudinal responses were coded from 1 (positive) to 5 (negative) to give overall attitude scores and an indication of overall attitude direction. A calculation of the sum of responses gave a possible range of scores from 32 to 160 (the higher the score the more unfavourable the attitude).
- Descriptive statistics were used to quantify overall attitudes to food safety behaviours using coded responses.

⇒ *Examination of associations between overall scored attitude responses and respondent demographics.*

- An assessment of the association between age groups / SEG groups and median attitude scores (coded as in 3.4.6.2) was made using Spearmans *rho* correlation coefficient (2-tailed). Median scores, age and SEG groups were all considered to be ordinal data. Spearmans *rho* is a non-parametric test[2] used correlate ordinal data that are related by definition (Coolican, 1999). The correlation coefficient ranges in value from –1 to +1, and is expressed as an 'r' value. Two tailed tests were used in all cases and no assumptions of the direction of the data were made.
- As noted in section 3.4.6.1, male and female groups were considered to be nominal data, therefore comparisons with coded attitude scores (ordinal data) were made using the Mann Whitney U test statistic. The Mann Whitney U test is a non-parametric test used when a comparison of two samples is made to determine whether responses come from the same or different underlying populations (Elmes *et al.* 1995). A 'Z' score is obtained when using the test and is defined as '*a way of expressing any raw score in terms of standard deviation units*' (Norman and Streiner, 2000, p28). When 'Z' scores represent >+2 or >-2 standard deviations then a significant difference in the normal distributions is implied between the two samples and a 'Z' score obtained between –1.9 and +1.9 is likely to indicate no significant difference.

⇒ *Analysis of scored responses to individual attitudes towards food safety behaviours.*

Median and mean attitude scores have been used to describe responses to individual attitude statements to indicate central tendencies and skewness of data. In addition standard deviations were determined to indicate the measure of spread.

⇒ *Analysis of quantitative responses to individual attitudes towards food safety behaviours.*

- Descriptive statistics have been used to summarise responses to individual attitude statements.

⇒ *Identification of associations between attitudes towards food safety behaviours.*

- Spearmans rank correlation coefficient (*rho*) was used to identify correlations between responses to attitude statements (ordinal data).

[2] No assumptions are made about population parameters.

Examination of associations between individual attitude responses and respondent demographics.

- Correlations between individual attitude statements and SEG and age groups have been determined using Spearmans *rho*. Attitude responses, SEG and age groups were all considered to be ordinal data so use of Spearmans *rho* is an appropriate statistic to use.
- Comparisons made between attitude responses (ordinal data) and male and female groups (nominal data) were made using the Mann Whitney U test statistic.

3.4.6.3 Analysis of perceptions towards risk, control and responsibility.

⇒ *Quantitative analysis of consumer perceptions of risk, control and responsibility.*

- Descriptive statistics were used to identify proportions of respondents who stated values 1 to 3 (denoting little or no control, low / very low risk and little or no responsibility) and values 8-10 (denoting nearly full or full control, high / very high risk or nearly total / total responsibility).
- It is not possible to assume differences between ordinal ranks, therefore median values were calculated to indicate central tendency and were used as the main determinants of rank. Mean values were determined to indicate skewness of the data.

⇒ *Identification of statistical associations between perceptions of risk, control and responsibility.*

- Spearmans rank correlation coefficient (*rho*) was used to identify correlations between responses to ranked responses to risk, control and responsibility (ordinal data).

⇒ *Identification of statistical associations between perceptions of risk, control and responsibility, and respondent demographics.*

- As noted in 3.4.6.1, ranked data has been categorised as ordinal data, therefore correlations between ranked data and age / SEG group were identified using Spearmans *rho* (r), and differences between male / female ranked responses were identified using the Mann Whitney U test statistic (Z score).

3.4.6.4 Analysis of perceptions of potential locations to acquire food poisoning.

⇒ *Quantitative analysis of perceptions of potential locations to acquire food poisoning.*

- Descriptive statistics were used to identify proportions of respondents who ranked listed locations.
- As in section 3.4.6.3, it is not possible to assume differences between ordinal ranks, therefore median values were calculated to indicate central tendency and were used as the main determinants of rank. Mean values were determined to indicate skewness of the data.

⇒ *Identification of statistical associations between perceptions of locations to acquire food poisoning.*

- Spearmans rank correlation coefficient (*rho*) was used to identify correlations between ranked responses to locations where it was expected to acquire food poisoning (ordinal data).

⇒ *Identification of statistical associations between perceptions of locations to acquire food poisoning and respondent demographics.*

- Correlations between ranked data and age group / SEG group (all ordinal data) were identified using Spearmans *rho* correlation coefficients (r), and differences between male and female ranked responses (nominal data) were identified using the Mann Whitney U test statistic (Z score).

3.4.6.5 Bonferroni correction.

When making multiple comparisons to identify statistical associations it is necessary to apply Bonferroni corrections to alpha levels. Application of Bonferroni correction makes significance levels more conservative by accounting for multiple comparisons (Bland, 2002). Bonferroni correction is calculated by the alpha level (0.05 or 0.01) divided by the total number of comparisons, thus making the alpha level more stringent (Norman and Streiner, 2000). Results discussed in this chapter have included weaker correlations of note where Bonferroni correction has <u>not</u> been used (denoted as * for <0.05, and ** for <0.01) as well as stronger correlations where Bonferroni correction <u>has</u> been used (denoted as ◗ for <0.05, and ● for <0.01). Such symbols will be used in the text and in relevant tables.

3.5 RESULTS.

3.5.1 Introduction.

Respondents representing a cross-section of the population of Cardiff completed a total of 100 questionnaires in UWIC (100% response rate). Demographics of respondents (age groups and SEG) can be seen in Table 3.1. Collection of information from a cross section of the population of Cardiff enabled findings to be generalised to attitudes and perceptions of consumers from the local area. Seventy seven percent of the respondent sample was female and 23% was male. This quota was based on the proportions of men and women who prepare meals on a daily basis (Nicholaas, 1995).

Table 3.1. Demographics of respondents who answered the 'Attitudes and Perceptions to Food Preparation Behaviours' questionnaire.

Age groups	% respondents.
16 -24	17
25 - 34	20
35 - 44	22
45 - 54	19
55 -64	12
65 +	10

SEG	% respondents.
AB	21
C1	41
C2	23
DE	15

- Eighty two percent of the sample prepared a meal once or twice a day or more and the remaining respondents prepared a meal only once or twice a week.
- Thirty percent of the sample were employed on a full time basis (>30 hours per week), 25% were employed part time (<30 hours per week), 16% were housewives, 13% were retired, 12% were full-time or part-time students and 4% were unemployed.
- Sixty percent of the sample was married or living with a partner and the remaining were categorised as single, divorced or widowed.
- Household sizes of the respondent sample mainly consisted of 2 adults, however 35% of households consisted of 3 or more adults and the remaining were one adult households.
- Sixty percent of respondents had no children, 19% had one child, 14% had two children and 7% had between three and five children.

3.5.2 Consumer attitudes towards food safety behaviours.

3.5.2.1 Quantitative analysis for overall scored attitude responses towards food safety behaviours.

A summary of coded responses to attitude statements can be seen in Table 3.2. In total, 76% of respondents answered all attitude statements fully and using such responses total, comparable attitude scores were determined. Total obtainable scores ranged from 32 to 160 and the minimum score obtained 62 was and the maximum score obtained was 99. Table 3.2 indicates that 64% of total attitude scores ranged between 70 and 84 and these are normally distributed. Thus, 92% of respondents mean scores ranged between 2 and 3, (1=positive, 5= negative). This indicated that overall consumer responses to food safety behaviours were more positive than negative. However, the fact that few respondents (4%) overall expressed stronger attitudes towards safe food safety practices suggests that uncertainties may exist about correct procedures.

Table 3.2 Total attitude scores and mean attitude scores for all participants who answered all attitude statements (*n*=76).

Total attitude scores	*n* (%)
55	0
60	3 (4)
65	9 (12)
70	11 (14)
75	18 (24)
80	20 (26)
85	10 (13)
90	2 (3)
95	3 (4)
100	0

Mean attitude scores	*n* (%)
1.00	0
1.50	3 (4)
2.00	37 (49)
2.50	33 (43)
3.00	3 (4)
3.50	0
4.00	0
4.50	0
5.00	0

3.5.2.2 Examination of associations between overall scored attitude responses and respondent demographics.

An assessment of the association between age groups / SEG groups and median attitude scores was made using Spearmans *rho* correlation coefficient (2-tailed) (n=100). Results indicated no significant correlation (r=-0.048, p>0.05*) between SEG's and median attitude values. However, a significant negative correlation (r=-0.209, p<0.05*) was identified between age groups and median attitude values. This suggests that older respondents are significantly associated with having a more positive attitude towards food safety behaviours and younger respondents are associated with having a more negative attitude meaning that older respondents have a better attitude towards food safety than younger respondents. Using the Mann Whitney U test statistic a significant difference between male and female overall attitudes towards food safety was determined (Z=-2.743, p<0.01**). Further analysis of the data indicated that a larger proportion of females were in agreement with attitudes than males, and females attitudes were stronger than that of males.

Table 3.3 Median and mean attitude scores per attitude statement.

Attitude Statements	*n*	Median value per statement	Mean attitude score per statement	SD▲
Inadequate cooking of food increases the risk of being ill.	*100*	1	1.49	0.70
There is no need to wash hands before handling raw chicken.	*93*	1	1.54	0.65
It is better to use different chopping boards for the preparation of raw and cooked meats.	*99*	1	1.58	0.82
The use of clean utensils / equipment is essential when handling cooked foods.	*94*	2	1.57	0.6
It is all right to eat food if the outside looks well cooked.	*94*	2	1.81	0.81
Keeping food at a luke warm temperature for later consumption is acceptable.	*95*	2	1.87	0.95
Ensuring that frozen food has been thoroughly defrosted before cooking is not necessary.	*96*	2	1.88	1.14
Preparing food whilst suffering from an upset stomach is not a good idea.	*97*	2	1.88	0.75
Cooked foods, once cooled should be refrigerated or frozen immediately.	*99*	2	1.89	0.98
It is unacceptable to store cooked meats at room temperature.	*99*	2	1.90	0.99
It is acceptable to eat beef-burgers that are cooked to 'medium-rare' (slightly pink in the middle).	*94*	2	2.04	1.02
Reheating food to a warm temperature is acceptable.	*98*	2	2.11	1.05
It is not all right to leave cooked rice in a bowl on a kitchen work surface overnight.	*94*	2	2.12	1.06
Pre-packaged raw meats are free from germs.	*100*	2	2.14	0.86
Convenience meals are much safer to eat than meals made from raw ingredients.	*100*	2	2.17	0.79
It is all right to taste food with fingers during food preparation.	*99*	2	2.41	0.87
It is essential to clean the work surface after food preparation using an anti-bacterial spray.	*98*	2	2.45	1.02
Paper towels are more useful in the kitchen than J-cloths.	*98*	2	2.46	0.81
Eating runny eggs is undesirable.	*98*	2	2.49	1.11
It is not important to check the temperature of the refrigerator regularly.	*100*	2	2.51	1.11
It is safe to eat steak that has been cooked 'rare' or 'medium-rare'	*94*	2	2.65	0.96
It is essential for hot food to be cooled down quickly for storage.	*98*	2	2.7	1.14
Following manufacturers instructions on food packaging is not essential.	*98*	2.5	2.82	1.13
It is acceptable to eat foods containing raw egg.	*98*	3	2.63	0.99
A meat thermometer is not particularly useful when cooking meat.	*99*	3	2.96	0.82
A microwave thermometer is not a particularly useful gadget to have in the domestic kitchen.	*93*	3	3.05	0.71
Preparation of food in advance does not increase the risk of becoming ill.	*99*	3	3.24	0.96
Good hygiene is more important when handling raw foods than when handling cooked foods.	*99*	4	3.19	1.28
It is acceptable to cool foods at room temperature.	*93*	4	3.46	0.84
It is not necessary to cool portions of left over (e.g.) casseroles with cold water.	*94*	4	3.61	0.74
Washing hands after handling cooked, sliced ham is not necessary.	*95*	4	3.65	1.03
Food manufacturers are ultimately responsible for the safety of their foods.	*98*	4	3.78	0.97

▲SD= Standard deviation.

3.5.2.3 Analysis of scored responses to individual attitudes towards food safety behaviours.

Data in Table 3.3 indicate mean and median scores obtained for each attitude statement. It can be seen that the attitude with the most positive score (1.49) was towards the risk of becoming ill as a result of inadequate cooking of food. Conversely the attitude with the least positive score (3.78) was towards food manufacturers being ultimately responsible for safety of their foods, such a finding suggests responses may have either been neutral towards the statement or in slight disagreement. This indicates that it may be perceived that manufacturers are not considered to be entirely responsible for the safety of their products. Variance to statements (indicated by SD) ranged from 0.60 to 1.28. The least variance of responses was attributed to the attitude statement concerning the need for the use of clean utensils / equipment when handling cooked foods. The greatest variance was obtained for response to the statement 'good hygiene is more important when handling raw foods than when handling cooked foods'. It is possible that different respondents may have interpreted this particular statement in two ways.

3.5.2.4. Quantitative responses to individual attitudes towards food safety behaviours.

Responses to attitude statements from Section A of the Questionnaire can be found in Table 3.4. Overall, a total of 76 respondents answered all attitudinal statements, and between 94-100 responses were obtained for each attitude statement. Although the majority of the responses to attitude statements were positive, many consumers (in albeit small proportions) held attitudes that were contrary to safe food preparation practices. Such proportions of consumers should be noted with importance, especially when considering the generalisable nature of the results to the population of Cardiff at large (327,500 persons) (CRCE, 2002).

- Although the majority of respondents thought that it is essential to use clean utensils / equipment for preparation of cooked foods, attitudes towards best practice 'cleaning' processes were not as positive. A fifth of respondents did not consider the use of an antibacterial spray to clean a work surface after food preparation to be essential, and nearly half respondents did not consider paper towels to be more useful in the kitchen than J-cloths.
- Attitudes towards defrosting were largely positive, however, 14% of respondents did not think that frozen food should be defrosted thoroughly before cooking.
- Consumer attitudes towards consumption of raw and undercooked eggs were concerning. More respondents indicated a neutral attitude towards the acceptability of eating foods containing raw egg than held a neutral attitude towards the desirability of consuming runny eggs. More than half (52%)

respondents failed to indicate a positive attitude towards consumption of raw egg in foods and less than half (46%) failed to indicate a positive attitude towards consumption of runny eggs.

- Response to the statement 'inadequate cooking of food increases the risk of being ill' elicited the largest proportion of respondents who held a 'strong' attitude towards the listed statements, whereby the majority of respondents were in agreement with the statement.
- Attitudes towards the use of a meat thermometer for cooking meat and use of a microwave thermometer were largely undecided.
- Of the respondents who considered it safe to eat rare steak, nearly a fifth also considered it acceptable to consume beef-burgers that had been cooked to medium-rare.
- Although more than half of respondents (54%) indicated a positive attitude towards the need to cool hot foods quickly for storage, fewer respondents indicated a positive attitude towards appropriate methods for increasing cooling of foods.
- Up to 25% of respondents indicated negative attitudes towards appropriate storage concepts.
- Although 95% of respondents considered that inadequate cooking of food increases the risk of being ill, nearly a quarter of respondents also considered reheating food to a warm temperature to be acceptable.
- Food manufacturers were considered to be ultimately responsible for the safety of foods by 69% of respondents.

3.5.2.5 Identification of associations between attitudes towards food safety behaviours.

Tabulated correlations between attitude responses can be found in Appendix 3.2. A total of 28 Spearmans *rho* correlation coefficients were determined. Data detailing correlations between attitudes may provide useful information in the development for food safety education strategies by identifying associated behavioural cognitions.

Many of the correlations determined were between attitudes towards food safety practices with common features, particularly relating to cooling and storage of cooked food products. The strongest correlation coefficient determined was a positive association ($r=0.519$, $p<0.01^{\bullet}$) between the acceptability of reheating food to a warm temperature and the acceptability of storing food at a luke warm temperature for later consumption. With regards to a positive correlation of this sort, agreement or disagreement both variables increase / decrease proportionately with each other. Ninety three percent of correlations determined, although significant to $<0.05^{\bullet}$ level, were relatively low. This is generally because consumer attitudes towards objects or concepts can be considered to be individualistic and variable.

Table 3.4 Consumer attitudes towards food safety behaviours.

Attitude statement	*n*	Strongly Agree *n* (%)	Agree *n* (%)	Neither Agree or Disagree *n* (%)	Disagree *n* (%)	Strongly Disagree *n* (%)
The use of clean utensils / equipment is essential when handling cooked foods.	*94*	44 (47)	47 (50)	2 (2)	1 (1)	0
It is better to use different chopping boards for the preparation of raw and cooked meats.	*99*	57 (58)	32 (32)	6 (6)	3 (3)	1 (1)
It is essential to clean the work surface after food preparation using an anti-bacterial spray.	*98*	18 (18)	38 (40)	22 (22)	20 (20)	0
Paper towels are more useful in the kitchen than J-cloths.	*98*	8 (8)	49 (50)	29 (30)	12 (12)	0
Good hygiene is more important when handling raw foods than when handling cooked foods.	*99*	15 (15)	37 (38)	8 (8)	30 (30)	9 (9)
It is all right to taste food with fingers during food preparation.	*99*	0	16 (16)	18 (18)	56 (57)	9 (9)
Washing hands after handling cooked, sliced ham is not necessary.	*95*	4 (4)	11 (12)	15 (16)	49 (52)	16 (17)
There is no need to wash hands before handling raw chicken.	*93*	1 (1)	0	2 (2)	42 (45)	48 (52)
Ensuring that frozen food has been thoroughly defrosted before cooking is not necessary.	*96*	7 (7)	4 (4)	3 (3)	38 (40)	44 (46)
Inadequate cooking of food increases the risk of being ill.	*100*	59 (59)	36 (36)	3 (3)	1 (1)	1 (1)
Eating runny eggs is undesirable.	*98*	22 (22)	31 (32)	21 (21)	23 (23)	1 (1)
It is acceptable to eat foods containing raw egg.	*98*	2 (2)	19 (19)	30 (31)	35 (36)	12 (12)
It is acceptable to eat beef-burgers that are cooked to 'medium-rare' (slightly pink in the middle).	*94*	3 (3)	9 (10)	5 (5)	49 (52)	28 (30)
It is safe to eat steak that has been cooked 'rare' or 'medium-rare'	*94*	5 (5)	47 (50)	21 (22)	18 (19)	3 (3)
It is all right to eat food if the outside looks well cooked.	*94*	1 (1)	3 (3)	8 (9)	47 (50)	35 (37)
A meat thermometer is not particularly useful when cooking meat.	*99*	3 (3)	21 (21)	45 (46)	29 (29)	1 (1)
A microwave thermometer is not a particularly useful gadget to have in the domestic kitchen.	*93*	1 (1)	22 (24)	52 (56)	17 (18)	1 (1)
It is essential for hot food to be cooled down quickly for storage.	*98*	13 (13)	39 (40)	14 (14)	28 (29)	4 (4)

Table 3.4 ***(continued).***

Attitude statement	*n*	Strongly Agree *n* (%)	Agree *n* (%)	Neither Agree or Disagree *n* (%)	Disagree *n* (%)	Strongly Disagree *n* (%)
It is acceptable to cool foods at room temperature.	*93*	2 (2)	56 (60)	20 (22)	13 (14)	2 (2)
It is not necessary to cool portions of left over (e.g.) casseroles with cold water.	*94*	5 (5)	55 (59)	27 (29)	6 (6)	1 (1)
Cooked foods, once cooled should be refrigerated or frozen immediately.	*99*	38 (38)	46 (47)	6 (6)	6 (6)	3 (3)
Keeping food at a luke warm temperature for later consumption is acceptable.	*95*	3 (3)	5 (5)	4 (4)	48 (51)	35 (37)
It is unacceptable to store cooked meats at room temperature.	*99*	38 (38)	45 (46)	8 (8)	4 (4)	4 (4)
It is not all right to leave cooked rice in a bowl on a kitchen work surface overnight.	*94*	28 (30)	42 (45)	13 (14)	7 (7)	4 (4)
Reheating food to a warm temperature is acceptable.	*98*	2 (2)	13 (13)	9 (9)	44 (45)	30 (31)
Preparation of food in advance does not increase the risk of becoming ill.	*99*	5 (5)	43 (44)	24 (24)	25 (25)	2 (2)
It is not important to check the temperature of the refrigerator regularly.	*100*	5 (5)	18 (18)	15 (15)	47 (47)	15 (15)
Preparing food whilst suffering from an upset stomach is not a good idea.	*97*	32 (33)	47 (49)	16 (16)	2 (2)	0
Following manufacturers instructions on food packaging is not essential.	*98*	4 (4)	33 (34)	12 (12)	39 (40)	10 (10)
Food manufacturers are ultimately responsible for the safety of their foods.	*98*	22 (23)	45 (46)	20 (20)	9 (9)	2 (2)
Pre-packaged raw meats are free from germs.	*100*	2 (2)	3 (3)	24 (24)	49 (49)	22 (22)
Convenience meals are much safer to eat than meals made from raw ingredients.	*100*	1 (1)	4 (4)	23 (23)	55 (55)	17 (17)

3.5.2.6 Examination of associations between individual attitude responses and respondent demographics.

A statistical analysis using Spearmans *rho* and Mann Whitney U test were carried out to identify differences or commonalties between individual attitude responses towards food safety behaviours and SEG, age groups and males and females. Findings are summarised in Table 3.5.

It was determined that 22% (7/32) attitude statements were correlated with age of respondent. All correlations made were considered to be moderate to weak associations, therefore should be interpreted with caution. The only positive correlation ($r=0.307$, $p<0.01$**) identified was regarding the statement 'Reheating food to a warm temperature is acceptable'. Younger respondents were associated with agreeing with the statement, but as respondents' age increased, so did disagreement with the statement. From this it can be deduced that a positive attitude to the food safety concept of reheating increased with age. Attitude agreement regarding the use of clean utensils for food preparation, cooling and storage was negatively associated with age. Therefore, it can be surmised that negative attitudes were held by younger respondents towards such behaviours, and as age increased so did indication of a positive attitude. A negative correlation coefficient ($r=-0.234$, $p<0.05$*) was also determined between the statement 'preparation of food in advance does not increase the risk of becoming ill' and age of respondent. In this case, as age increased, so did a positive response to the statement. Therefore, generally younger respondents held the attitude that preparation of food in advance does increase the risk of illness, whereas older people think the contrary.

Significant differences between male and female responses were identified for 22% (7/32) of the attitude statements. 'Z' scores determined ranged from –4.03 to –1.9. A larger difference between male and female responses was detected for items obtaining a larger 'Z' score (e.g.) –4.033 opposed to a smaller 'Z' score such as –1.984, where a significant difference was only marginally detected. No significant differences for male and female responses were determined for attitudes related to cross contamination or hand-washing actions. However, significant differences were identified for attitudes relating to temperature control, preparation of food in advance and preparation of food whilst suffering from an upset stomach. Proportions of male and female responses to the attitude statements where differences have been identified can be found in Table 3.6. The underlying pattern for each of the responses for such attitude statements includes a larger proportion of male respondents indicating negative or neutral attitude towards food safety behaviours. For example, 63% of females and 14% of males indicated a positive attitude towards the need for hot food to be cooled down quickly for storage, 10% of females and 29% of males indicated a neutral attitude and 37% of females and 57% of males indicated a negative attitude. Such data could be useful for targeting specific food safety message in future food safety education initiatives.

Table 3.5 Statistical differences between male / female respondents, different age groups, SEGs and attitudes towards food safety behaviours.

[1] Comparisons of male and female responses using Mann Whitney U test statistic.

[2] Correlations identified between age / SEG and attitude responses using Spearmans *rho* correlation coefficient.

Attitude statement	M/F[1]	Age[2]	SEG[2]
The use of clean utensils / equipment is essential when handling cooked foods	-	*r*=-0.332**◗	-
It is better to use different chopping boards for the preparation of raw and cooked meats.	-	-	-
It is essential to clean the work surface after food preparation using an anti-bacterial spray.	-	-	-
Paper towels are more useful in the kitchen than J-cloths.	-	-	-
Good hygiene is more important when handling raw foods than when handling cooked foods.	-	-	*r*=-0.211*
It is all right to taste food with fingers during food preparation.	-	-	-
Washing hands after handling cooked, sliced ham is not necessary	-	-	-
There is no need to wash hands before handling raw chicken	-	-	-
Ensuring that frozen food has been thoroughly defrosted before cooking is not necessary.	-	-	-
Inadequate cooking of food increases the risk of being ill.	Z=-1.984*	*r*=-0.279**	-
Eating runny eggs is undesirable.	-	-	-
It is acceptable to eat foods containing raw egg.	-	-	-
It is acceptable to eat beef-burgers that are cooked to 'medium-rare' (slightly pink in the middle).	-	-	-
It is safe to eat steak that has been cooked 'rare' or 'medium-rare'	-	-	-
It is all right to eat food if the outside looks well cooked.	-	-	-
A meat thermometer is not particularly useful when cooking meat.	-	-	-
A microwave thermometer is not a particularly useful gadget to have in the domestic kitchen	-	-	-
It is essential for hot food to be cooled down quickly for storage	Z=-4.033**●	-	-
It is acceptable to cool foods at room temperature	-	-	-
It is not necessary to cool portions of left over (e.g.) casseroles with cold water	-	-	-
Cooked foods, once cooled should be refrigerated or frozen immediately.	Z=-3.425**◗	*r*=-0.254*	-
Keeping food at a luke warm temperature for later consumption is acceptable	-	-	-
It is unacceptable to store cooked meats at room temperature.	-	*r*=-0.209*	-
It is not all right to leave cooked rice in a bowl on a kitchen work surface overnight	Z=-3.247**◗	*r*=-0.225*	-
Reheating food to a warm temperature is acceptable.	Z=-2.258*	*r*=0.307**	-
Preparation of food in advance does not increase the risk of becoming ill.	Z=-2.511*	*r*=-0.234*	-
It is not important to check the temperature of the refrigerator regularly.	-	-	*r*=-0.261**
Preparing food whilst suffering from an upset stomach is not a good idea.	Z=-2.407*	-	-
Following manufacturers instructions on food packaging is not essential.	-	-	*r*=-0.238*
Food manufacturers are ultimately responsible for the safety of their foods.	-	-	-
Pre-packaged raw meats are free from germs.	-	-	*r*=-0.301**
Convenience meals are much safer to eat than meals made from raw ingredients.	-	-	-

*p<0.05 (significant with Bonferroni correction see ◗);

**p<0.01 (with Bonferroni correction see●).

'-' no association / relationship determined

Only 13% (4/32) of attitude statements were associated with SEG of respondent, none of which were considered to be significant with Bonferroni correction, indicating weakness of the correlations determined. All correlations were negative which meant that agreement with each of the statements was associated with higher SEG, such as 'AB'. For example, respondents from SEG 'AB' were associated ($r=-0.301$, $p<0.01$**) with a positive attitude towards the statement 'prepackaged raw meats are free from germs', and respondents from SEG 'DE' were associated with having a negative attitude towards the same statement.

Table 3.6 Attitudes towards food safety behaviours where statistically significant differences between male and female respondents has been made using Mann Whitney U test statistic.

Attitude statement.	Level of agreement / disagreement.	Male % total no. of respondents n=23	Female % total no. of respondents n=77
Inadequate cooking of food increases the risk of being ill.	Strongly agree / agree†	87	97
	Neither	4	3
	Strongly disagree / disagree	9	0
It is essential for hot food to be cooled down quickly for storage.	Strongly agree / agree†	14	63
	Neither	29	10
	Strongly disagree / disagree	57	37
Cooked foods, once cooled should be refrigerated or frozen immediately.	Strongly agree / agree†	66	91
	Neither	17	3
	Strongly disagree / disagree	17	6
It is not all right to leave cooked rice in a bowl on a kitchen work surface overnight.	Strongly agree / agree†	50	81
	Neither	25	11
	Strongly disagree / disagree	25	8
Reheating food to a warm temperature is acceptable.	Strongly agree / agree	24	13
	Neither	19	7
	Strongly disagree / disagree†	57	80
Preparation of food in advance does not increase the risk of becoming ill.	Strongly agree / agree	26	56
	Neither	30	22
	Strongly disagree / disagree†	43	22
Preparing food whilst suffering from an upset stomach is not a good idea.	Strongly agree / agree†	64	87
	Neither	32	12
	Strongly disagree / disagree	4	1

† = positive response

3.5.3 Consumer perceptions of risk, control and responsibility.

3.5.3.1 Quantitative analysis of consumer perceptions of risk, control and responsibility.

Determination of consumer perceptions of risk control and responsibility can be found in Tables 3.7, 3.8 and 3.9. The majority of respondents (66%) considered *themselves* to have full control or nearly full control over food safety during their own food preparation and a slightly smaller proportion of respondents (58%) considered *other people* to have equivalent control over food safety during food preparation. On a scale of 1 to 10 (where 1= no control at all and 10= full control) the median ranked value for both perception of personal control and control of others for food safety during food preparation was '8'. Equivalent proportions (8-9%) of respondents considered themselves and others, respectively, to have no control or very little control over food safety.

Perception of personal risk of illness and risk of illness of others after food preparation differed considerably. The personal risk of illness after consuming food prepared by themselves was considered to be very low or low by 90% of respondents, however, only 41% of consumers considered the risk of other people experiencing food poisoning after their own food preparation to be of an equivalent very low or low risk. This difference was reflected in the median ranked values, (1= very low risk and 10= very high risk) whereby perceived personal risk of illness was ranked '2' and perceived risk of illness of others was ranked '4'. Therefore, perception of risk was considered to be less than for oneself than for others.

It was determined that the majority (83%) of respondents considered themselves to have either total responsibility or nearly total responsibility for their own food safety. Only 5% respondents considered themselves to have no responsibility at all or a very small amount of responsibility. The median ranked value (whereby 1= no responsibility at all, and 10= total responsibility) was identified as being '9'.

Table 3.7 Perceptions of personal control and control of others during food preparation.

	n	1 = No Control at all, 10 = Full Control Proportion of respondents who stated values 1 to 3 *n* (%).	Proportion of respondents who stated values 8 to 10 *n* (%).	Mean ranked value	**Median ranked value**
How much control do you feel that you have during your own food preparation?	*98*	8 (8)	65 (66)	7.7	**8**
How much control do you think that OTHERS have over food safety during their own food preparation?	*93*	8 (9)	54 (58)	7.2	**8**

Table 3.8 Perceptions of personal risk and risk of others after food preparation.

	n	1= Very Low Risk, 10= Very High Risk Proportion of respondents who stated values 1 to 3 *n* (%)	Proportion of respondents who stated values 8 to 10 *n* (%)	Mean ranked value	**Median ranked value**
What do you consider the risk of illness to be after your own food preparation?	*97*	87 (90)	2 (2)	2.1	**2**
What do you consider the risk of other people experiencing food poisoning to be after their own food preparation?	*93*	38 (41)	3 (3)	4.1	**4**

Table 3.9 Perceptions of responsibility.

	n	1 = No responsibility at all, 10 = Total responsibility Proportion of respondents who stated values 1 to 3 *n* (%)	Proportion of respondents who stated values 8 to 10 *n* (%)	Mean ranked value	**Median ranked value**
How much responsibility for your own food safety do you have?	*96*	5 (5)	80 (83)	8.5	**9**

3.5.3.2 Identification of statistical associations between perceptions of risk, control and responsibility.

Data presented in Appendix 3.3 illustrates the Spearmans *rho* correlation coefficients between perceptions of risk, control and responsibility. A positive correlation ($r=0.568$, $p<0.01$●) was observed between personal control for food safety and perception of control others have over their food safety during food preparation (see Figure 3.1). Thus, if respondents perceived themselves to have full control over food safety, they also perceived 'others' to have equivalent control; conversely, if respondents perceived themselves to have little or no control over their own food safety, they would consider 'others' to have a similar level of control. It can be seen in Figure 3.1 that the majority of respondents considered themselves and others to have a relatively high level of control over food safety during food preparation.

A negative correlation ($r=-0.266$, $p<0.05$●) was identified between perception of personal risk of illness and personal control for food safety. This weaker correlation suggests that respondents who considered themselves to have little or no control over their own food safety were also likely to perceive themselves to have a higher risk of experiencing food poisoning after their own food preparation. Conversely respondents who perceived themselves to have full or nearly full control over their own food safety also perceived themselves to have a lower risk of experiencing food poisoning after their own food preparation.

Personal responsibility was determined to be positively correlated with personal control for food safety ($r=0.570$, $p<0.01$●) and perception of control others have over their own food preparation ($r=0.439$, $p<0.01$●), whilst negatively correlated with perceived personal risk of illness after ones own food preparation ($r=-0.409$, $p<0.01$●). Thus suggesting that as perception of personal control increases, so does increased recognition of responsibility, conversely, perception of decreased control is associated with less assumed responsibility (see Figure 3.2). Figure 3.2 also illustrates that the majority of respondents have perceived themselves to have a higher level of control with acceptance of a high level of responsibility. The correlation between perception of control others have over their food safety and personal perception of assumed responsibility is not as strong, but results follow a similar pattern to the correlation just described, between personal control for food safety and personal assumed responsibility. The negative correlation illustrated in Figure 3.3 indicates there is a significant (albeit weak) association between personal risk of illness and personal responsibility for food safety. A perception of high risk of illness is associated with a low recognition for responsibility and a perception of a low risk of illness is associated with increased responsibility.

Figure 3.1 A sunflower† scatterplot to illustrate a positive Spearmans *rho* correlation between perceived personal control for food safety and perceived control others have for food safety (r=0.568, p<0.01●) (n=93 responses).

1 = No control at all, 10 = Full control.

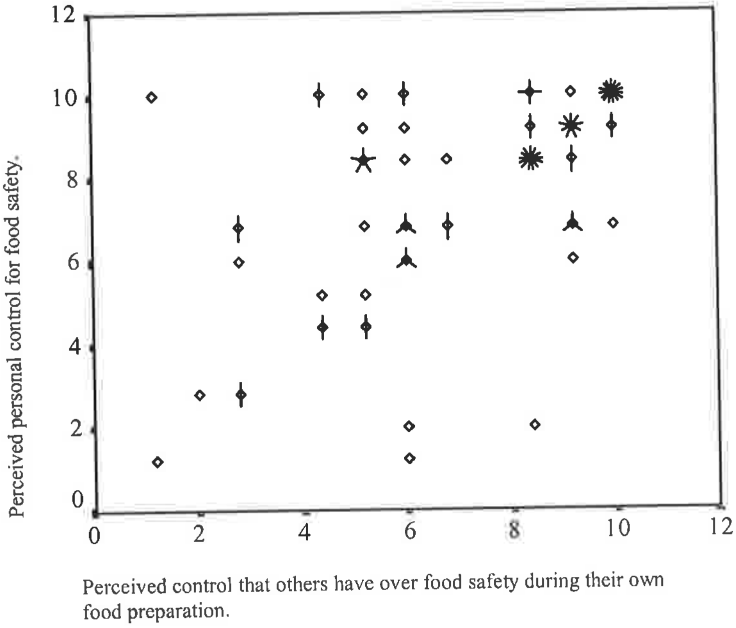


Figure 3.2 A sunflower scatterplot to illustrate a positive Spearmans *rho* correlation between perceived control for food safety during food preparation and personal responsibility for food safety, (r=0.570, p<0.01●) (n=96 responses).

1 = No control at all, 10 = Full control.

1 = No responsibility at all, 10 = Total responsibility.

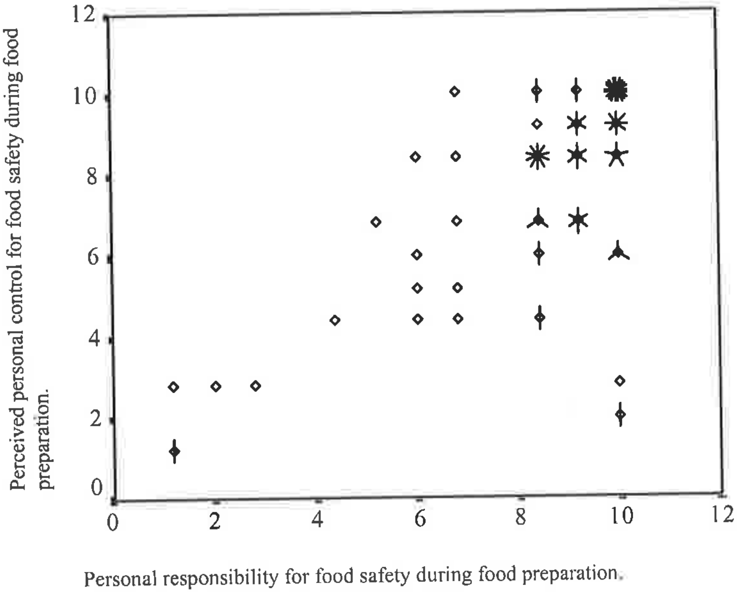
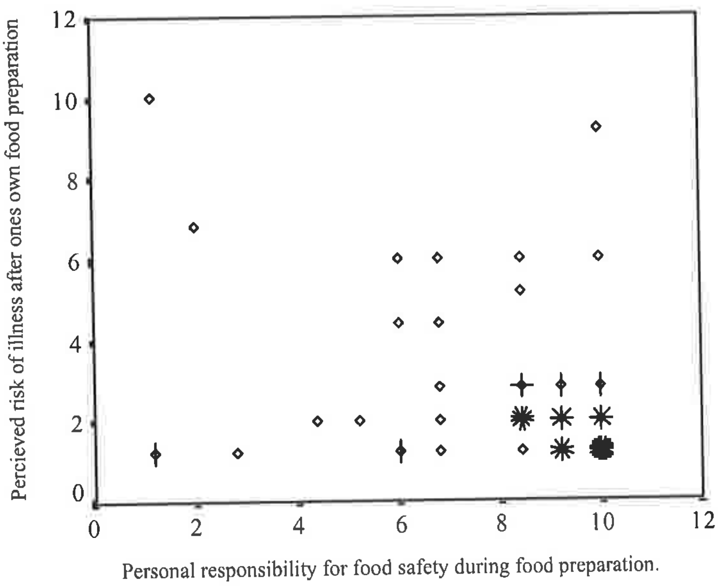


Figure 3.3 A sunflower scatterplot to illustrate a negative Spearmans *rho* correlation between perceived personal risk of illness after ones own food preparation and personal responsibility for food safety (r=-0.409, p<0.01●) (n=95 responses).

1 = Very low risk of illness, 10 = Very high risk of illness.

1 = No responsibility at all, 10 = Total responsibility.



† Each response is represented by a small circle followed by a sunflower 'petal'. The density of the petals indicates how the responses cluster (Norusis, 1999).

3.5.3.3 Identification of statistical associations between perceptions of risk, control and responsibility and respondent demographics.

Spearmans *rho* correlation coefficient was used to identify any significant associations between ranked perceptions of risk, control and responsibility and age groups / SEG's of respondents. Results showed no correlations between SEG and any variables associated with perception risk, control responsibility. In addition, no correlations were found between age of respondents and personal control, control of others and perceived risk of others experiencing food poisoning after their own food preparation. However, a negative correlation ($r=-0.404$, $p<0.01$●) was determined between age of respondent and perception of risk of illness after ones own food preparation. Thus suggesting that younger respondents had a high perception of risk and older respondents were associated with decreased perception of risk of illness. Conversely a positive correlation ($r=0.313$, $p<0.01$●) was determined between personal responsibility for food safety and age. It appears that younger respondents felt less responsible for their own food safety than older people. As age increased, percieved personal responsibility for food safety also increased.

A Mann Whitney U test was carried out to see if there were any significant differences of responses given to perceptions of risk, control and responsibility between male and female respondents. There were no differences for perceptions of control and risk of others experiencing food poisoning after their own food preparation. However, significant differences were identified between male and female respondents for perceptions of personal risk after food preparation ($Z=-2.072$, $p<0.05$◗) and for perceptions or responsibility ($Z=-2.925$, $p<0.05$◗). Quantified differences of responses between male and female respondents can be seen in Table 3.10. It can be seen that larger proportions of female respondents (93%) considered themselves to have a lower risk of experiencing food poisoning after their own food preparation than male respondents (77%). More female respondents (88%) also considered themselves to have total responsibility or nearly total responsibility for food safety than did male respondents (64%).

Table 3.10 Male and female responses for perceptions of personal risk and responsibility where use of Mann Whitney U test statistic identified significant differences.

		Male (n=22) % of total	Female (n=75) % of total
What do you consider the risk of illness to be after your own food preparation? (1= Very Low Risk, 10= Very High Risk)	Proportion of respondents who stated values 1 to 3 (%)	77	93
	Proportion of respondents who stated values 8 to 10 (%)	0	3
How much responsibility for your own food safety do you have? (1 = No responsibility, 10 = Total responsibility)	Proportion of respondents who stated values 1 to 3 (%)	9	4
	Proportion of respondents who stated values 8 to 10 (%)	64	88

3.5.4 Perceptions of different locations where food can be consumed regarding the expectation of acquiring food poisoning.

3.5.4.1 Quantitative analysis of perceptions of locations to acquire food poisoning.

A total of 78% of respondents answered this question fully, so results are solely based data from 78 responses. Overall, results showed that the home was ranked the least likely location to get food poisoning (see Table 3.11), followed by parents or friends house and a 5 star hotel. Locations ranked as most likely locations to get food poisoning included takeaway vans, ethnic style restaurants and pubs. Frequency of ranked responses denoting expectation of the home as a location for getting food poisoning can be seen in Figure 3.4. It can be seen that the majority of respondents indicated the home to be a location where there is least expectation to acquire food poisoning.

3.5.4.2 Identification of statistical associations between perceptions of locations to acquiring food poisoning.

The strongest significant correlation's between locations included negative associations between a respondents own home / a friends or family house and fast-food establishments, takeaway vans and ethnic restaurants (see Appendix 3.4). In each case, increased expectation of food poisoning resulting from food consumed from fast-food establishments, takeaway vans and ethnic restaurants was correlated with decreased perception of the home (own home, a friends or parents home) as a location to acquire food poisoning.

3.5.4.3 Identification of statistical associations between perceptions of locations to acquire food poisoning and respondent demographics.

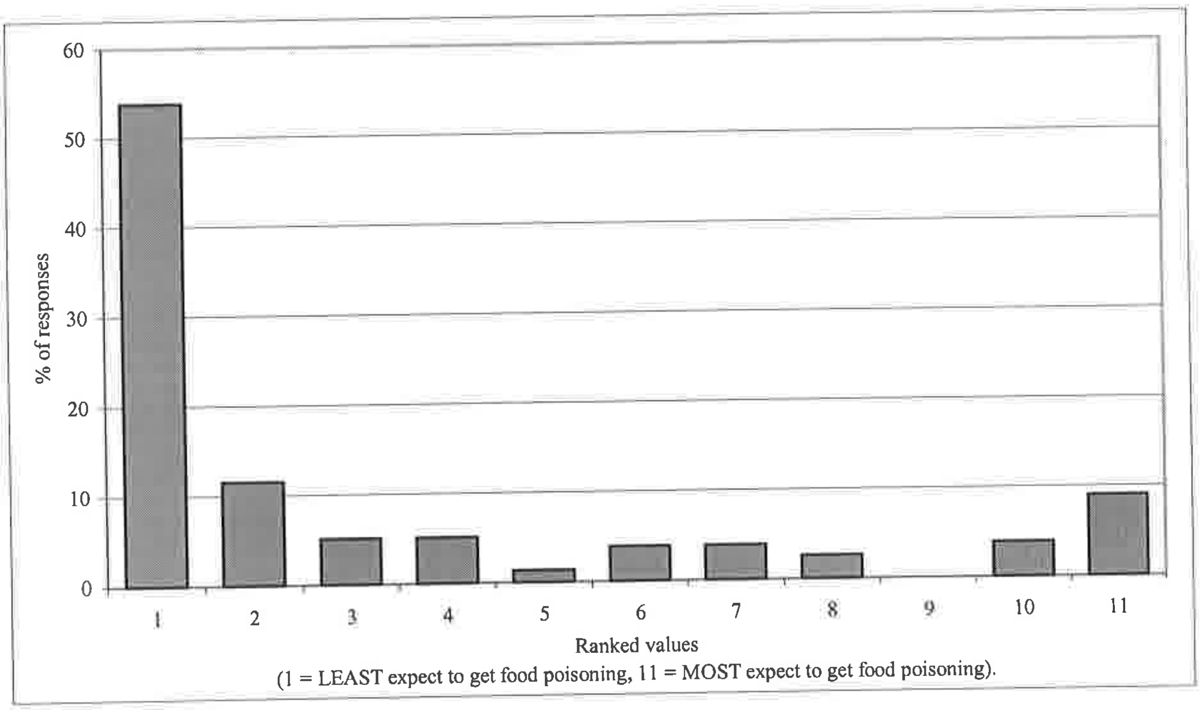
Spearmans *rho* correlation coefficient was used to identify any significant associations between ranked likely locations for getting food poisoning and age groups and SEG's of respondents. Few significant associations were determined. A weak positive correlation coefficient was determined ($r=0.250$, $p<0.05$*) between SEG and perception of a fast-food establishment as being a likely location for getting food poisoning. Respondents from social classes 'AB' were significantly more likely to think fast food establishments were associated with locations where there was a higher risk of getting food poisoning, whereas respondents from social classes 'DE' attributed the contrary. A similar, weak association was determined ($r=0.283$, $p<0.05$*) between age of respondent and expectation of getting food poisoning from a hospital or old peoples homes. Older respondents considered there to be a less chance of getting food poisoning from hospitals and old peoples homes than younger respondents.

Mann Whitney U test was carried out to see if there were any differences between male and female responses to ranked locations denoting likelihood of getting food poisoning. The only significant difference identified was for a 2 star hotel (Z=-3.005, $p<0.05$[•]). It was found that more female respondents expected to get food poisoning from a 2 star hotel than men. It is noted that no significant differences between male and female perceptions of the home as an expected location to get food poisoning were identified.

Table 3.11 Ranked locations denoting perceived expectation for getting food poisoning (*n*=78).

Location.	Mean ranked value.	**Median ranked value.**	
Takeaway van.	9.4	**11**	Most likely location to get food poisoning.
Ethnic restaurant.	7.0	**8**	
Pub.	7.0	**8**	
Fast food (e.g. McDonald's).	6.7	**7**	
University / school / Work canteen.	6.6	**7**	
2 star hotel.	6.5	**7**	
Supermarket.	5.9	**6**	
Hospital / Old Peoples home.	5.3	**5**	
5 star hotel.	4.2	**4**	
Parents / friends house.	4.2	**3**	Least likely location to get food poisoning.
Own home.	3.3	**1**	

Figure 3.4 Frequency of responses regarding perceived expectation of the home as a location to get food poisoning (*n*=78).



3.6 DISCUSSION.

3.6.1 Introduction.

Consumer attitudes towards food safety behaviours and perceptions of food safety risk, control and responsibility have been identified using a self-administered, self-complete questionnaire. In the following discussion findings determined in this study will be compared with knowledge and self-reported practices from other research to provide a more complete understanding of food safety behaviours that are known to contribute to incidents of food poisoning. Comprehension of such will improve understanding of consumer food preparation behaviours.

3.6.2 Consumer attitudes towards food safety behaviours.

Although many consumers expressed positive attitudes towards the majority of food safety behaviours, many also expressed attitudes that were not consistent with safe food preparation concepts. Notable proportions of consumers indicated negative and neutral attitudes and perceptions to issues under investigation. It is surmised that having a negative attitude towards a specific food safety behaviour may increase the likelihood of implementation of the associated food-handling malpractice. When considering findings from this study in terms of population figures, proportions of negative responses may represent substantial numbers of the population whom continue to implement unsafe practices. Substantial numbers of consumers reported to 'neither agree nor disagree' to many of the attitudinal statements regarding food safety behaviours, suggesting a lack of knowledge of the behaviours in question. In addition to this, results showed that few (4%) consumers expressed strong attitudes towards statements, suggesting that uncertainties may exist about specific food-handling procedures.

Corresponding with previous research (Griffith *et al.* 1999a) more than 80% of respondents from this study indicated that they prepared food at least once or twice a day. It is concerning to reveal that 29% of consumers from this study also believed prepackaged meats are free from 'germs'. Given that 90% of consumers have reported to eat and purchase fresh meat in the UK (FSA, 2001e) and that the bulk of raw chicken and meat purchased and brought into the domestic kitchen in a prepackaged state, an attitude to signify that such meat may be free from 'germs' may have serious implications for food safety of products when in the home.

3.6.2.1 Attitudes towards hand-washing and preparation of raw meat / poultry and RTE foods.

Attitudes related to actions associated with cross contamination, such as hand-washing after handling raw meat, poultry or eggs and use of adequately washed and dried utensils / separate utensils for raw and RTE foods were generally good and correspond favourably with previous research findings detailing consumer knowledge and self-reported practices. Ninety seven percent of consumers from this study expressed an attitude indicating the need to wash hands before handling raw chicken and 69% of consumers considered washing hands after handling cooked, sliced ham to be necessary. Such attitudinal findings concur with knowledge based data, whereby between 75-100% of consumers reportedly know that hand-washing is a necessary action during food preparation (Redmond and Griffith, 2003a) and 100% of consumers consider hand-washing and hand drying after handling raw food to be 'very important' (Griffith *et al.* 2001). In addition, self-reported data indicate that the majority (87-92%) of consumers always wash and dry their hands immediately and adequately before handling food (DHSS and NIHSSB, 1998; FDF, 1996; FSAI, 1998). Although frequent hand-washing during food preparation is preferable, the correct timing of such an action is important. Hand-washing is necessary before handling cooked, sliced ham, and after handling raw meat. Although, research denoting consumer attitudes towards hand-washing has been limited, it has been determined that 29-43% of consumers believed that poor personal hygiene, such as failure to wash and dry hands adequately, was a main cause of food poisoning in the home (FDF, 1993; FDF, 1996; FSAI, 1998; NHSS, NIHSSB, 1998). Further research is required to identify attitudes towards the specific component actions of the hand-washing and hand drying process.

Substantial food safety risks are associated with actions relating to cross contamination in the domestic kitchen. Results from this study have shown that nearly all respondents (97%) expressed an attitude that the use of clean utensils or equipment is essential when handling cooked foods. This corresponds with attitudinal findings detailed by Mathias (1999) who found that 81% of consumers expressed a positive attitude towards similar food safety behaviours. Such findings from this study and from Mathias (1999) concur with research that indicates consumer knowledge of corresponding food safety practices related to cross contamination in the domestic kitchen. For example, between 77-97% of consumers know that it is unsafe to use the same unwashed utensil to cut raw poultry and then RTE foods as such an action may result in food poisoning (ADA and Conagra, 1999; Bloomfield and Neal, 1997; Lader, 1999). This concurs with self-reported data that indicates 83-93% of consumers reported they always / usually used separate utensils and chopping boards for preparation of raw meat and cooked food or changed cutting boards after cutting raw meat or poultry (FDA / FSIS, 2000; Nunnery, 1997; Shiferaw *et al.* 2000). Such findings compare with attitudinal results from this study that indicate 90-97% of consumers have positive attitudes to the same actions.

Consideration of the data described above provides a relatively optimistic outlook on consumer perceptions towards specific cross contamination actions. However, results from this study also revealed that 10% of respondents from this study failed to agree that the use different chopping boards for the preparation of raw and cooked meats is necessary, and 20% did not perceive the use of an antibacterial spray to be essential to clean work surfaces after food preparation. Such findings correspond with previous research undertaken by Griffith *et al.* (2001) who found that 10% consumers did not believe that if they use different utensils or washed utensils for preparation of raw and RTE foods, they will help to prevent food poisoning. Although such figures represent small proportions of the sample, research has shown that pathogens such as *Salmonella* and *Campylobacter* are readily cross contaminated from foods such as raw poultry to RTE foods when utensils used for preparation not cleaned adequately (Cogan *et al.* 1999; De Boer and Hahne, 1990; Redmond *et al.* 2001). When 10-20% of the respondent sample is translated into actual population figures e.g. between 32,750-65,500 persons in Cardiff who may possess a negative attitude towards preparation of foods using utensils cleaned using best practice procedures or separate utensils or equipment the potential for contamination and subsequent infection is significant.

3.6.2.2 Attitudes towards aspects of cleaning.

Many studies assessing microbial contamination of the kitchen environment have stated that dishcloths are a common source of micro-organisms (Scott *et al.* 1982; Enriquez *et al.* 1997; Worsfold and Griffith, 1996a) and the kitchen dishcloth is considered to be one of the main vectors for cross contamination and dissemination of bacteria in the kitchen (Spiers *et al.* 1995). In view of this, research has indicated that use of a paper towel opposed to a dishcloth is better as it reduces the risk of spreading organisms around the kitchen as paper towels tend to be used just once and then disposed of (Griffith and Redmond, 2001). However, only 58% of consumers in this study expressed an attitude that paper towels were of more use in the kitchen than J-cloths. Such results suggested that up to 42% of consumers may prefer to use a dishcloth than paper towel and thus present risks of contamination in the kitchen. Reported practice of treatment of cleaning materials such as the dishcloth is a subject that has not been investigated widely. Nevertheless, Beddows (1983) indicated that 89% of consumers have reported to use the same dishcloth for multiple purposes including wiping surfaces and washing up, thus increasing the potential for cross contamination of organisms around the kitchen environment.

3.6.2.3 Attitudes towards adequate temperature control.

Adequate temperature control, including heating practices, cooling principles and refrigeration and freezing temperatures are required to minimise proliferation of any organisms present. However, temperature misuse, including inadequate refrigeration, thawing, heating, hot holding and storage were associated with nearly half of all reported European outbreaks identified and recorded between 1992 and 1994 (Schmidt, 1995). Attitudes towards aspects of temperature control have been assessed in this study and results are discussed below.

A large proportion of consumers in this study (62%) expressed a positive attitude towards the need and importance of checking the temperature of the refrigerator regularly. However, previous research denoting consumer knowledge indicated that up to 93% of consumers did not know that the correct refrigeration temperature is 0-5°C (FSAI, 1998). It can therefore be surmised that many consumers who think that it is important to check the refrigerator temperature would not recognise an unsafe temperature. Findings detailing consumers' refrigerator temperatures correspond with lack of knowledge described above, yet are inconsistent with attitude findings from this study. Results have shown that large proportions (up to 70%) of consumers refrigerators exceed recommended temperatures (Daniels, 2001; Johnson *et al.* 1998; VanGarde and Woodburn, 1987) therefore providing conditions that encourage the proliferation of bacterial cells to potentially dangerous levels thus, increasing the risk of illness.

The practice of adequate thawing of food, particularly for joints of meat, is essential before cooking. Appropriate methods for adequate thawing have previously been discussed (see Chapter 2.0). In this study, the majority (86%) of consumers considered it necessary for frozen food to be defrosted thoroughly before cooking. Corresponding with such findings, 90% of consumers have reported to always thaw meat and poultry thoroughly before cooking (FDF, 1993). However, other research has identified substantial malpractices regarding defrosting methods. Between 60-75% of consumers have reported to defrost foods (including raw meat and poultry) at room temperature and on the kitchen work surface (FDF, 1993; MAFF, 1988; Spriegal, 1991). In comparison, between only 15-25% of consumers have reported to defrost foods (such as raw meat and poultry) in the fridge (FDF, 1993; MAFF, 1988; Ministry of Health, 1995; Worsfold, 1994). It can therefore be surmised that although consumers have a positive attitude and knowledge of the necessity for thorough defrosting before cooking, they are unaware how adequate, safe thawing should be implemented and thus increasing the risk of inadequate heating and potential for causing food poisoning.

A total of nine statements in this study assessed attitudes related to cooking efficacy in the domestic kitchen. Epidemiological data has shown that inadequate heating or reheating of foods has contributed to 50% of foodborne outbreaks in England and Wales, 1995-1996 (Evans *et al.* 1998). Thus, inadequate practices related to improper cooking and reheating present substantial risks of food poisoning. Most consumers (95%) from this study held a positive attitude towards inadequate cooking of food increasing the risk of illness. Corresponding with findings from this study, Mathias (1999) found that 89% of UK consumers acknowledge undercooking as a risk factor associated with foodborne disease and data from USA has shown that 67–74% consumers think that cooking meat well decreases the risk of food poisoning (Altekruse *et al.* 1996; ADA & Conagra, 1999). However, other research has indicated that consumers' knowledge of the internal temperature at which cooked meat is safe to eat is lacking. For example, Griffith *et al.* (2001) found that 85% of consumers did not know the temperature at which a beef-burger was safe to eat. Therefore, although overall consumers may have a positive attitude and knowledge regarding the need for adequate heating and consequences of inadequate heating, key concepts (such as end-point temperature) (EPT) remain to be unknown by the majority of consumers, thus increasing the risk of undercooking. Limited research has been carried out regarding knowledge, attitudes and self-reported practice of the concepts associated with reheating of foods. In this study 24% of consumers expressed a negative or neutral attitude towards the acceptability of reheating food to a warm temperature, suggesting that many consumers may not reheat foods to an acceptably safe temperature, thereby increasing the risk of food poisoning. Results from this study indicated that older consumers were significantly associated with a more positive attitude towards cooking efficacy and reheating practices. Therefore younger consumers (particularly males) may be an appropriate target for education about cooking efficacy in future food safety initiatives.

Rapid cooling of cooked foods an important food safety practice (see Chapter 2.0) and inadequate cooling procedures have been associated with many incidents of food poisoning (Bryan, 1978; Roberts, 1985). Attitude findings from this study have indicated that substantial misunderstandings exist about the concept of adequate cooling of cooked foods. Previous research detailing consumer knowledge and self-reported practices of cooling principles has been limited, and available data has indicated that perceptions of cooling of foods are inadequate (Redmond and Griffith, 2003a). In this study, 47% of the sample disagreed or expressed a neutral attitude towards the need for cooling of hot food quickly for storage and 33% of the sample did not consider rapid cooling to be an essential process. Thus implying that if such attitudes are associated with corresponding behaviours, large proportions of consumers may implement unsafe cooling practices. In addition, 62% of consumers expressed an attitude that it is acceptable to cool foods at room temperature and 93% were either unsure or disagreed for the need to cool (e.g.) a leftover casserole with cold water. Such findings indicate that consumers are unsure of correct, safe methods to actually cool cooked foods. Research has shown that pathogens and spoilage flora are capable of growing on meat at temperatures of 20°C and 30°C (Gill and Newton, 1980) and therefore the length of time foods are left at room temperature should be minimised.

Prevention the proliferation of bacterial cells and germination of spores is largely dependant upon effective temperature control (Roberts, 1982). Results from this study have indicated that consumers have a more positive attitude towards temperature control for storage of foods than for the cooling of foods. Most (75-84%) consumers expressed an attitude that it is unacceptable store cooked meats at room temperature and that it also unacceptable to leave cooked rice in a bowl on a work surface over night. However, between 16-25% of the sample expressed an attitude denoting the contrary, suggesting that malpractices such as storage of cooked foods and cooked rice at room temperature is considered to be acceptable by some consumers. Results from this study regarding attitudes towards storage practices have corresponded from previous research that indicates ~75% of consumers have demonstrated knowledge of correct storage practices (Redmond and Griffith, 2003a). However, knowledge and attitude responses towards such practices have not corresponded with self-reported practices, where 45% of consumers have reported to store foods at room temperature (Albrecht, 1995).

It has been reported that preparation of food in advance of consumption has been the biggest contributory factor for reported outbreaks of foodborne disease in England and Wales (Roberts, 1985). Consumer attitudes towards the risk of illness being greater when food is prepared in advance were largely negative, and accounted for 49% of the sample. Such a findings is concerning as failure to realise risks associated with such practices may result in implementation of unsafe practices thus, increasing the potential for food poisoning.

3.6.2.4 Attitudes towards consumption of foods with the potential to cause food poisoning.

A substantial amount of media attention has been attributed to the microbiological hazards of undercooked eggs and beef-burgers due to outbreaks of foodborne disease from *E.coli* 0157:H7 and *Salmonella*. Many consumer food safety surveys have determined self-reported prevalence of food consumption practices that may have the potential to cause foodborne disease. Overall, large proportions of consumers have reported eating raw foods of animal origin. Attitudes towards consumption of potentially high-risk foods determined in this study have been identified and results correspond with findings denoting self-reported data from other studies. Nearly half (46%) of consumers considered consumption of 'runny' eggs to be desirable and a fifth (21%) of consumers expressed an attitude denoting acceptability of consuming foods containing raw egg. Since 1997, prevalence of consumption of undercooked or raw eggs has ranged from 5-56% (Altekruse *et al.* 1999; Jabusche and Hilliers, 1999; Meer and Misner, 2000; Shiferaw *et al.* 2000; Unklesbury *et al.* 1998; Yang *et al.* 1998; Zhang and Penner, 1999). Research has shown that pathogens such as *Salmonella* can survive forms of cooking when some of the yolk remained liquid (Humphrey *et al.* 1989). It has been recommended that '*people should avoid eating raw eggs or uncooked foods made from them*' (ACMSF, 1993b, p39) to reduce the risk of food poisoning, especially for the immuno-compromised, young and old. It is disconcerting to realise that a large proportion of consumers (which may be generalised to nearly half of the population of Cardiff) have expressed an attitude to indicate that consumption of raw or undercooked eggs is acceptable.

In the USA, outbreaks of *E.coli* 0157:H7 have been attributed to consumption of undercooked hamburgers (CDC, 1994). Although self-reported prevalence of consumption of undercooked hamburgers has ranged from 4-30% of American consumers (Altekruse *et al.* 1999; Jabusche and Hilliers, 1999; Meer and Misner, 2000; Nunnery, 1997; Raab and Woodburn, 1997; Shiferaw *et al.* 2000; Unklesbury *et al.* 1998; Woodburn and Raab, 1997; Yang *et al.* 1998; Zhang and Penner, 1999), only 13% consumers from this study expressed an attitude that it is acceptable to eat beef-burgers that are cooked to medium-rare. It was considered that attitudinal responses towards the acceptability of consumption of medium-rare steak (regarded as a safe practice) (Brownsell *et al.* 1989) may have been associated with perception that beef-burgers cooked to the same level were also safe. However, no significant correlation between the two attitudes was determined. Nevertheless, of the 55% of respondents who agreed that it is safe to eat steak that has been cooked to rare or medium-rare, 17% also agreed that it was acceptable to consumer beef-burgers to the same level. Conversely, of the 21 (22%) respondents who considered it unsafe to eat rare or medium-rare steak, only 1 (5%) thought it to be acceptable to consume beef-burgers to 'medium-rare'.

In this study attitudes towards the use of a meat thermometer for cooking meat and use of a microwave thermometer were largely undecided (46-56% respondents expressed a neutral attitude), and similar proportions of respondents relatively evenly agreed and disagreed with each statement. Results such as this suggest the use of thermometers may not be used by many consumers in the domestic kitchen and hence cooked foods may not reach required EPT's prior to consumption. A substantial amount of research has been undertaken to associate meat colour as an indication of meat 'doneness' (Snyder, 1998). Guidelines have suggested that cooked ground beef patties (~beef-burgers) require cooking until there is no pink colour and juices run clear (Snyder, 1998). However, further research has indicated that colour of meat is not a reliable indicator that the meat has reached a temperature high enough to destroy harmful bacteria such as *E.coli* 0157 (FSIS, USDA, 1998b). Therefore, it is recommended that use of a thermometer is the only reliable way to ensure safety and determine the 'doneness' of meat, poultry and egg products (USDA, FSIS, 2000). Thus, it is concerning to realise that a large proportion of consumers from Cardiff have a negative attitude towards such a practice.

3.6.3 Perceptions of risk, control and responsibility.

Bruhn (1997) has suggested that the occurrence of food poisoning incidence and frequency of serious consequences are under-estimated by consumers. An underestimation of the actual likelihood of experiencing a negative event is known as optimistic bias (Weinstein and Klein, 1996). A large proportion (90%) of consumers from this survey (more females than males) perceived there is a very low-risk of getting food poisoning after their own food preparation and only 41% perceived others to have equivalent risk, thus indicating judgements of optimistic bias. These data supports findings from Frewer *et al.* (1995) which indicates that consumers associate the lowest personal risk of food poisoning with home produced food and a greater risk of food poisoning is perceived when food is prepared by others, opposed to themselves. Results from this survey concur with findings whereby it has been reported that public perception of food poisoning shows a marked optimistic bias (Weinstein, 1987), an effect that has also been discussed by other workers (Frewer *et al.* 1994b; Frewer *et al.* 1995a; Miles *et al.* 1999). Under-estimation of personal risk to food may prevent consumers from taking appropriate steps to reduce their exposure to microbiological food-related hazards (Frewer *et al.* 1995a; Sammarco *et al.* 1997). Indeed, recent research has indicated that consumers only think about safe food preparation behaviours when they perceive a risk, yet it is reported that consumers may have mistaken ideas about which practices are effective at reducing risks (Levy, 2002). Optimistic biases are important because they may hinder efforts to reduce risk-reducing behaviours (Miles *et al.* 1999). It is considered that an understanding of public risk perceptions will facilitate communication of risk issues and as such is of direct relevance to experts, policy makers and the public (Frewer *et al.* 1995a).

Investigations of consumer perceptions of control have been limited. Findings from this study indicated that individuals (66%) consider themselves to have slightly more control over food safety than others (58%), thus indicating a tendency of the illusion of control – a similar judgement as optimistic bias. McKenna (1993) has noted that an overly positive perception of events may stem from an illusionary perception of personal control. However, Frewer *et al.* (1994a) reported that no direct relationship between perception of risk and perception of control was determined. Results from this study indicated that respondents who perceived themselves to have full or nearly full control over their own food preparation also perceived themselves to have a lower risk of experiencing food poisoning. This agrees with findings reported by Levy (2002) who indicated that consumers may not perceive a risk if they are confident that that they are controlling the risks. Conversely, those who perceived themselves to have little or not control over food safety during their own food preparation also perceived themselves to have a higher risk of experiencing food poisoning. Analysis of results from this study also revealed that as perception of personal control increased, so did perception of control for others, even if not to the same extent.

Numerous studies in the UK, USA, Canada, Australia and New Zealand have investigated consumer perceptions of responsibility for safe food preparation. Consumers are considered to be responsible for proper food-handling practices when preparing food in the home (Albrecht, 1995), yet it has been reported that consumers are frequently unaware of their role in the prevention of foodborne disease (Schmidt, 1995). Results from this study have suggested inconsistent perceptions of responsibility for food safety. Although 83% of consumers ranked themselves to have nearly total or total responsibility for food safety during their own food preparation, 69% of consumers expressed an attitude suggesting food manufacturers are ultimately responsible for the safety of their foods. Such incongruities have been identified within and between other research studies. In New Zealand, Hodges (1993) reported that 95% consumers indicated they have taken some responsibility for food safety during food preparation. Yet findings from Canada (CFIA, 1998) have indicated that 77% of consumers feel that they should not be entirely responsible for food safety in the home. During the late 1970's, Jones and Weimer (1977) found that most consumers underrated their individual responsibility for hygienic food preparation and relied on government inspection for the prevention of bacterial contamination of raw meat and poultry. Nearly three decades later, data suggest that many consumers remain unaware that the home is a likely place for food safety problems, believing that the responsibility lies instead with the food manufacturer or restaurants (Worsfold and Griffith, 1997a). Results may suggest that consumers are beginning to recognise the requirement for personal responsibility, but still consider external providers of food are also accountable to maintain levels of food safety. Griffith (2000b) has suggested the notion of a shared responsibility between industry and consumers, and other workers have suggested that more emphasis need to be given to personal responsibility for food safety by educators (Unklesbury *et al.* 1998).

3.6.4 Perception of the home as an important location for food poisoning.

Failure to associate home food-handling practices with foodborne illnesses is considered to be a serious impediment to convincing consumers to change inappropriate food-handling behaviour (Fein *et al.* 1995). Overall, most consumers in this study in perceived their own homes to be the most unexpected location to acquire food poisoning. The homes of their friends and family were considered to be the second most unexpected location to acquire food poisoning.

Results showed that 71% consumers considered the home to be the least likely location where they would expect to get food poisoning and 13% considered it the location where they would most expect to get food poisoning. Such findings concur with previous research that has indicated that only 9-11% of British consumers (MAFF, 1988; Mathias, 1999), 16-23% of American consumers (Fein *et al.* 1995; Williamson *et al.* 1992; Woodburn and Raab, 1997) and 16% of Canadian consumers (CFIA, 1998) perceived the home as a likely place to acquire food poisoning. Such data does not concur with perceptions of Australian consumers, as Jay *et al.* (1999b) found that 77% of Australian respondents thought the home *was* a likely place to acquire food poisoning. Nevertheless, more Australians, like American and UK consumers perceived takeaway vans, pubs and restaurants to be more likely locations for acquiring food poisoning. American consumers have also attributed a greater likelihood of food safety problems occurring in manufacturing facilities or in restaurants. Results for this subject appear to be consistent from all international surveys reviewed and despite increased media / educational attention, perception of the home as an unlikely location for getting food poisoning appears to be relatively unchanged over the past 15 years.

3.7 CONCLUSIONS.

Overall, consumer attitudes towards food safety in general were relatively positive, although small proportions of respondents expressed attitudes that were contrary to safe food preparation practices. Given that attitudes may influence behaviours, future food safety initiatives may need to focus upon improving consumer attitudes towards food safety practices before attempting to improve actual food safety behaviours. Indeed, to raise consumer awareness of food safety issues it is considered to be important to determine baseline attitudes towards food safety behaviours to inform food safety education strategies.

Age was found to be significantly correlated with attitudes towards food safety practices related to both temperature control and cross contamination during food preparation in the domestic kitchen. In all cases correlations associated negative responses of young adults and positive responses with older adults. Thus it is suggested that to improve food safety behaviours of young adults it may first be necessary to change their attitudes towards such practices.

Male and female responses determined for actions related to temperature control, preparation of food in advance and preparation of food with an upset stomach showed significant differences. For all cases larger proportions of females expressed positive attitudes towards statements than males. Such a finding suggests that future food safety education initiatives require differing strategies to bring about improvements of food safety behaviours.

Expression of attitudes towards specific food safety behaviours was compared to previous research denoting knowledge and self-reported practices associated with the same food-handling practices. Attitude responses from this study concurred with knowledge and self-reports of heating efficacy, hand-washing and use of separate / adequate washed utensils for preparation of raw meats or poultry and RTE foods. Although consumers expressed relatively positive attitudes (from this study) and demonstrated knowledge (from previous research) towards safe storage procedures, substantially fewer consumers self-reported safe storage practices. Overall attitudes towards cooling principles required the most improvement of all food safety behaviours under investigation, such finding compared well with lack of knowledge and unsafe self-reported practices determined by other workers. Although attitudes towards consumption of runny or uncooked eggs compared well with self-reported data from other research, attitudes towards consumption of rare / medium-rare beef-burgers were better than self-reported data.

Identification of judgements of optimistic bias were determined for perceptions of risk and control of food safety during consumer food preparation. More consumers considered their personal risk of getting food poisoning after their own food preparation to be lower than other people do after their own food preparation. In addition to this, consumers considered themselves to have slightly more control over food safety than other people. Such perceptions of risk and control explained by the notion of optimistic bias have negative implications for food safety education initiatives.

Discrepancies were identified regarding identified perceptions of responsibility for food safety. Although the majority of consumers in this study considered themselves to have total or nearly total responsibility for food safety during food preparation, a substantial number of consumers also maintained the attitude that food manufacturers are ultimately responsible for the safety of their foods. Such incongruity of responses may suggest that consumers do not wholly assume themselves to be responsible for the safety of foods they may prepare and consume, and therefore hinder efforts to improve food safety behaviours in the domestic kitchen.

In agreement with the majority of previous international research findings it was determined that the majority consumers from the sampled population in Cardiff considered the home to be the least likely location where they would expect to acquire food poisoning. No significant differences were determined between male and female responses for this perception, and no significant relationships were determined between perception of the home as the least likely location to get food poisoning and SEG or age. Food consumed from a takeaway van was considered to be the most likely location where food poisoning could be acquired.

Attitudes and perceptions of food safety behaviours from this chapter will contribute valuable information to the field of food safety research and provide food safety researchers and health educators with information to further understand why consumers continue to implement food safety malpractices during domestic food preparation. Findings will be considered during strategy development of a community food safety initiative in Chapter 7.0.

CHAPTER 4.0

CONSUMER ATTITUDES AND PERCEPTIONS TOWARDS FOOD SAFETY EDUCATION.

4.1 INTRODUCTION.

Effective food safety education is required to reduce the incidence and risk of foodborne disease. Determination of consumer attitudes and perceptions of health-related educational attempts are known to aid the development of effectual initiatives that can result in behavioural change. This chapter determines attitudes and perceptions towards aspects of food safety education.

4.2 REVIEW OF LITERATURE.

Education of in-home food handlers can reduce foodborne illness by positively influencing behaviours (Hilliers *et al.* 1994). Indeed, the ultimate objective of health-related educational attempts is to bring about positive behavioural change (Bryant, 1998). However, to date, public communication campaigns to encourage people to adopt safe food-handling practices have had minimal success (Kretzer and Larson, 1998).

Behavioural scientists have stated that '*human beings are not empty vessels in which correct information can simply be poured which in turn will eliminate undesirable customs*' (Foster and Kaferstein, 1985). For communication to have the desired impact a whole chain of responses needs to be elicited (McGuire, 1984). Therefore the development of community based interventions for food safety initiatives is considered to be a complex process, due to the need for provision of information for diverse target audiences in many different settings. Diverse strategies are required for many different groups of consumers, each having their own food preparation practices (Campbell *et al.* 1998) and social and environmental influences. Of importance for food safety education is the message and the manner in which the message is communicated to and received by the public (Griffith *et al.* 1994). Better education depends upon better understanding of the modes and channels of communication that people actually use (Khare, 1988; WHO, 1988).

Sources of food safety education have previously been discussed (see Chapter 2.0). Limited research has been conducted to determine consumer preferences for such food safety information sources. A review of 65 consumer food safety surveys found that less than a quarter (23%) of the surveys included questions to identify preferable or influential sources. These surveys were conducted in England and Wales, North America, Australia and the North and South of Ireland. Overall, findings indicated that consumers use many sources of food safety information. The most common sources identified were television (Jay *et al.* 1999b; Lader, 1999; Meer and Misner, 2000; NCC, 1991) and magazines and leaflets (Griffith et al 1994; Jay *et al.* 1999b). Other sources of food safety information included radio programmes, supermarket leaflets, newspaper articles, cookbooks, packaging instructions, posters, magnets and family and friends. Research has indicated that a large proportion (58%) of Canadians reported learning about the safe ways to cook, store and handle food from their family and friends (CFIA, 1998) whereas only 21% British consumers have reported similar experiences (NCC, 1991). Research from England, Wales and Northern Ireland indicated that consumers considered there to be a shortfall in expectation and perceived provision of food safety information for many organisations – namely food manufacturers and supermarkets (DHSS & NIHSSB, 1998; FDF, 1996). For example, although between 68-72% of consumers though food manufacturers should provide food safety information, only 32-43% of the same consumers thought that food manufacturers actually did provide such information (DHSS & NIHSSB, 1998; FDF, 1996). Although in the surveys many consumers reported having seen food safety information from a variety of sources, research into their preference and consequential effectiveness for appropriate behavioural change is required and currently lacking.

One of the most important determinants of consumer reactions to food risk information is the extent to which the public trusts the source from which the information originates (Frewer *et al.* 1995b; Shepherd *et al.* 1996). People are unlikely to change their behaviour or attitudes if they do not trust the source of information (Frewer *et al.* 1996), thus, information from a credible source is more likely to influence the public than a source that lacks this attribute (FAO /WHO, 1998). For example, a scientist or other health care worker may seem the ideal source of public health information, however, a community activist or lay person affected by the disease may carry more credibility and have a greater public impact (Freimuth *et al.* 2000). A source low in credibility may be discounted and have limited or no impact, whereas a highly credible source is likely to be more influential (Griffin *et al.* 1991). Research from England and Wales has indicated that only small proportions of consumers actually classed common sources of food safety information as being reliable. For example, although 40% consumers reported seeing food safety information from TV programmes, only 46%

considered the information they had heard to be reliable (Lader, 1999). Similarly between 3-15% of all other sources of food safety information that had been seen by respondents of the survey were also considered to be reliable (Lader, 1999). Such findings have adverse implications for the impact of the effectiveness of food safety initiatives in England and Wales.

Generally, it has been reported that there is little public understanding of the exact mechanisms of food poisoning (MAFF, 1988) and research has indicated that consumers fail to recognise key clinical features of foodborne illness (Leman, 2001). It has been suggested that personal experience of ill health may challenge a persons sense of invulnerability when it comes to health risks (Denscombe, 2001) and therefore experience of food poisoning may have an effect on actual food preparation behaviours. For example, 69% of UK consumers who reported to experience food poisoning have also reported to take extra precautions to prevent suffering a similar bout of food poisoning occurring again (MAFF, 1988). Another UK survey has determined that 19% of consumers had given up specific foods as a result of experiencing food poisoning (Lader, 1999). Therefore it can be suggested that inclusion of information detailing 'experience' and consequences of food poisoning may be effective as part of food safety education initiatives.

Food safety education is likely to be most effective when messages are targeted toward changing behaviours most likely to cause foodborne illness, and towards specific audiences (Mederios *et al.* 2001a). Research has indicated that the most effective way to provide information is in a context that makes sense to the target audience (Fraser and Smith, 1997). If food safety communication is to have the desired behavioural effect, an individual must be exposed to it, pay attention to it, become sufficiently engrossed in it to persist, comprehend what it says, agree with it and ultimately act as the message suggests (McGuire, 1984). For such conditions to take place the health communication process needs to be structured and identify and prioritise audience segments, deliver accurate, scientifically based messages from credible sources and reach audiences through familiar channels (Freimuth *et al.* 2000). A variety of differing conditions affect the receptivity of health communications. Such conditions include demographic and socioeconomic variables, personal receptivity to new information, previous knowledge, educational background, cultural influences, perceptions of risk, control and responsibility and attitudes to the health issue in question.

It is anticipated that such quantitative data detailing attitudes and perceptions of food safety education from this chapter will, along with data from Chapter 3.0, aid the formative research process in the development of a targeted food safety educational strategy in Chapter 7.0.

4.3 AIMS AND OBJECTIVES.

4.3.1 Aims.

- Examine factors that influence the efficacy of food risk communication.
- Investigate consumer preferences for methods of food safety education.

4.3.2 Objectives.

- Determine consumer attitudes towards the efficacy of current food safety behaviours.
- Ascertain attitudes towards response to food safety information in the past and likelihood of acting upon food safety information in the future.
- Assess consumer preferences for different food safety information sources.
- Identify consumer perceptions of spokespersons that are likely to be believed for the promotion of food safety information.
- Determine organisations that are perceived as credible and trustworthy providers of food safety information.

4.4 METHODS.

4.4.1 Introduction.

Quantitative methods of data collection can be used for the determination of attitudes and perceptions. The present chapter uses a questionnaire to assess attitudes and perceptions of consumer food safety education. As in Chapter 3.0, the use of a questionnaire was considered to be the most appropriate research method to use to collect the required information.

4.4.2 Questionnaire development.

The purpose of this questionnaire was to investigate consumer attitudes towards food safety education, examine preferences for different sources of food safety information and determine perceptions of organisations / spokespersons deemed credible and trustworthy. Health education and health promotion literature was reviewed to provide background information to aid the development of attitude statements and questions that were based upon key concepts influencing the efficacy of food safety communication.

This questionnaire comprised of five sections. Section A included 27 attitude statements that were designed to determine consumer receptivity to food safety information, attitudes towards the likelihood of acting on new information, perceptions of current behaviours and attitudes towards different locations where food safety information may be placed in future initiatives. Attitude responses were given on a Likert-type rating scale and as for the questionnaire in Chapter 3.0, statements were placed in an order whereby some responses warranted a positive response and others warranted a negative response.

The majority of responses to questions in sections B-E were based on the <u>variation</u> of a VAS in the Likert-type scale (as described in section 3.4.2, paragraph 3). Such responses were obtained to give an indication of where respondents were likely to pick up food safety leaflets, preferable sources of food safety information, spokespersons most likely to believe and credible / trusted providers of food safety information.

4.4.3. Pilot testing.

The questionnaire was piloted using recommended procedures (Breakwell *et al.* 1995) on 10 adult consumers. During the piloting process of this questionnaire, issues that were considered and addressed are described in section 3.4.3. Administration of the questionnaire with covering letter (see Appendix 4.1) was piloted and no amendments to the process were necessary. The final version of this questionnaire: 'Attitudes and perceptions towards food safety education' can be found in Appendix 4.2.

4.4.4. Determination of validity and reliability.

For background information and methods used for ensuring validity and reliability of this questionnaire see section 3.4.4 of Chapter 3.0. As in the questionnaire detailing attitudes and perceptions of food safety behaviours in the domestic kitchen, measures of internal consistency / reliability were obtained for attitude statements in the food safety education questionnaire. A Cronbachs alpha coefficient of 0.8 was determined. For internal consistency of a questionnaire to be acceptably reliable, Cronbachs alpha should be between >0.7 and <0.9 (Streiner and Norman, 2001) and therefore it was determined that the attitude scale in this questionnaire was acceptable and measured a single construct.

4.4.5 Sampling and data collection.

This questionnaire was administered by post to the 100 respondents who had completed the questionnaire in Chapter 3.0. The food safety education questionnaire was sent with a covering letter and prepaid addressed envelope. Respondents were offered a £5 supermarket incentive to return a completed questionnaire within one month of administration. Follow-up telephone calls were made and reminder letters were sent to respondents at intervals after the initial survey had been distributed to potentially increase response rates.

4.4.6 Data analysis.

All questionnaire responses were inputted and stored on the Consumer Food Safety Microsoft Access 1997 database that had been specifically designed for this project (see section 5.4.8.1), and statistical analysis was carried out using SPSS (for windows) version 7.5 / 9.0 and Microsoft Excel 1997. See section 3.4.6.1 for details of data assumptions.

4.4.6.1 Analysis of attitudes towards food safety information sources.

⇒ *Quantitative analysis of overall scored attitude responses towards food safety information sources.*

- Attitudinal responses were coded from 1 (positive) to 5 (negative) to give overall attitude scores and an indication of overall attitude direction. A calculation of the sum of responses gave a possible range of scores from 27 to 135 (the higher the score the more unfavourable the attitude).
- Descriptive statistics were used to quantify overall attitudes to food safety behaviours using coded responses.

⇒ *Examination of associations between overall scored attitude responses and respondent demographics.*

- An assessment of the association between age groups / SEG groups and median attitude scores (coded as in 4.4.6.1) was made using Spearmans *rho* correlation coefficient (2-tailed). For the rationale for choice of this statistical test, see section 3.4.6.2 (paragraph 2).

- As noted in section 3.4.6.1, male and female groups were considered to be nominal data, therefore comparisons with coded attitude scores (ordinal data) were made using the Mann Whitney U test statistic. For the rationale for choice of this statistical test, see section 3.4.6.2.

⇒ *Analysis of scored responses to individual attitudes towards food safety information sources.*

- Median and mean attitude scores have been used to describe responses to individual attitude statements. Median scores indicated central tendency of responses and mean scores indicate skewness of data, and SD indicates the measure of spread.

⇒ *Analysis of quantitative responses to individual attitudes towards food safety information sources.*

- Descriptive statistics have been used to summarise responses to individual attitude statements.

⇒ *Identification of associations between attitudes towards food safety information sources.*

- Spearmans rank correlation coefficient (*rho*) was used to identify correlations between responses to attitude statements (ordinal data).

⇒ *Examination of associations between individual attitude responses and respondent demographics.*

- Correlations between responses to individual attitude statements (ordinal data) and SEG and age groups (ordinal data) have been determined using Spearmans *rho*.
- Comparisons made between attitude responses (ordinal data) and male and female groups (nominal data) were made using the Mann Whitney U test statistic.

4.4.6.2 Food Safety Leaflets.

⇒ *Quantitative analysis of responses to receipt of food safety leaflets through the post and picking food safety leaflets up from outside the home (questions B1, B2 on the questionnaire, see Appendix 4.2).*

- Descriptive statistics were used to quantify proportions of consumers who stated 'yes' and 'no'.

⇒ *Examination of the association between the likelihood of reading a food safety leaflet and respondent demographics.*

- Spearmans rank correlation coefficient (*rho*) was carried out to examine and identify correlations between the likelihood of reading a food safety leaflet. Differences between male / female responses were identified using the Mann Whitney U test (Z score).

⇒ *For analysis of questions B3 and B4 see section 4.4.6.4.*

4.4.6.3 Television as a source for food safety information.

⇒ *Quantitative analysis of responses denoting aspects of watching TV cookery programmes and TV documentaries on food safety (questions C1 to C7 on the questionnaire, see Appendix 4.2).*

- Descriptive statistics were used to quantify responses to questions C1 to C7.

⇒ *Examination of the association between the likelihood of watching TV cookery programmes and watching TV documentaries about food safety.*

- Responses to Likert style questions ('extremely likely' to 'extremely unlikely') were assumed to be ordinal data. Therefore Spearmans rank correlation coefficient (*rho*) was used to examine the association between such responses.

⇒ *Examination of the association between the likelihood of watching TV cookery programmes / TV documentaries about food safety and respondent demographics.*

- Spearmans rank correlation coefficient (*rho*) was carried out to examine identify correlations between likelihood of watching TV cookery programmes and TV documentaries about food safety and respondent demographics. Differences between male / female responses were identified using the Mann Whitney U test statistic (Z score).

4.4.6.4 Analysis of responses to the following questions (see Appendix 4.2):

B3: Likelihood of picking food safety leaflets up from different locations.

D1: Preference of receiving food safety information from different sources.

E1: Credibility / trustworthiness of food safety information from different organisations.

E2: Likelihood of believing a variety of spokespersons to deliver food safety information.

⇒ *Quantitative analysis of responses to questions B3, D1, E1, E2 (Appendix 4.2).*

- Descriptive statistics were used to identify proportions of respondents who stated values 1-3 and 8-10.
- It is not possible to assume differences between ordinal ranks, therefore median values were calculated to indicate central tendency and were used as the main determinants of rank. Mean values were calculated to indicate skewness of data.

⇒ *Examination of the association between responses from questions B3, D1, E1, E2.*

- Spearmans rank correlation coefficient (*rho*) was used to identify correlations between ranked responses from questions B3, D1, E1, E2. (ordinal data).

⇒ *Quantitative analysis of responses to variables in questions B3,D1,E1,E2 and respondent demographics.*

- Median values were determined and tabulated for all of the variables of each of the questions stated above according to age groups, SEG's and male and female responses.

⇒ *Examination of the association between questions B3, D1, E1, E2 and respondent demographics.*

- Correlations between ranked data and age group / SEG group were identified using Spearmans rank correlation coefficients (*rho*), and differences between male and female ranked responses were identified using the Mann Whitney U test statistic (Z score).

4.4.6.5 Bonferroni correction.

As introduced in section 3.4.6.5, Bonferroni correction has been applied to alpha levels when making multiple comparisons to identify statistical associations. Results discussed in this chapter have included weaker correlations of note where Bonferroni correction has <u>not</u> been used (denoted as * for <0.05, and ** for <0.01) as well as stronger correlations where Bonferroni correction <u>has</u> been used (denoted as ◗ for <0.05, and ● for <0.01). Such symbols will be used in the text and in relevant tables.

4.5. RESULTS.

4.5.1. Introduction.

The response rate for the questionnaire to assess consumer attitudes and perceptions towards food safety education was 61%. This is considered to be particularly high for a postal questionnaire (Oppenheim, 1998). Likelihood of consumer response would have been increased due to previous personal contact with respondents, a supermarket voucher incentive for return of completed questionnaires, the inclusion of an SAE for return of the questionnaire and telephone and written reminders. Eighty three percent of respondents to this questionnaire were female and 17% were male, maintaining similar proportions of the male: female ratio outlined in section 3.5.1. Demographics of respondents for this questionnaire are found in Table 4.1.

Table 4.1 Demographics of respondents who answered the Food Safety Education Questionnaire.

Age groups	*n* (%) respondents.
16 -24	5 (8)
25 - 34	11 (18)
35 - 44	12 (20)
45 - 54	15 (25)
55 -64	8 (13)
65 +	10 (16)

SEG	*n* (%) respondents.
AB	15 (25)
C1	25 (41)
C2	13 (21)
DE	8 (13)

4.5.2 Consumer attitudes towards food safety information sources.

4.5.2.1 Quantitative analysis of overall scored attitude responses towards food safety information sources.

A summary of coded responses to attitude statements can be see in Table 4.2. In total 58 (95%) of respondents answered all attitude statements fully and these response were used for analysis of total and mean attitude scores. Total obtainable scores ranged from 27 to 135 and the minimum total score obtained was 44 and the maximum score obtained was 79. It can be seen in Table 4.2 that 79% of total attitude scores ranged from 55 to 74. Thus, 95% of respondents scores ranged from 2 to 3 (1=positive, 5=negative). Overall, the majority of mean consumer responses to food safety education were more positive than negative.

Table 4.2 Total attitude scores and mean attitude scores for all participants who answered all attitude statements (*n*=58).

Total attitude scores	*n* (%)
35	0
40	1 (2)
45	1 (2)
50	3 (5)
55	12 (20)
60	11 (20)
65	12 (20)
70	11(19)
75	7 (12)
80	0

Mean attitude scores	*n* (%)
1.00	0
1.50	3 (5)
2.00	31 (54)
2.50	24 (41)
3.00	0
3.50	0
4.00	0
4.50	0
5.00	0

4.5.2.2 Examination of associations between overall scored attitude responses and respondent demographics.

An assessment of the association between age groupings and SEG groups and median attitude values was made using Spearmans *rho* correlation coefficient (2-tailed) (*n*=61). Results showed there was no significant correlation (r=-0.132, $p>0.05$*) between age groupings and median attitude values. However, a positive significant correlation (r=0.346, $p<0.01$**) was identified between SEG groupings and median attitude values. This suggests that respondents from higher social classes (AB) are significantly associated with having a more positive attitude towards food safety education and respondents from lower social classes (DE) are correlated with having a more negative attitude. Use of a Mann Whitney test statistic identified no significant differences between male and female responses.

4.5.2.3 Analysis of scored responses to individual attitudes towards food safety information sources.

Mean scores and median values per attitude statement from this questionnaire are tabulated in Table 4.3. Mean scores ranged from 1.64 to 3.80 (1=positive response, 5=negative response). It can be seen that the most positive attitude (1.64) was towards the importance of TV chefs to implement all necessary food safety practices when preparing food on TV shows. The attitude that obtained the least positive response was regarding the respondents perception of confidence that their own current food preparation behaviours do not give rise to the risk of food poisoning. Based on previous research detailing consumers observed food preparation behaviours it was decided that a response representing confidence should be negatively scored. Such a decision was based on the surmise that very few consumers have been observed to implement all necessary food safety precautions and so perception that personal food preparation did not present risk of food poisoning may be inaccurate. Variance of responses to statements ranged from 0.56 to 1.46. The least variance to responses was based on the attitude towards the possible impact that information about the risks of inadequate food safety practices may have on food safety behaviours. The attitude statement regarding the need for food safety to be taught in schools resulted in the largest variance in responses.

Table 4.3 Mean and median attitude scores per attitude statement.

Attitude statement (food safety education).	*n*	Median value per statement	Mean attitude score per statement	SD▲
• It is important for TV chefs to carry out all necessary food safety practices when preparing food on television shows.	61	1	1.64	0.82
• I never carry out all the necessary food safety precautions that I know during food preparation.	60	2	1.72	0.67
• I am not prepared to listen or read any advice regarding food safety.	61	2	1.77	0.69
• I am willing to listen or read any information on food safety	61	2	1.82	0.59
• No information given to me is likely to change my food safety behaviour.	61	2	1.92	0.80
• I have never acted upon any food safety advice in the past	61	2	2.00	0.77
• I am likely to read food safety advice stated on food packaging.	61	2	2.07	0.75
• Information about the risks of inadequate food safety practices *may* change my current food preparation practices.	61	2	2.08	0.56
• I always carry out all the necessary food safety precautions that I know during food preparation.	61	2	2.10	0.81
• I am unlikely to act upon information given to me in the future concerning food safety.	61	2	2.11	0.78
• I am likely to pay no attention to food safety advice on food packaging.	61	2	2.16	0.93
• Information about the risks of inadequate food safety practices *will not* have any effect upon my current food preparation practices.	61	2	2.18	0.90
• Information regarding the consequences of inadequate food safety practices is likely to alter my food preparation behaviour.	61	2	2.28	0.73
• Information about the risks of inadequate food safety practices would *definitely* make me change my current food preparation practices.	61	2	2.33	0.72
• There is a need for food safety to be taught in schools.	61	2	2.39	1.46
• Hearing stories about cases of food poisoning will lead to improvements in my food safety behaviour.	60	2	2.45	0.85
• I do not need to be given any food safety advice.	59	2	2.64	0.96
• I do not like hearing the symptoms and medical details about food poisoning.	61	3	2.77	0.92
• I think I know all of the food safety precautions necessary for safe food preparation.	61	3	2.90	1.01
• I do not feel that enough food safety advice is available to me.	61	3	2.97	0.86
• Other people need for advice concerning food safety more than I do.	61	3	3.10	0.70
• My current food safety behaviours do not need improvement.	61	3	3.20	0.81
• Other people take more notice of food safety advice than I do.	61	3	3.41	0.94
• Personal experience of food poisoning has a greater chance of improving food safety behaviour than education.	60	4	3.33	1.04
• I sometimes carry out all the necessary food safety precautions that I know during food preparation.	61	4	3.74	0.87
• I am confident that my current food preparation behaviours do not give rise to a risk of food poisoning.	61	4	3.80	0.75

▲SD = Standard deviation

4.5.2.4. Summary of main findings: consumer attitudes towards food safety information sources.

It was noted that few respondents in this section of the questionnaire held strong attitudes towards aspects of food safety education. The majority of responses given were 'agree' or 'disagree'. In addition to this, a substantial proportion of respondents (up to 60%) held neutral attitudes towards issues under investigation. Indeed, for responses to six statements, the majority of respondents neither agreed nor disagreed with the statements. Results are tabulated in Table 4.4.

- The majority of respondents were confident that their current food preparation behaviours do not give rise to the risk of food poisoning, yet nearly a fifth of respondents indicated they do not always carry out all of the necessary food safety precautions they know during food preparation.
- The sample was evenly split as to whether they knew all of the food safety precautions necessary for safe food preparation and more than half respondents indicated the need for improvement of their current food safety behaviours.
- A large proportion of respondents indicated they did need to be given food safety advice and the sample was largely undecided as to whether enough information is available to them.
- The majority of respondents indicated they are willing to listen or read any advice about food safety and a similar proportion of respondents (87%) indicated that information given to them is likely to change their food safety behaviours.
- Marginally more respondents (69%) indicated that information about the consequences of inadequate food safety behaviours is likely to change their food preparation behaviour than information detailing the risks of inadequate food safety practice (62%). A further 21% indicated that information about risks of inadequate food safety practices *may* change current behaviours.
- The majority of attitude responses regarding other peoples need for food safety advice and attention to food safety advice (when compared to self) were largely neutral. However, tendencies were towards agreement that others are in need more food safety advice, and others do not take as much of notice of food safety advice than they do themselves.
- Between 79-82% of respondents were likely to pay attention to food safety advice stated on food packaging.
- More than half respondents indicated that personal experience and hearing stories about cases of food poisoning is likely to improve their food safety behaviours. However, 23% of the sample stated they did not like to hear the symptoms and medical details about food poisoning.
- Three quarters of respondents thought they were more likely to take notice of messages about specific food safety behaviours opposed to generalised messages.

Table 4.4 Attitudes towards food hygiene information sources.

Attitude statement.	*n*	Strongly Agree *n* (%)	Agree *n* (%)	Neither Agree or Disagree *n* (%)	Disagree *n* (%)	Strongly Disagree *n* (%)
• I am confident that my current food preparation behaviours do not give rise to a risk of food poisoning.	*61*	8 (13)	37 (61)	12 (20)	4 (6)	0
• I think I know all of the food safety precautions necessary for safe food preparation.	*61*	2 (3)	21 (35)	12 (20)	24 (39)	2 (3)
• My current food safety behaviours do not need improvement.	*61*	4 (6)	15 (25)	31 (51)	11 (18)	0
• I do not need to be given any food safety advice.	*59*	1 (2)	14 (24)	10 (17)	31 (52)	3 (5)
• I do not feel that enough food safety advice is available to me.	*61*	1 (2)	19 (31)	23 (37)	17 (28)	1 (2)
• I am willing to listen or read any information on food safety.	*61*	17 (28)	38 (62)	6 (10)	0	0
• I am not prepared to listen or read any advice regarding food safety.	*61*	2 (3)	3 (5)	35 (57)	21 (35)	0
• I am unlikely to act upon information given to me in the future concerning food safety.	*61*	0	5 (8)	7 (12)	39 (64)	10 (16)
• No information given to me is likely to change my food safety behaviour.	*61*	1 (2)	2 (3)	5 (8)	36 (59)	17 (28)
• I have never acted upon any food safety advice in the past.	*61*	0	5 (8)	3 (5)	40 (66)	13 (21)
• I always carry out all the necessary food safety precautions that I know during food preparation.	*61*	11 (18)	38 (62)	8 (13)	3 (5)	1 (2)
• I sometimes carry out all the necessary food safety precautions that I know during food preparation.	*61*	8 (13)	38 (62)	6 (10)	9 (15)	0
• I never carry out all the necessary food safety precautions that I know during food preparation.	*60*	0	2 (3)	1 (2)	35 (58)	22 (37)
• Information about the risks of inadequate food safety practices would *definitely* make me change my current food preparation practices.	*61*	6 (10)	32 (52)	20 (33)	3 (5)	0
• Information about the risks of inadequate food safety practices *may* change my current food preparation practices.	*61*	6 (10)	45 (73)	9 (15)	1 (2)	0
• Information about the risks of inadequate food safety practices *will not* have any effect upon my current food preparation practices.	*61*	1 (2)	5 (8)	10 (16)	33 (54)	12 (20)
• Information regarding the consequences of inadequate food safety practices is likely to alter my food preparation behaviour.	*61*	6 (10)	36 (59)	15 (25)	4 (6)	0

Table 4.4 Attitudes towards food hygiene information sources (continued).

Attitude statement.	*n*	Strongly Agree *n* (%)	Agree *n* (%)	Neither Agree or Disagree *n* (%)	Disagree *n* (%)	Strongly Disagree *n* (%)
• Other people need advice concerning food safety more than I do.	*61*	1 (2)	14 (23)	37 (60)	8 (13)	1 (2)
• Other people take more notice of food safety advice than I do.	*61*	2 (3)	5 (8)	28 (46)	18 (30)	8 (13)
• I am likely to pay no attention to food safety advice on food packaging.	*61*	1 (2)	7 (11)	5 (8)	36 (59)	12 (20)
• I am likely to read food safety advice stated on food packaging.	*61*	11 (18)	39 (64)	7 (12)	4 (6)	0
• Hearing stories about cases of food poisoning will lead to improvements in my food safety behaviour.	*60*	8 (14)	23 (38)	23 (38)	6 (10)	0
• I do not like hearing the symptoms and medical details about food poisoning.	*61*	1 (2)	13 (21)	22 (36)	21 (34)	4 (7)
• Personal experience of food poisoning has a greater chance of improving food safety behaviour than education.	*60*	6 (10)	25 (42)	14 (23)	13 (22)	2 (3)
• There is a need for food safety to be taught in schools.	*61*	21 (34)	21 (34)	3 (5)	6 (10)	10 (17)
• It is important for TV chefs to carry out all necessary food safety practices when preparing food on television shows.	*61*	32 (53)	21 (34)	7 (11)	0	1 (2)
• I am more likely to take notice of messages about specific food safety behaviours than generalised messages.	*61*	5 (8)	41 (68)	13 (21)	2 (3)	0

4.5.2.5. Identification of associations between individual attitude responses.

Tabulated correlations between attitude responses can be found in Appendix 4.3. A total of 23 Spearmans *rho* correlations were determined ($p<0.05^{\bullet}$), the majority of which reaffirmed the reliability of data collected in this particular section of this questionnaire. The strongest correlation ($r=0.701$, $p<0.05^{\bullet}$) was positive and determined between two statements denoting the impact of food safety information upon food safety behaviours.

Positive Spearmans *rho* correlation coefficients were determined between responses to statements indicating the likelihood of acting upon food safety information in the past and the likelihood of acting upon information in the future. In addition, perceived adequacy of current food preparation behaviours was significantly associated ($r=0.546$, $p<0.05^{\bullet}$) with perceived knowledge all of the food safety precautions required for safe food preparation. Thus, perception that current food preparation behaviours do not need improvement was associated with reported knowledge of all of the necessary food safety precautions required for safe food preparation. Conversely, an attitude indicating current food safety behaviours do need improvement was associated with a lack of appropriate knowledge. Confidence that food safety behaviours do not present a risk of food poisoning was found to be significantly associated ($r=0.541$, $p<0.05^{\bullet}$) with the belief that all of the necessary food preparation behaviours are implemented during food preparation. On the other hand, lack of confidence that food safety behaviours do not present a risk of food poisoning was associated with the belief that all food safety behaviours known were not implemented at all times.

Further correlations were identified between the likelihood of others taking notice of food safety information and willingness to listen or read any advice regarding food safety. Agreement that others take more notice of food safety information than oneself was positively correlated ($r=0.527$, $p<0.05^{\bullet}$) with not personally being prepared to listen or read any advice regarding food safety. On the other hand, when others are perceived to take less notice of information than oneself, there is an association with personal willingness to listen and read any food safety advice.

4.5.2.6. Associations between attitude responses to food safety information sources and respondent demographics.

To aid development of informed placement strategies for food safety education interventions, differences between attitudinal responses and demographics of the respondent sample have been investigated. Findings are found in Table 4.5.

No correlations were determined between age groups and attitudes towards food safety information sources. However, 22% of attitude statements were correlated with SEG. All such correlations identified were negative. The strongest of these correlations ($r=-0.422$, $p<0.05^{\bullet}$) suggested that as SEG decreased, agreement with the attitude 'information about the risks of inadequate food safety practices *will not* have any effect upon my current food preparation practices' increased. Therefore, respondents from SEG 'AB' indicated that information about the risks of food safety practices will have an effect upon current food preparation behaviours, and respondents from SEG 'DE' indicated the contrary.

A correlation ($r=-0.278$, $p<0.05$*) was identified between SEG and the statement 'I do not like hearing the symptoms and medical details about food poisoning'. Findings suggested that respondents from SEG 'AB' did not mind to hear about the symptoms and medical details about food poisoning, whereas, respondents from SEG 'DE' were associated with not liking to hear such details.

Further associations were made between the likelihood of acting upon food safety information and SEG. Negative associations suggested that respondents from SEG 'AB' were likely to act upon food safety information in the future and respondents from SEG 'DE' were not. In addition to this, a negative association ($r=-0.345$, $p<0.01^{\bullet}$) between SEG and the attitude statement 'I have never acted upon food safety information in the past'. Thus, consumers from SEG 'AB' indicated they have acted upon food safety information in the past, and consumers from SEG 'DE' had not.

Significant differences between male and female responses occurred for 9% of the attitude statements present in this questionnaire. Z scores ranged from –1.98 to –2.41 indicating that differences between the two samples were not that big. Actual proportions of male and female responses to statements where differences were detected can be seen in Table 4.6. A significant difference in responses for male and female respondents was identified for perception of knowledge of all of the food safety precautions necessary for safe food preparation ($Z=-1.981$, $p<0.05$*). It appears that a large proportion of males (70%) than females (37%) disagreed with the statement, thus indicating that males perceive themselves not to know all food safety practices required for safe food preparation. In contrast, 43% of females and only 10% of males thought they did know sufficient food safety precautions for safe food preparation. The second statement where significant differences ($Z=-2.410$, $p<0.05$*) were identified between male and female responses was regarding perception of availability of food safety advice. More males (70%) considered that insufficient food safety advice is available than females (26%).

Table 4.5 Statistical differences between male / female respondents, different age groups, SEGs and attitudes towards food safety education.

[1] Comparisons of male and female responses using the Mann Whitney U test statistic.

[2] Correlations identified between age / SEG and attitude responses using Spearmans *rho* correlation coefficient.

Attitude statement	M/F[1]	Age[2]	SEG[2]
• I am confident that my current food preparation behaviours do not give rise to a risk of food poisoning.	-	-	-
• I think I know all of the food safety precautions necessary for safe food preparation.	Z=-1.981*	-	-
• My current food safety behaviours do not need improvement.	-	-	-
• I do not need to be given any food safety advice.	-	-	-
• I do not feel that enough food safety advice is available to me.	Z=-2.410*		
• I am willing to listen or read any information on food safety	-	-	-
• I am not prepared to listen or read any advice regarding food safety.	-	-	-
• I am unlikely to act upon information given to me in the future concerning food safety.	-	-	r=-0.329**
• No information given to me is likely to change my food safety behaviour.	-	-	r =-0.359**
• I have never acted upon any food safety advice in the past	-	-	r =-0.345**
• I always carry out all the necessary food safety precautions that I know during food preparation.	-	-	-
• I sometimes carry out all the necessary food safety precautions that I know during food preparation.	-	-	-
• I never carry out all the necessary food safety precautions that I know during food preparation.	-	-	-
• Information about the risks of inadequate food safety practices would *definitely* make me change my current food preparation practices.	-	-	-
• Information about the risks of inadequate food safety practices *may* change my current food preparation practices.	-	-	-
• Information about the risks of inadequate food safety practices *will not* have any effect upon my current food preparation practices.	-	-	r =-0.422**▸
• Information regarding the consequences of inadequate food safety practices is likely to alter my food preparation behaviour.	-	-	-
• Other people need for advice concerning food safety more than I do.	-	-	-
• Other people take more notice of food safety advice than I do.	-	-	-
• I am likely to pay no attention to food safety advice on food packaging.	-	-	-
• I am likely to read food safety advice stated on food packaging.	-	-	-
• Hearing stories about cases of food poisoning will lead to improvements in my food safety behaviour.	-	-	-
• I do not like hearing the symptoms and medical details about food poisoning.	-	-	r =-0.278*
• Personal experience of food poisoning has a greater chance of improving food safety behaviour than education.	-	-	-
• There is a need for food safety to be taught in schools.	-	-	-
• It is important for TV chefs to carry out all necessary food safety practices when preparing food on television shows.	-	-	-

*p<0.05 (significant with Bonferroni correction see ▸)

**p<0.01 (with Bonferroni correction see●)

'-' no association / relationship determined

Table 4.6 Attitudes towards food safety information sources where statistically significant differences between male and female respondents have been identified using the Mann Whitney U test statistic.

Attitude statement.	Level of agreement / disagreement.	Male % total no. of respondents (10 respondents sampled)	Female % total no. of respondents (51 respondents sampled)
I think I know all of the food safety precautions necessary for safe food preparation.	Strongly agree / agree	10	43
	Neither	20	20
	†Strongly disagree / disagree	70	37
I do not feel that enough food safety advice is available to me.	†Strongly agree / agree	70	26
	Neither	20	41
	Strongly disagree / disagree	10	33

†=positive response.

4.5.3 Leaflets as a source of food safety information.

4.5.3.1 Quantitative analysis of responses denoting receipt of food safety leaflets though the post and picking such leaflets up outside from the home.

A common source of dissemination of consumer food safety information is by distribution of leaflets. Distribution can occur through placing leaflets in public places (shops, medical locations, schools etc.) to be voluntarily picked up by consumers, placed in magazines or newspapers or posted through the door. Fifty two percent of respondents of all ages and SEG indicated that they do pick leaflets up and only 10% of respondents stated that they had previously received a food safety leaflet posted through their door. Many respondents reported that they are likely to read the leaflets that they have picked up. Of the respondents who indicated that they do pick leaflets up 58% reported themselves extremely likely / likely to read the leaflet. The remaining ranked responses ranged from 4 to 6 (1=extremely likely, 10=extremely unlikely), and no respondents who reported themselves likely pick a leaflet up indicated that they were unlikely to read it.

4.5.3.2 Examination of the association between the likelihood of reading a food safety leaflet and respondent demographics.

No significant differences in the likelihood of male or female respondents to read a leaflet were identified (using the Mann Whitney U test statistic), and no Spearmans *rho* correlations between age or SEG and likelihood of reading a leaflet were determined.

4.5.3.3 Quantitative analysis denoting likelihood of picking food safety leaflets up from different locations.

Data in Table 4.7 indicates consumer perceptions of likely locations where leaflets may be picked up. It can be seen that the most likely locations for picking leaflets up are the supermarket and in magazines and newspapers. Least likely locations included schools and colleges and Environmental Health departments. The majority of median ranked values ranged from 4 to 5, indicating that likelihood of picking leaflets up from all locations was relatively weak.

Table 4.7 Likely locations for picking food safety leaflets up.

		1 = Extremely likely, 10 = Extremely unlikely				
	n	Proportion of respondents who stated values 1 to 3 *n* (%)	Proportion of respondents who stated values 8 to 10 *n* (%)	Mean ranked value	**Median ranked value**	
Supermarket	*60*	26 (43)	8 (13)	4.28	**4**	Most likely
Magazines / newspapers	*61*	23 (38)	12 (20)	4.66	**4**	
Doctors surgery / clinic	*60*	16 (26)	17 (28)	5.16	**5**	
Dentist	*59*	14 (23)	18 (30)	5.62	**5**	
Library	*59*	11 (18)	23 (38)	5.97	**5**	
Environmental Health Dept.	*60*	23 (37)	32 (53)	6.57	**8**	
Schools / colleges	*59*	10 (16)	32 (53)	6.72	**8**	Least likely

4.5.3.4 Examination of the association between likely locations to pick food safety leaflets up.

The use of Spearmans *rho* identified numerous significant correlations between likely locations where food safety leaflets may be picked up. Such information can be found in Appendix 4.4 and could be used during the planning for the placement of intervention materials such as leaflets to maximise reach and potential effectiveness.

4.5.3.5 Examination of the association between likely locations to pick food safety leaflets up and respondent demographics.

Data in Table 4.8 illustrates the median ranked values rated from respondents from males and females and from different SEG and age groups. Such information may aid placement strategies for the targeting of specific intervention materials in future food safety education initiatives. Results show that overall more median values were ranked between 8-10 (indicating extremely unlikely to unlikely) opposed to between 1-3 (extremely likely to likely). It can be seen that consumers who were more likely to pick up a food safety leaflet in a supermarket were those aged 45-54, SEG 'AB' or 'DE'. Older respondents (aged 45-65+ years) were unlikely to pick up food safety leaflets from a school or college and more likely to pick them up from magazines, the doctors surgery or the dentist.

Table 4.8 Locations where respondents may be likely to pick up food safety leaflets according to respondent demographics (*n*=61) (1 = extremely likely, 10 = extremely unlikely).

	Median ranked values.											
	Age groups.						SEG groups.				Male (M), Female (F).	
Locations.	16-24	25-34	35-44	45-54	55-64	65+	AB	C1	C2	DE	M	F
Supermarket.	4	5	4	3	3.5	4.5	3	5	4	2	4	4
Magazines / newspapers.	4	5	4	3	4	3.5	4	4	5	4	4	4
Doctors surgery / clinic.	4	5	4	8	4	3.5	4	5	4	4	5	4
Dentist.	5	5	5	7	6	3.5	4	5	7	4.5	6	5
Library .	9	10	5	5	6.5	4.5	5	6	6	4.5	6	5
Environmental Health Dept.	4	7	9	9	6	8.5	8	6	7	6	6.5	8
Schools / colleges.	4	9	5	8	9	9.5	8	8	9	5	6	8

NB: Light grey = median ranked values between 1 and 3 (extremely likely to likely); Dark grey = median ranked values between 8 and 10 (extremely unlikely to unlikely).

A Spearmans *rho* correlation was undertaken to determine any significant associations between age group / SEG and likely location for picking a food safety leaflet up. Results showed no correlations between SEG and location, however a weak negative correlation ($r=-0.297$, $p<0.05$*) was determined between age and likelihood of picking a food safety leaflet up from a library. Older respondents were more likely to pick a leaflet up in a library and younger respondents significantly less likely. No relationship (using Mann Whitney test statistic) was determined between responses for male and female respondents.

4.5.4 Television documentaries and cookery programmes as sources for food safety information.

4.5.4.1 Quantitative analysis of responses denoting TV documentaries and cookery programmes as sources for food safety information.

Perception of television as a source for dissemination of food safety education advice has been investigated. Ninety seven percent of respondents have stated that they previously watched television cookery programmes. Results have shown that 20% of consumers indicated that they watched between 1 and 3 of the listed TV cookery programmes, 41% watched between 4 and 6, 30% watched between 7 and 9, and 6%

watched between 10 and 12. Ninety one percent of respondents stated that they thought that TV chefs should demonstrate good food safety practices and 88% of respondents considered that food safety behaviours of TV chefs were 'good' or 'average', 8% thought they were 'excellent' and 3% thought practices were 'poor'. Forty-four percent of respondents thought they did pick up good food safety habits from TV cookery programmes.

Thirty three percent of respondents stated that they had previously watched a television documentary about food safety issues, however, the majority of these respondents could not recall the name of the documentary. Data in Table 4.9 indicates respondent perceptions of likelihood of watching a TV documentary about food safety and TV cookery programmes. Data shows that a marginally larger proportion of consumers (63%) are extremely likely / likely to watch a TV cookery programme than watch a documentary on food safety (52%).

Table 4.9 Likelihood of watching a food safety TV documentary and TV cookery programmes (*n*=61).

Likelihood.	Likelihood of watching a television cookery programmes *n* (%).	Likelihood of watching a television documentary on food safety *n* (%).
Extremely likely.	20 (33)	5 (13)
Likely.	18 (30)	24 (39)
Neither likely nor unlikely.	13 (21)	18 (30)
Unlikely.	8 (13)	8 (13)
Extremely unlikely.	2 (3)	3 (5)

4.5.4.2 Examination of the association between the likelihood of watching TV cookery programmes and TV documentaries about food safety.

A significant correlation (r= 0.493, p<0.01●) was determined between the likelihood of watching both types of television programmes. Respondents who were likely or extremely likely to watch TV cookery programmes were also likely or extremely likely to watch TV documentaries about food safety. Conversely, those who were unlikely to watch cookery programmes were also unlikely to watch documentaries about food safety.

4.5.4.3 Examination of the association between the likelihood of watching TV cookery programmes / TV documentaries about food safety and respondent demographics.

Using Spearmans *rho* no correlations were identified between age group / SEG and the likelihood of watching a TV documentary and / or TV cookery programme. Using Mann Whitney U, no differences were identified between male and female responses.

4.5.5 Preferred sources of food safety information.

4.5.5.1 Quantitative analysis of responses denoting exposure to food safety information sources.

To determine what food safety information sources the sampled population was familiar with and had been exposed to, respondents were asked what food safety information sources they had seen in the six months previous to questionnaire administration. Results are presented in Appendix 4.5. It is apparent that the most frequently seen food safety information source was food packaging, followed by magazine articles and TV cookery programmes. Sources 'seen' by the least numbers of respondents included information from universities, posters, magnets and t-towels. Analysis of these findings showed that 15% respondents had seen none of the listed sources of food safety information, 25% had seen 1-2 sources, 41% had seen 3-4 sources, 16% had seen 5-6 sources and 3% had seen 7-8 sources.

4.5.5.2 Quantitative analysis of responses denoting preferred sources of food safety information.

Preferred sources of food safety information have been determined and results can be seen in Table 4.10. The most preferred sources of food safety information ranked were food packaging and advice from doctor or health visitor or equivalent. In both cases 64% of the sample ranked such sources as between 1-3, and only 2% of the sample ranked them as between 8-10 (1= most preferable source and 10= least preferable source). Other sources that were ranked as positive sources of food safety information included leaflets, TV documentaries, recipes and TV cookery programmes. For such sources more than half of the sample (52-54%) ranked values between 1-3 to indicate more preferable sources. The least preferred sources (by 39-43% of repondents) were gimmicks such as fridge magnets and t-towels.

4.5.5.3 Examination of the association between preferred sources of food safety information.

To aid effectual placement of food safety interventions, ranked preferences of listed information sources have been correlated with each other (see Appendix 4.6). Results have shown nine positive Spearmans *rho* correlation coefficients where $p<0.01^{\bullet}$). Thus, preference for one food safety information source is correlated with another preferred source. The strongest of the correlations was determined between preference of fridge magnets and t-towels as sources for food safety advice, giving a correlation coefficient of 0.910 ($p<0.01^{\bullet}$). Another particularly strong correlation of interest includes ranked preference for advice from 'the family' with advice from 'friends' ($r=0.811$, $p<0.01^{\bullet}$). Additional correlations that have been identified can be found in Appendix 4.5.

Table 4.10 Preference for receiving food safety information from different sources.

Source of information.	*n*	1 = Most preferable source, 10 = Least preferable source. Proportion of respondents who stated values 1 to 3 *n* (%).	Proportion of respondents who stated values 8 to 10 *n* (%).	Mean ranked Value.	**Median ranked value.**	
Food packaging.	*61*	39 (64)	1 (2)	3.03	**3**	Most preferable source
Advice from doctor / health visitor or equivalent.	*61*	39 (64)	1 (2)	3.05	**3**	
Leaflet.	*60*	33 (54)	3 (5)	3.38	**3**	
TV documentaries.	*61*	33 (54)	6 (10)	3.56	**3**	
Recipes.	*61*	33 (54)	3 (5)	3.70	**3**	
TV cookery programmes.	*61*	32 (52)	5 (8)	3.90	**3**	
Magazine articles.	*61*	29 (48)	6 (10)	3.95	**4**	
Posters with food safety information.	*61*	29 (46)	6 (10)	4.08	**4**	
TV other (e.g. morning television, news programmes).	*59*	25 (41)	10 (16)	4.25	**4**	
Radio progammes.	*59*	25 (41)	12 (20)	4.41	**4**	
Advice from family.	*61*	22 (36)	7 (11)	4.59	**5**	
Advice from friends.	*61*	16 (26)	7 (11)	4.80	**5**	
Advice from schools/ colleges.	*59*	24 (39)	14 (23)	4.85	**5**	
Fridge magnets with food safety information.	*61*	13 (21)	24 (39)	6.28	**6**	Least preferable source
T'towels.	*61*	10 (16)	26 (43)	6.64	**7**	

4.5.5.4 Examination of the association between preferred sources of food safety information and respondent demographics.

To determine preferred information sources for male and female respondents, different age groups and SEG ranked median values for each information source have been tabulated in Table 4.11. It is apparent that overall, positive responses were given to many of the information sources. Using Spearmans *rho*, weak positive correlations were determined between preferable sources of food safety information and SEG and age groupings. The association between SEG and radio programmes ($r=0.261$, $p<0.05$*) indicated that respondents from SEG 'AB' preferred receiving food safety information from radio programmes, whereas respondents from SEG 'DE' considered radio programmes to be an unpreferable source of food safety information. Positive correlations between age groups and fridge magnets ($r=0.309$, $p<0.05$*) and t-towels ($r=0.290$, $p<0.05$*) were determined. Results indicated that respondents of lower age groups considered fridge magnets and t-towels were a preferable source of food safety information, whereas older respondents significantly considered the contrary. Using Mann Whitney U test statistic no significant relationship was determined between male and female responses.

Table 4.11 Preferable sources of food safety information according to respondent demographics (*n*=61) (1= most preferable source, 10= least preferable source).

	Median ranked values											
	Age groups						SEG groups				Male (M), Female (F)	
	16-24	25-34	35-44	45-54	55-64	65+	AB	C1	C2	DE	M	F
Food packaging.	2	3	3.5	2	2	1.5	3	2	2	3.5	2.5	3
Advice: doctor / health.	5	3	2.5	2	3	2.5	2	3	2	2.5	3.5	3
Leaflet.	3	5	3	2	3.5	5	3	3	2	5	4	3
TV documentaries.	2	4	2	3	4	3	3	3	3	4	4	3
Recipes.	3	3	3.5	4	3	3	4	3	3	4	4	3
TV Cooking programmes.	3	3	2.5	3	3.5	5	4	4	3	4	4	3
Magazine articles.	2	4	3.5	3	4	4.5	4	3	4	4	4.5	4
Posters.	3	5	3	4	3	5	3	5	3	4	4	4
TV (Other).	4	3	3	5	4	4	4	4	3	5	3	4
Radio programmes.	4	7	4	3	3	4	3	4	5	4.5	4	4
Advice: family.	3	5	4	5	4	5	5	4	4	5	4	5
Advice: schools / colleges.	3	5	3	5	3.5	5.5	4	5	3	5	5	5
Advice: friends.	3	5	5	4	5	5	5	4	5	5	4	5
Fridge magnets.	5	5	5.5	7	4.5	9	6	5	5	8	5	6
T-towels .	5	6	6.5	8	4.5	9	8	7	5	8	5	7

NB: Light grey = median ranked values between 1 and 3 (most preferable), Dark grey = median ranked values between 8 and 10 (least preferable).

4.5.6. Credibility and trust of food safety information provided from different organisations.

4.5.6.1. Quantitative analysis of perceptions of credibility / trust of food safety information provided from different organisations

Analysis of data indicating consumer perceptions of credibility and trustworthiness of different organisations that promote food safety advice can be seen in Table 4.12. Overall, on a scale of 1-10 (1= most trustworthy / credible organisation, 10=least trustworthy / credible organisation) results have shown that consumers generally have a positive perception of listed organisations in terms of trustworthiness and credibility. It can be seen that Environmental Health Departments and the Food Standards Agency have been perceived as the most trustworthy organisations that provide credible information. On the other hand information provided from government authorities and supermarkets have been ranked as least trustworthy, providing less credible information.

Table 4.12 Credibility / trustworthiness of different organisations who provide food safety information.

		1 = Most trustworthy / credible organisation, 10 = Least trustworthy / credible organisation.				
	n	Proportion of respondents who stated values 1 to 3 *n* (%)	Proportion of respondents who stated values 8 to 10 *n* (%)	Mean ranked value	**Median ranked value**	
Environmental Health Departments.	*61*	44 (72)	2 (3)	2.77	**2**	Most trustworthy organisation
Food Standards Agency.	*61*	41 (67)	0	2.79	**2**	
Health Education Authority.	*61*	43 (70)	2 (3)	2.77	**3**	
Health Promotion Units.	*60*	36 (59)	1 (2)	3.20	**3**	
Medical Council.	*61*	38 (62)	3 (4)	3.36	**3**	
Product Specific Advisory Councils (e.g. Dairy Council).	*61*	26 (43)	7 (11)	4.26	**4**	
Commercial Advisory Councils (e.g. Domestos).	*60*	18 (30)	6 (10)	4.31	**4**	
Food and Drink Federation.	*60*	20 (33)	6 (10)	4.33	**4**	
Supermarkets.	*60*	20 (5)	5 (8)	4.33	**5**	Least trustworthy organisation
Government authorities.	*59*	16 (26)	7 (11)	4.49	**5**	

4.5.6.2. Examination of associations between perceptions of credibility / trust of food safety information provided from different organisations.

Correlations between ranked credibility / trustworthiness of listed organisations can be found in Appendix 4.7. In total 29 Spearmans *rho* correlation coefficients were determined at $0.01^{\bullet}$ level between organisations perceived to be trustworthy and provide credible information. The most significant correlation was determined between Environmental Health Departments and the FSA (r=0.738, $p<0.01^{\bullet}$). Information provided in Appendix 4.6 can be used to determine potential partnerships for dissemination of food safety information.

4.5.6.3. Examination of associations between perceived credibility / trustworthiness of food safety information provided from different organisations and respondent demographics.

Data presented in Table 4.13 show median values indicating perceived trustworthiness / credibility associated with male and female responses and different age groups and SEG's. Using the Mann Whitney U test statistic, no relationship was determined between responses from male and female respondents and no significant Spearmans *rho* correlations were determined between age and perception of trustworthiness of the listed organisations. One negative correlation was determined (r=-0.291, $p<0.05$*) between SEG and commercial advisory councils. Respondents from SEG 'AB' did not consider food safety information from this source to be trustworthy or credible, whereas respondents from SEG 'DE' ranked this information source with increased level of credibility.

Table 4.13 Perceptions of organisations in terms of trustworthiness and credibility of providing food safety information according to respondent demographics (*n*=61) (1=most trustworthy / credible organisation, 10= least credible / trustworthy organisation).

	Median ranked values.											
	Age groups.						SEG groups.				Male (M), Female (F).	
Organisation.	16-24	25-34	35-44	45-54	55-64	65+	AB	C1	C2	DE	M	F
Environmental Health Departments	2	2	2	2	3.5	2.5	2	2	3	2.5	3	2
Food Standards Agency.	2	2	3	3	2.5	2	2	2	3	3.5	2	2
Health Education Authority.	2	3	3	2	3	3	3	3	2	3	3	2
Health Promotion Units.	3	3	3	3	3.5	2	3	4	2	3.5	3.5	3
Medical Council.	3	3	3	2	3.5	2.5	3	3	3	4	3	3
Product Specific Advisory Councils.	5	4	5	4	4.5	3	4	3	4	5	4.5	4
Commercial Hygiene Advisory Councils.	4	5	4	5	4.5	3.5	5	4	3	4	4	4
Food and Drink Federation.	4	4	5	5	4	4.5	4	5	4	4.5	5.5	4
Supermarkets.	5	5	4	4	3.5	5	4	5	5	4	5	4
Government authorities.	5	4	4	4	4.5	5	4	5	5	5	4.5	5

NB: Light grey = median ranked values between 1 and 3 (Most trustworthy / credible organisation); Dark grey = median ranked values between 8 and 10 (Least trustworthy / credible organisation).

4.5.7 Likelihood of believing food safety information from different spokespersons.

4.5.7.1 Quantitative analysis of responses denoting likelihood of believing food safety information from different spokespersons.

Food safety information can be presented by a variety of spokespersons. Perceptions of trust may influence the likelihood of believing the message(s) such spokespersons may be delivering. Therefore, perceptions of the likelihood of believing different spokespersons have been determined and findings are presented in Table 4.14. The most likely spokesperson be believed by the sample was an Environmental Health Officer (EHO), followed by the Chief Medical Officer (CMO) and a medical doctor. More than three quarters of respondents ranked values 1 to 3 (1= extremely likely to believe, 10= extremely unlikely to believe) for believing information delivered by an EHO and 70% of respondents ranked likelihood of believing a CMO at an equivalent level. Spokespersons that are least likely to be believed included politicians and TV personalities.

Table 4.14 Determination of the likelihood of respondents believing a variety of spokespersons to promote food safety information.

Spokesperson.	*n*	1 = Extremely likely to believe, 10 = Extremely unlikely to believe. Proportion of respondents who stated values 1 to 3 *n* (%).	Proportion of respondents who stated values 8 to 10 *n* (%).	Mean ranked Value.	**Median ranked value.**	
Environmental Health Officer.	*61*	47 (77)	0	2.33	**2**	Most likely to believe
Chief Medical Officer.	*61*	43 (70)	3 (5)	3.00	**3**	
Medical doctor.	*61*	36 (59)	0	3.15	**3**	
Health educator.	*61*	35 (57)	3 (5)	3.25	**3**	
Scientist.	*61*	35 (57)	4 (7)	3.44	**3**	
Health visitor.	*61*	32 (52)	1 (2)	3.54	**3**	
Nurse.	*60*	34 (56)	3 (5)	3.77	**3**	
TV chef.	*60*	25 (41)	2 (3)	3.97	**4**	
Midwife.	*60*	37 (44)	4 (6)	4.00	**4**	
School teacher.	*59*	24 (39)	4 (7)	4.07	**4**	
News reader.	*59*	13 (21)	14 (23)	5.30	**5**	
Shop assistant / manager.	*61*	9 (15)	14 (23)	5.77	**5**	
Farmer.	*61*	10 (16)	14 (23)	5.87	**6**	
TV personality.	*59*	5 (8)	16 (26)	6.11	**6**	Least likely to believe
Politician.	*61*	3 (5)	30 (49)	7.13	**7**	

4.5.7.2 Examination of the associations between responses denoting likelihood of believing food safety information from different spokespersons.

Spearmans *rho* correlations between the likelihood of believing the listed spokespersons have resulted in 40 positive correlation coefficients where $p<0.01^{\bullet}$ (see Appendix 4.8). The most significant correlation determined ($r=0.761$, $p<0.01^{\bullet}$) was between the likelihood of believing information presented by and EHO and CMO.

4.5.7.3 Examination of the associations between responses denoting likelihood of believing food safety information from different spokespersons and respondent demographics.

Median values of responses for male and female respondents and respondents from different age groups and SEG's can be found in Table 4.15. Data indicates that more positive responses were obtained than negative responses indicating that consumers are more likely to believe the listed spokespersons in general rather than not. However, it can be noted that median values for both male and female respondents, and respondents from all SEG's and age groups were ranked between 1-3 (1= extremely likely to believe, 10= extremely unlikely to believe). Ranked median values for females appeared to be slightly lower than for males, suggesting that females are more likely to believe food safety information than males. Negative responses were particularly apparent for respondents from lower social classes (C2, DE) and respondents from age groups 25-34, 45-54 and 65+. Such responses were related to the likelihood to believe food safety information delivered by a politician. Respondents aged 65+ also indicated that they would be more unlikely to believe information promoted by a TV personality.

Table 4.15 Likelihood of believing listed spokespersons according to respondent demographics (*n*=61) (1 = extremely likely to believe, 10 = extremely unlikely to believe).

	Median ranked values.											
	Age groups.						SEG groups.				Male (M), Female (F).	
Spokesperson.	16-24	25-34	35-44	45-54	55-64	65+	AB	C1	C2	DE	M	F
Environmental Health Officer.	1	3	2.5	1	2.5	2	1	2	2	2	3	2
Chief Medical Officer.	2	3	3	3	3	2	2	3	3	3	3	2
Medical doctor.	3	3	3	3	4	2	2	4	3	3.5	3.5	2
Health Educator.	3	3	3.5	3	2.5	2.5	2	3	3	3.5	3.5	3
Scientist.	2	4	3	3	3.5	3	2	3	3	4.5	4	3
Health visitor.	3	3	4	3	3.5	4	3	4	3	5.5	3.5	3
Nurse.	3	3	3	4	3	5	3	4	2	5	4	3
Television Chef.	3	5	4	3	4	4	4	4	4	4	4	4
Midwife.	3	3	4	4	4	3.5	3	4	3	5	4	4
Teacher / lecturer.	3	4	3.5	3	4.5	5	3	4	4	5	5	4
Newsreader.	6	5	4	5	3.5	6	5	5	5	5	6	5
Shop assistant / manager.	5	7	5	5	7	7	6	5	5	5	5.5	5
Farmer.	7	6	5.5	5	5	7	6	5	6	5	7	5
Familiar TV personality.	7	5	5	7	5	8	6	7	5	5	7	6
Politician.	5	8	5.5	8	7.5	9	7	7	9	8	7.5	7

NB: Light grey = median ranked values between 1 and 3 (extremely likely to be believed); Dark grey = median ranked values between 8 and 10 (extremely unlikely to be believed).

No correlations using Spearmans *rho* were identified between ranked likelihood to believe any of the spokespersons to promote food safety information and age. However a weak positive correlation ($r=0.273$, $p<0.05$*) was determined between SEG and the likelihood to believe a scientist for promoting food safety information. Results indicate that respondents from social groups 'AB' are associated with an extreme likelihood of believing a scientist, and respondents from social groups 'DE' are associated being extremely unlikely to believe a scientist when promoting food safety information. No relationship (using Mann Whitney test statistic) was determined between responses to likelihood of believing any of the listed spokepersons and male and female respondents.

4.6 DISCUSSION.

4.6.1 Introduction.

Many variables can affect the impact of a media message (Bennett and Murphy, 1999), and for food safety interventions to be effective, delivery of messages needs to be through communication channels preferred by members of the audience (Maibach and Parrott, 1995). Findings from this chapter provide valuable information for the development of informed food safety education strategies for future initiatives.

4.6.2 Attitudes towards food safety information sources.

Overall, attitudinal responses towards food safety education were found to be more positive than negative. For many statements consumers responded with a neutral attitude and few respondents indicated that they had strong attitudes towards subject matter.

Of importance to the success of any health education campaign is the perceived need for the information (Griffith *et al.* 1994). Large proportions of consumers from this study (69%) have indicated they do need (or do not know if they need) to improve their food safety behaviours and 62% admitted they lacked knowledge (or did not know if they lacked knowledge) of all of the necessary precautions necessary for safe food production. However, the majority (74%) still has expressed an attitude indicating that they are confident that their current food preparation behaviours do not give rise to the risk of food poisoning. Such findings concur with responses of commercial food handlers who perceived there to be a low risk of someone contracting food poisoning from their business even though many admitted to sometimes or often not carrying out food safety behaviours (Griffith *et al.* 2001).

Findings from this study showed that correlated attitudinal responses may have implications that impede upon intervention effect. For example, an attitude indicating that current food safety behaviours do not need improvement was found to be associated with reported knowledge of all food safety precautions necessary for safe food preparation. In addition, confidence that food preparation behaviours do not present a risk of food poisoning was associated with the belief that all necessary food safety behaviours are implemented during food preparation. Implications of such attitudes may cause consumers to disassociate themselves to food safety education efforts and may be considered within the realms of optimistic bias. Weinstein (1989) has further discussed impediments to behavioural change including the failure to admit that behaviours such as smoking or driving whilst intoxicated do present risks. This, as with findings from this study concur with previous research findings that have shown perceived risk of hazards are seen to apply other to people rather than oneself (Frewer *et al.* 1995c).

If people consider themselves to be relatively invulnerable, educational messages may be perceived as meant only for others (Hoorens, 1994). Within this study, judgements of optimistic bias have been associated with the perceived need for food safety education. Although the majority of consumers responded with a neutral attitude, more consumers agreed (25%) than disagreed (15%) that others needed advice concerning food safety more so than themselves. In addition to this a larger proportion of consumers thought they took more notice of food safety advice (43%) than did others (13%). It is considered that one of the greatest challenges associated with promotion of health-related information is that of overcoming such audience biases (Menon *et al.* 2002).

Attitudes regarding implementation of food safety behaviours revealed that 80% consumers strongly agreed or agreed that they 'always' carried out all of the food safety precautions that they know during food preparation, yet 75% also strongly agreed or agreed that they 'sometimes' carried out all the food safety precautions that they know during food preparation. Thus suggesting attitudinal responses may be subject to social desirability bias (Bowling, 2000), and the latter finding is presumed to be a more honest account of the frequency of safe food-handling behaviours. The notion of social desirability bias has been found to be prevalent in many consumer food safety surveys during a review of consumers' self-reported food safety practices (Redmond and Griffith, 2003a). Nevertheless, such findings consequently imply the need for food safety education to improve food-handling behaviours during food preparation in the home.

Although 26% of consumers indicated that they did not need to be given any food safety advice, an assessment of the willingness for consumers to listen or read any information about food safety received an extremely positive response, where 90% of consumers strongly agreed or agreed that they are willing to pay attention to food safety advice. However, a discrepancy in responses was noted where only 35% of consumers also *disagreed* that they are *not* willing to listen or read any advice about food safety.

In 1988, 42% of consumers indicated that sufficient food safety information was not available (MAFF, 1988). Results from this study indicate that slightly fewer (33%) consumers did not think enough food safety advice was available to them (more males than females), however a similar proportion (31%) indicated that they thought that enough food safety information is available to them. A comparison of data from the MAFF study (1988) and this study (2002) could suggest over the past 14 years there may have been a reduction of the proportion of consumers who perceive there to be insufficient food safety information available to them.

Findings from this study determined that respondents who have never acted on information in the past are unlikely to act upon information detailing risks and consequences of food poisoning. Conversely those who have acted on information in the past are more receptive to information about risks and consequences of food poisoning. Therefore consumers who have not acted upon previous food safety information will require a modified and refined educational approach as traditional methods appear to have been ineffective at reaching some consumers (Fraser and Smith, 1997).

The majority (82%) of respondents in this survey have indicated that they are likely to read food safety advice stated on food packaging, and in addition, such a source was also ranked as the most preferred source of food safety information. Results such as these indicate food packaging to be a positive source of food safety information. However, an investigation to determine the effectiveness of a food safety label on raw meat found that the label did not successfully prevent persons from having risky food-handling behaviours (Yang *et al.* 2000). Thus, a combination of such findings illustrate that consumer perception of the likelihood to read advice from a specific source and indication of receptivity of the advice from a preferred source may not be sole prerequisites for behavioural change.

Statistically significant differences between male and female responses to attitude statements illustrate the need for targeted food safety education strategies. Seventy percent of females and only 37% males thought they knew all of the food safety precautions necessary for safe food preparation. Therefore a targeted educational strategy for males may initially concentrate on increasing self-efficacy and knowledge of food safety behaviours prior to the promotion of interventions designed to advocate actual behavioural change. A further significant difference between male and female responses was regarding perceived availability of advice. More male respondents (70%) than female respondents (26%) considered that insufficient food safety advice is available to them, suggesting that further investigative research is required to identify life-point-paths suitable for placement of food safety education interventions for male consumers.

No significant associations were determined between age of consumer and response to attitude statements. However, significant associations between SEG and attitudinal response have been identified. Possibly the most potentially influential association identified suggested that consumers from higher social classes (AB) were more likely to act on food safety information in the future, whereas consumers from lower social classes (DE) were not. Thus, the same type of food safety education interventions should not be appropriate for higher and lower social classes and therefore targeting is required so that different groups of consumers receive tailored messages.

4.6.3 Food safety leaflets as a source for food safety information.

As previously described (Chapter 2.0), one of the simplest and most frequently used methods for attempting to facilitate behavioural change is through the provision of information leaflets (Bennett and Murphy, 1999). However, in the present study only half (52%) of consumers reported to have ever picked a food safety leaflet up from a public place, and only half of these consumers (representing 30% of the whole sample) reported to actually read the leaflet. A similar apathy towards the use of leaflets has been reported by Cole and Holland, (1980) who found that 90% persons did not pick up or read information leaflets placed in a health centre waiting room. All responses from this study indicating likely locations for picking food safety leaflets up were relatively weak or negative. Nevertheless, respondents ranked the supermarket as the most likely location where they would pick a food safety leaflet up. However, although supermarkets are a convenient location for picking up leaflets, results from this study indicate they were not perceived to be a credible or trustworthy source of food safety information. Frewer *et al.* (1996a) reported that supermarkets are viewed as having a self-protective and vested interest when providing information to consumers and nearly 40% consumers indicated a distrust in supermarket information leaflets. Although the Environmental Health Department was ranked as a provider of the most trusted and credible food safety information, it was also ranked as the second most unlikely location where food safety leaflets would be picked up. When making an overall comparison between responses indicating an likelihood to pick food safety leaflets up from listed locations, it was noted that a larger proportion of consumers indicated they were extremely unlikely or unlikely to pick food safety leaflets up than were extremely likely or likely. Such findings question the effectiveness of leaflets as a source for food safety information and reflect concerns of many health professionals who are unconvinced that leaflets are effective for increasing knowledge or changing behaviour (Bennett and Murphy, 1999).

No strong relationships or associations were determined between likely locations to pick food safety leaflets up, SEG, age or sex. However, the strongest association between responses was between picking leaflets up in the doctors surgery and dentist, suggesting that consumers who are likely to pick up a leaflet from one place are also likely to pick it up from the other. Interestingly, the library was strongly associated with all other listed locations where leaflets could be picked up. However, the library was also weakly negatively correlated with the age of respondent, suggesting that it is not a suitable location to place leaflets for younger consumers, whereas it may be an appropriate location to place food safety leaflets for older consumers.

4.6.4 Television documentaries and cookery programmes as sources for food safety information.

Television has been the prime channel of communication of general population approaches for health education and has been consistently shown to reinforce existing behaviour and raise awareness but have little or no effect on actual behavioural change (Bennett and Murphy, 1999). It is considered that the medium of television possesses advantages over other media forms for the presentation of food hygiene information because good skills and practices can be demonstrated as well as providing a feeling of interpersonal involvement (Griffith *et al.* 1994). The present study indicates that consumers who are likely to watch a TV documentary on food safety are positively associated with those likely to watch TV cookery programmes. However, results showed that more consumers (63%) were extremely likely or likely to watch a cookery programme than documentary on food safety (52%). Overall, 97% consumers indicated that they have watched at least one of the listed cookery programmes, therefore such programmes should be utilised as an important source of food safety information whereby safe practices can be demonstrated. Eighty seven percent of the sample expressed the attitude that it is important for TV chefs to carry out all necessary food safety practices. However, the safety of food-handling practices demonstrated by TV chefs on such cookery programmes has been analysed and considered to be unsatisfactory (Griffith *et al.* 1994). This raises concerns, as 44% of consumers from this survey thought that they did pick up food safety habits from such cookery programmes. The majority of respondents in this study thought that TV chefs should demonstrate good practice, and nearly half thought current practices demonstrated by such chefs were good or excellent. Such a finding illustrates that, in light of the assessment of food safety behaviours implemented on TV cookery programmes (Griffith *et al.* 1994), opposing perceptions of acceptable food safety behaviours exist between consumers and professionals.

4.6.5 Preferable sources of food safety information.

Preference for different sources of food safety information may impact upon source effectiveness. The population at large is comprised of individuals with different ages, sexes, social classes, family influences and educational backgrounds and not everyone has the same attitudes, perceptions or behavioural traits, nor do they have the same needs (Hastings and Haywood, 1991). Therefore, identification of preferable sources of interventions may aid the development of effectual, targeted food safety education initiatives.

The most preferable source of food safety information for the Cardiff based sample was determined as food packaging, closely followed by advice from the doctor or health visitor. In both cases 64% of respondents indicated such sources were either the most preferable or very preferable source of food safety information. Results also showed that food packaging was the most frequently seen source of food safety information, seen by 59% of the sample during 6 months prior to the survey. In comparison, only 10% of the sample acquired food safety advice from a doctor or health visitor during the same duration of time. Given that medical doctors and health visitors have been ranked as believable spokespersons for the promotion of food safety information, it may be beneficial for such sources to be more proactive regarding the provision of food safety advice.

Leaflets, followed by TV documentaries, recipes and TV cooking programmes were also regarded as preferable ways of receiving food safety information and between 20-34% of consumers reported recent exposure to such types of information. Previous research has indicated that between 50-67% consumers perceived television to be a common source of food safety information (Jay *et al.* 1999b; NCC, 1991; Meer and Misner, 2000). Research has also shown that broadcast has been determined to be a preferable means for communicating with persons who are less concerned with the issue, whereas print formats have received a more positive response from those have a higher concern for the issue (Chipman *et al.* 1996). Least preferable sources of food safety information included reminder aids such as fridge magnets and t-towels, such sources were only seen by one of the respondents in the study. Disfavour for such intervention types does not correspond with qualitative data that has suggested consumers have responded positively to reminder aids such as magnets for food safety information (Li-Cohen *et al.* 2002; Redmond *et al.* 2000). Indeed, key interventions for the ongoing nationwide US Fight-Bac® food safety initiative are fridge magnets (Partnership for Food Safety Education, 2002).

No difference in preferred sources of information was identified between male and female respondents, however, a positive correlation was determined between SEG and radio as a preferred source. Thus, consumers from higher social classes indicated that they preferred to hear food safety information from the radio and consumers from lower social groups considered the contrary. Therefore when considering use of the radio as a means for communicating food safety advice, targeting the information at lower social classes may prove to be ineffective. A negative statistical association was determined between age and preference for magnets and t-towels as sources of food safety information. Such a finding indicated that in some cases provision of food safety information may be more appropriate for younger consumers rather than older consumers. Research has shown that use of multiple channels and sources of information may increase potential effectiveness of educational initiatives (Bruhn and Schultz, 1999). Findings from this study showed that consumers who preferred information provided from TV documentaries were significantly associated with those who preferred TV cookery programmes, similarly, those who preferred food safety information to come from food packaging, were associated with those who indicated preference for information from recipes. A strong association was identified between preference for magnets and t-towels as well as between advice from friends and family. Use of such information may aid effectual placement of interventions using multiple information sources.

4.6.6 Credibility and trust of spokespersons and organisations that promote food safety information.

The public does not equally trust all sources of information about food safety (FAO / WHO, 1998) and trust of information about food related hazards may be an important determinant of public reaction to risk information (Frewer *et al.* 1995b; Shepherd *et al.* 1996). Indeed it is considered that a trust of the information may be as important determinant for effectiveness of the information as the content of the information itself (Frewer *et al.* 1996). It is generally considered that if the public does not trust the source of the information, they will not believe the message (Groth III, 1991). Results from this study have shown that food safety information provided from Environmental Health Officers (EHO's) and the Chief Medical Officer (CMO) are considered to be the spokespersons most likely to be believed when conveying food safety information. Politicians and TV personalities are the spokespersons least likely to be believed. Previous research has shown that government officials are perceived as being insensitive to the information needs and concerns of the public (Shepherd *et al.* 1996), and results from this study support such findings. Members of Parliament or government ministers are not trusted due to perceptions of them distorting the facts, having a vested interest and being concerned with self-protection (Frewer *et al.* 1996). Factors that enhance trust and credibility include public perceptions of the communicators accuracy, knowledge and concern for public welfare, in addition addressing the public concerns about risks will also be beneficial (FAO/WHO, 1998). Findings from this study indicated that consumers from social groups were positively correlated with likelihood of believing food safety information delivered by a scientist. Thus a suitable spokesperson promoting food safety advice for targeted consumers from social groups 'AB' (and not 'DE') would be a scientist. No significant differences between male or female responses was identified and no significant correlations between age and response were determined. Belief of food safety information given from an EHO was positively correlated with belief of food safety information provided by the CMO. Future food safety initiatives could therefore provide information by both such spokespersons and thus may improve reach, receptivity and credibility of the intended educational message and improve the potential for effectiveness in terms of behavioural change.

Credibility is related to trust and is defined as '*believable or being worthy of belief*' (Allen, 1990 p272). Corresponding with findings regarding perceived spokespersons most and least likely to believe, results from this study indicated that Environmental Health Departments were the most trustworthy and credible of listed organisations that provide food safety information. Other research has also found that 81% consumers report that they would use Environmental Health Departments to obtain information about food safety (Mathias, 1999). However, although consumers have a positive perception of EHO's and Environmental Health Departments, and a positive intention to obtain food safety information from them, in practice such a location is rarely approached for consumer food safety advice (Griffith *et al.* 1994; Mathias, 1999).

Previous research has indicated that governments do not generate high levels of trust as a source of information about food safety (Finn and Louviere, 1992). Such findings concur with results from this study where government authorities were ranked the least trustworthy and least credible providers of food safety information. However, despite this the FSA was ranked as one of the most trusted and credible of the listed organisations in this study. The FSA was established in April 2000, and has close government links (see section 2.5.1). When considering findings of this study, it can be assumed that the key characteristics of the FSA, being to put the consumer first, to be open and accessible and to be an independent voice (FSA, 2000e,f) have been successfully communicated to the public over the past two years, and consumers appear not to equate the FSA with government ties.

4.6.7 Food safety message content.

The message is considered to be the core element of the communication process (McCormack-Brown, 1998a). More than three-quarters of consumers in this study indicated they were more likely to take notice of educational messages about specific food safety behaviours targeted in a health initiative rather than generalised messages. It is considered that an in-depth, separate understanding of the specific behaviours is required to obtain desired behavioural change (McCormack-Brown, 1998b) after implementation of health education initiatives. Communication strategies based on such an approach for other health-related behaviours have proven to be effective (Andreason, 1995) more so than when generalised behavioural issues have been addressed. Therefore it is positive to determine that consumers have a preference for messages based on specific food safety behaviours rather than unspecific concepts.

In this survey, 52% of consumers perceived personal experience of food poisoning to have a greater chance of improving food safety behaviour than education. As a substitute for personal experience of food poisoning, some communication strategies have identified the threat or fear of illness as a motivating factor for behavioural change (Bennett and Murphy, 1999), however in some cases fear appeals may have limited value (Schwartzer and Fuchs, 1999). A large proportion of consumers in this study (52%) thought that hearing stories about food poisoning would lead to improvements in their own food preparation behaviour, and only 10% indicated that such stories would have no impact. In addition to this, 41% of respondents stated that they did not mind hearing the symptoms and medical details about food poisoning. A qualitative assessment of the potential impact of shock tactics has been carried out in focus groups in South Wales (Redmond *et al.* 2000). Consumer responses to a graphic description of a child suffering from *E.coli* 0157:H7 were mixed, some consumers considered the story would make them more aware of the consequences of simple food-handling malpractices that can occur, other consumers were unable to comprehend the description as they considered it to be too disturbing (Redmond *et al.* 2000). Additional analysis of attitude responses in this survey identified a significant negative correlation between hearing the symptoms and medical details about food poisoning and SEG. Thus suggesting that consumers from SEG 'AB' did not mind hearing about the symptoms and medical details, however as SEG decreased, so did aversion to hearing such details of food poisoning. It can be surmised that communication strategies using shock tactics about food poisoning illnesses may impact some segments of the population and provide potential motivation for behavioural change. However, further work is required to evaluate perceptions of shock tactics upon specific target audiences as well as determine effect of such information on consumer food safety behaviours.

4.7 CONCLUSIONS.

Overall, consumers demonstrated relatively positive attitudes towards food safety education, although notions of social desirability bias and optimistic bias were apparent. Many consumers expressed confidence that their current food preparation practices presented no risk of food poisoning even though many also admitting not knowing all of the food safety precautions necessary for safe food preparation or always implementing the food safety behaviours that they do know. Contrary to previous findings detailing consumer food safety behaviours, results from this study show that many consumers did not think their own current food safety behaviours required improvement.

Significant differences were identified between attitudes expressed by male and female respondents, thus providing evidence to suggest that male and female consumers have different receptivity and perceptions towards food safety education and therefore require separate tailored strategies for educational initiatives. In addition to this, correlations between SEGs and attitudes and perceptions towards food safety education were determined – thereby further suggesting the need for targeted food safety education.

It has been reported that consumers judge a message by the credibility of the person conveying it, its appeal to their common sense and the frequency of the message (Bruhn, 1997) therefore findings in this chapter will provide valuable information for the development of future hygiene initiatives. Results from this study suggest that when risks of food poisoning and information about safe food-handling behaviours are communicated to the general public the information should come from trusted and credible sources such as EHOs and the CMO. Least trusted spokespersons were considered to be politicians and TV personalities, therefore it is suggested that such persons do not communicate food safety risks to the public. Corresponding with spokespersons most likely to be believed, consumers indicated that most credible and trusted food safety information was provided from Environmental Health Departments and the FSA. Conversely, the least trusted and credible information was perceived to be provided from government agencies and supermarkets.

Food packaging was perceived to be the most preferable source of food safety information and a source that was likely to be read and paid attention to by consumers. However, previous research has suggested that food safety advice on packaging of raw meat is not an effective method for improving food safety behaviours (Yang *et al.* 2000).

Leaflets were perceived to be a preferable source of information, although only 26% consumer reported to have seen a food safety leaflet during 6 months prior to the survey. However, only half (52%) consumers indicated that had ever picked a leaflet up and many of such consumers reported not to read it. Overall, responses for perceived likelihood of picking food safety leaflets up were relatively weak. Nevertheless, supermarkets were ranked as the most likely location for picking leaflets up. Contrary to this, responses indicated food safety information obtained from supermarkets was considered to be less credible or trusted than other listed organisations. However, even though Environmental Health Departments were ranked as most credible and trustworthy providers of food safety information, consumers also indicated them also to be unlikely locations that they would pick up food safety leaflets.

Findings from this study indicate that the mass media are responsible for providing the basis for many sources of food safety information to consumers. Nearly all consumers indicated they had previously watched at least one of the listed TV cookery programmes and a third of the sample indicated they had previously watched a TV documentary on food safety. Such findings suggest that in particular, TV cookery programmes have substantial potential for providing food safety information to a wide audience. However, only 21-34% of consumers had seen food safety information presented in such programmes on TV within 6 months prior to the survey. In addition to this, it has been suggested that food safety practices on TV cookery programmes are poor, yet the majority of consumers in this survey thought them to be good or average. Thus reaffirming the notion that different perceptions of acceptable food safety behaviours and consequent perceptions of risk exist between consumers and experts.

Judgements of optimistic bias were illustrated when consumers expressed the perception of other consumers requiring food safety information more than they did. The majority (90%) consumers indicated that they are willing to read or listen to any information about food safety – although a quarter of consumers also stated they did not need to be given any advice on food safety. It was also determined that those consumers who had acted on food safety information the past were more likely to act upon food safety advice in the future. A positive response towards information regarding risks and consequences of food poisoning and specific food-handling malpractices was obtained from consumers, therefore inclusion of such matters should be considered in future food safety interventions.

CHAPTER 5.0

DESIGN, DEVELOPMENT AND PILOTING OF AN OBSERVATIONAL RISK BASED SCORING SYSTEM FOR ASSESSMENT OF CONSUMER FOOD SAFETY BEHAVIOUR.

5.1 INTRODUCTION.

To date, the majority of studies that have assessed consumer food safety behaviour have used indirect survey approaches. However, research has suggested that survey responses may provide a more optimistic portrayal of consumers' food safety practices than studies based on observation (Chapter 2.0). Therefore it may be advantageous to study consumer food safety behaviours using observation and hence provide more accurate information detailing food safety actions that are and are not implemented. Development of an observational technique to facilitate consistent data collection detailing consumer food safety behaviour will provide information to increase our understanding of consumers' food preparation behaviours (Chapter 6.0). Such information will not only contribute valuable data for the development of food safety education strategies (Chapter 7.0) but also provide a method for evaluating intervention effectiveness based upon actual behavioural change (Chapter 8.0).

5.2 REVIEW OF LITERATURE.

Observation is a method of data collection used for understanding complex behavioural situations more accurately (Bowling, 2000; Malhotra and Birks, 2000). The direct observation of human and animal behaviour is considered by social scientists to be superior to other methods of data collection for assessment of actual behaviour. This belief stems from the assumption that data gathered through the direct observation of actions reflect those behaviours directly rather than through an intermediary means such as a questionnaire (Sven and Ary, 1989).

Observation is considered to be a fundamental aspect of any science (Wilkinson, 1995) and different approaches may be utilised for assessment of behaviours. Observational methods may be structured or unstructured, direct or indirect, and assessment can be made by a 'participant' or 'non-participant' observer. A participant observer is to some extent part of the group of individuals under observation, whereas a non-participant observer observes from a distance and should have no effect on the actions being observed (Coolican, 1999). Structured observation is systematic, quantitative and is limited to defined, measurable and observable behavioural variables, which are determined before the actual observation is carried out (Sven and Ary, 1989). In addition to this, the frequency of behaviours may be observed and recorded (Saunders *et al.* 2000). Unstructured methods are qualitative and the format for recording information is determined according to categories that are effectively defined by the data itself. Data collected using this method is considered to be difficult to record, organise and analyse (Bowling, 2000).

A review of previous consumer food safety research has identified seven observation studies detailing consumers' food safety behaviour. Direct, structured, 'non-participant' methods of observation have been used for data collection and all such studies have been carried out in uncontrolled, 'naturalistic' environments – consumer home kitchens. Although providing useful and valuable data, the consumer food safety observation studies that have been identified have been subject to a variety of limitations. For 71% (5/7) of the studies (Audits International, 1998; 1999; 2000; Mullen, 1997; Worsfold and Griffith, 1997b) observers openly watched consumers prepare food in home kitchens, and concurrently recorded preparations using audit based approaches. None of these studies discussed the impact of the observers' presence upon consumers' food preparation practices. Observations using video camera recording of consumer food-handling practices have been carried out in Australia and the USA. Research undertaken in Australia (Jay *et al.* 1999a) used time-lapse video monitoring from a single mounted camera in home kitchens for periods of time lasting one or two weeks. Such a study did not capture full meal preparations and the field of view from one camera may not have been able to cover all angles of food preparation in home kitchens. The American study (Anderson *et al.* 2000) used three portable video cameras to record food preparation practices implemented during one meal preparation session. Positioning of three video cameras (and accompanying video recorders and TV) in consumer home kitchens (for observation of a single food preparation session) ensured that all food preparation behaviours could be recorded and observed from all angles. However, the potential for reactivity to a substantial amount of technical video recording equipment in home kitchens may have been significant.

Both personal observation and direct observation using video recordings has the potential for reactivity bias, however, video recording has the advantage that behaviour can be analysed after the event, at any required pace (Coolican, 1999). This can be of great benefit because sometimes real-time recording of data is extremely difficult, especially when there are many different behaviours to be recorded and when behaviours are initiated and terminated very rapidly and frequently (Sven and Ary, 1989). Video recordings offer records of behaviours that can be re-played, re-assessed and analysed at any level of detail using different methods of analysis. Furthermore, video recordings can provide a means for assessment of observer reliability that may not always be possible from observations made directly in a laboratory or in the field (Breakwell *et al.* 1995).

Observation of consumer food safety behaviours in home kitchens has provided the opportunity to record food preparation practices in an environment that is usually, extremely familiar to the consumer. However, extraneous variables are uncontrollable and data collected between consumers may not be directly comparable. Furthermore, meal preparations in consumer homes are not so easily replicated. Use of a model domestic kitchen would enable a number of variables that are deemed to be important for safe food preparation to be controlled, for example, size and standard of kitchen work surfaces, the availability and condition of equipment, utensils and cleaning materials. Control of such variables would provide a situation whereby direct comparisons between and within, individual and repeated meal preparations could be made.

Observed actions from structured observations are usually collected and recorded using a predetermined standardised and validated 'coding schedule' or 'observational checklist'. A prerequisite for obtaining reliable and valid data from checklists is a set of clearly defined categories (Hutt and Hutt, 1970), thereby ensuring that it is clear which behaviours should be recorded. Categories should be unambiguous, allowing minimum observer interpretation and potential bias. Use of a predetermined checklist should yield highly reliable results by virtue of its replicability (Saunders *et al.* 2000).

All consumer food safety observation studies identified have, to date, used predetermined checklists for recording food safety malpractices. Each study had a varying rationale for choice of observed actions, however, food safety behaviours that have been observed and recorded were largely generic between studies. In the UK, Griffith and Worsfold (1994a) conducted the first consumer food safety observation study using a HACCP based audit to obtain information on domestic hazards and risks. A checklist was constructed to record food safety malpractices identified using HACCP principles. As there is no standard measure of hygienic handling of food, Worsfold and Griffith (1995) formulated a standard against which performance could be measured. Such a standard employed the concept of demerit scores, which were allocated according to failure to implement appropriate control measures. The scoring system was based on allocation of demerit scores to obtain FOR (Food Operation Risk) and FSR (Food Safety Risk) scores (Griffith and Worsfold, 1994a; Worsfold and Griffith, 1995). In the USA, observations recorded by Audits International, (1998; 1999; 2000) audited food preparation in consumers' homes using an approach that auditors used for observations in restaurants. In such a study, food-handling actions (known as violations) were identified as critical, major and minor (Audits International, 1998). Also in the USA, Anderson *et al.* (2000) recorded actions according to the Fight BAC! recommendations from the food safety education initiative in the USA. In Australia, Jay *et al.* (1999a) recorded the frequency of poor food-handling and hygiene practices using what appeared to be a content analysis approach. In the UK, Mullen (1997) recorded food-handling malpractices of children that had been frequently implicated as causes of foodborne disease.

Most of the consumer food safety observation studies identified have accounted for implementation of individual malpractices, as opposed to the frequency of implementation of food safety malpractices. It is considered however, that accounting for the frequency of implementation of all food safety malpractices is of substantial importance, as such frequency may have implications for the potential risk of food poisoning from foods prepared in the domestic kitchen as well as for the development and evaluation of future food safety education initiatives.

The potential to quantify observed food safety behaviours offers a multitude of advantages. Allocating numerical values to behaviours not only provides the opportunity to assess food safety behaviour objectively, but also facilitates comparisons between preparation of different foods or meals prepared at different times or by different consumers. At the beginning of this study, the only consumer food safety observational research using a quantitative measurement of food safety behaviours (using FOR and FSR scoring), was work conducted by Worsfold and Griffith (1995). Although such research provided valuable data, the prototype scoring system had a variety of limitations (see Table 5.1). To overcome such limitations the approach needed to be extended and refined to provide a greater scope for measurement of small changes in food safety performance and reflection of potential risk incurred by implementation of specific malpractices. Such changes would facilitate the assessment of the reproducibility and consistency of food safety malpractices implemented in domestic food preparation (Chapter 6.0). Furthermore, an improved quantitative scoring system would provide a quantitative means for the evaluation of behavioural change for measurement of intervention effectiveness (Chapter 8.0).

Table 5.1 Limitations of FOR and FSR scoring system.

Limitations.
• Scores were related to recipes or dishes not meals (i.e. more than one course).
• The approaches underestimated the contribution that would be made by cross contamination.
• The approaches were too broad to adequately reflect small changes in food-handling practices especially in relation to cross contamination.
• The FSR component was irrelevant as all meals contained food commonly implicated in food poisoning.
• The approaches were based upon epidemiological data that had become dated.

To establish reliability and validity of direct, structured observational methods the various potential for bias' needs to be addressed. Observer bias is considered to be the greatest threat of reliability when using the observational technique (Saunders *et al.* 2000). This type of bias is a systematic difference between a true situation and that observed owing to observer variation in perceptions (Bowling, 2000). To overcome such bias, measures of observer reliability can be obtained. *Intra*-observer reliability measures the extent to which a single observer obtains consistent results when measuring the same behaviour on different occasions (Martin and Bateson, 1995). *Inter*-observer reliability measures the extent to which two or more observers obtain similar results when they observe the same behaviours either simultaneously (live), or from a video recording (Martin and Bateson, 1995). Assessment of *intra*- and *inter*-observer reliability ensures that variation of measurement of the same behaviour within or between observers is minimal. To date, no consumer food safety observation studies that have been identified have conducted an assessment of observer reliability. Therefore, there is no record to indicate that recording of observed behaviours, within observers, and between observers in the same study, are consistent.

Overall, consumer food safety observation studies have reported that actual food safety practices related to hand-washing and drying, cross contamination, cooking, cooling and storage of foods are poor and require improvement. Use of observation facilitates a better and more accurate understanding of what food safety malpractices are implemented during food preparation as opposed to other research methods. Furthermore, use of observation provides more accurate baseline data detailing food safety behaviours which can be used to inform those developing food safety interventions regarding key actions that need targeting in future food safety education initiatives.

5.3 AIMS AND OBJECTIVES.

5.3.1 Aims.

- Establish a model domestic kitchen for observation of consumer food safety behaviours.
- Devise observational checklists and a generic risk based scoring system for recording specific food-handling actions.
- Evaluate consumer food preparation behaviours in a model domestic kitchen using observation and a risk based, quantitative analysis.

5.3.2 Objectives.

- Organise a model domestic kitchen with all of necessary equipment and utensils required for food preparation and CCTV as a means of observation.
- Review previous and current food poisoning incidence data in terms of implicated foods and contributory factors and from this, select suitable meals for preparation by consumers in model domestic kitchen.
- Develop observational checklists and a revised risk based scoring system to facilitate quantitative assessment of consumer food safety behaviours
- Pilot consumer meal preparations in model domestic kitchen and evaluate food-handling actions using developed observational checklists and risk based scoring system.
- Conduct an *intra*-observer reliability analysis for observation of meal preparations using observational checklists and risk based scoring system.
- Identify frequently implemented unsafe food-handling actions for individual meals and throughout all meal preparations.
- Investigate the frequency of generic unsafe food-handling actions.

5.4 METHODS.

The methods section of this chapter is largely based upon a description of the organisation of the model domestic kitchen, meal preparation sessions and methods used for development of observational checklists and risk based scoring system. Additionally, methods used for piloting and determination of *intra*-observer reliability are presented.

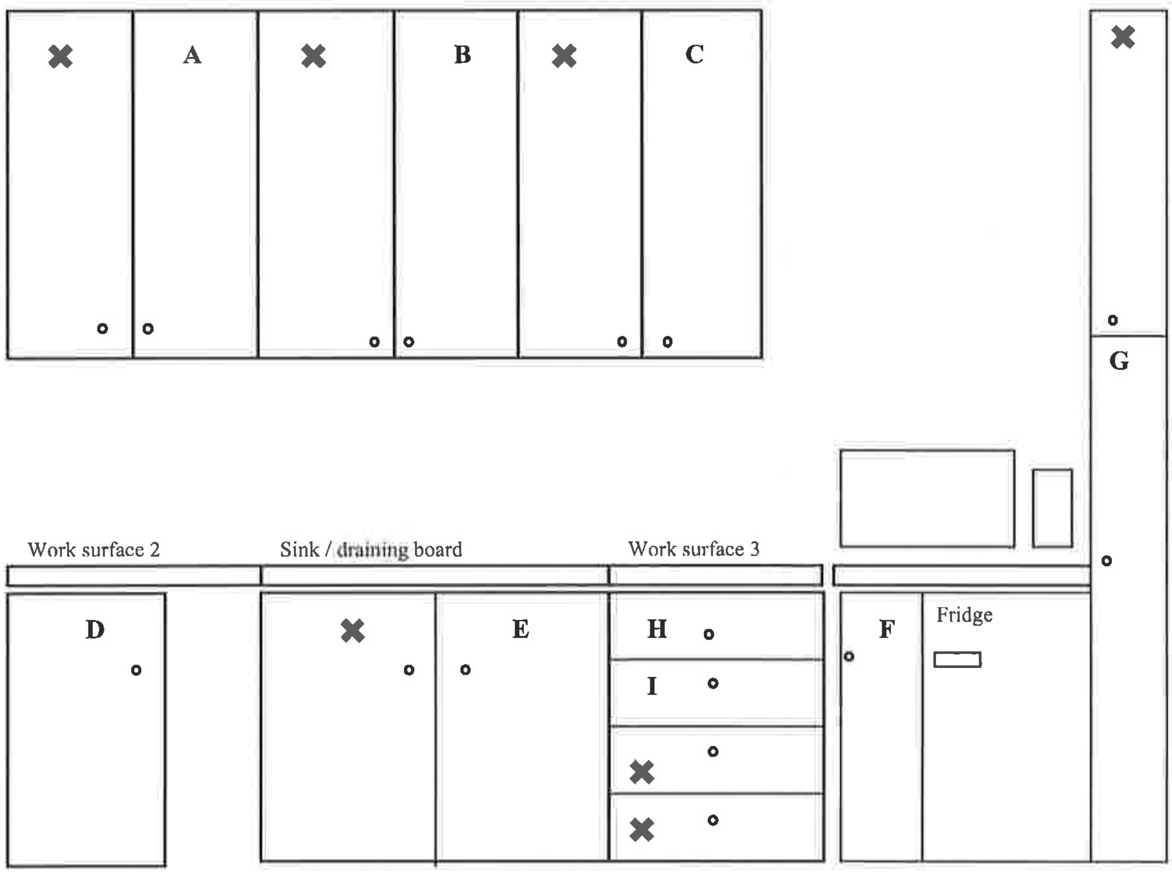
5.4.1 Organisation of model domestic kitchen for observation of meal preparations.

5.4.1.1 The model domestic kitchen.

The model domestic kitchen where meal preparations were carried out was of a modern design that had been recently installed. The design was considered to be typical of many domestic home kitchens. There were three distinct work surfaces available for use as well as a wide range of equipment, utensils, crockery and kitchenware (see Figure 5.1). More equipment / utensils etc. needed for meal preparations were provided in the model kitchen than necessary, thus allowing scope for participant selection. Equipment choice included a number and choice of (constructional) types of chopping boards (e.g. wood, plastic, glass), knives (of all sizes), saucepans (of all sizes) and a variety of mixing bowls, serving dishes and general use utensils etc. In addition, a full range of cleaning facilities and chemicals were also provided including soaps (ordinary / anti-bacterial), creams, detergents, sanitisers, cotton cloths and disposable paper towels. For a complete list of equipment, utensils and cleaning materials provided in the model domestic kitchen see Table 5.2.

All equipment and utensils provided in the model kitchen were purchased from well-known supermarkets and kitchenware shops and were considered of a typical standard for consumer usage. Placement of equipment and utensils in the model kitchen occurred in a logical manner and it was ensured that everything needed was easily accessible. To facilitate convenient usage of the kitchen, signs were placed on the doors of cupboards and drawers to inform participants of the contents (see Table 5.2). Some cupboard doors, when opened, partly obstructed the fields of view from CCTV cameras (see section 5.4.1.2). Therefore, no equipment and utensils were stored in such cupboard sections, and a sign instructing *'Do not open'* was placed on the door.

Figure 5.1 Diagram of model kitchen and kitchen facilities (see Table 5.2 for key).



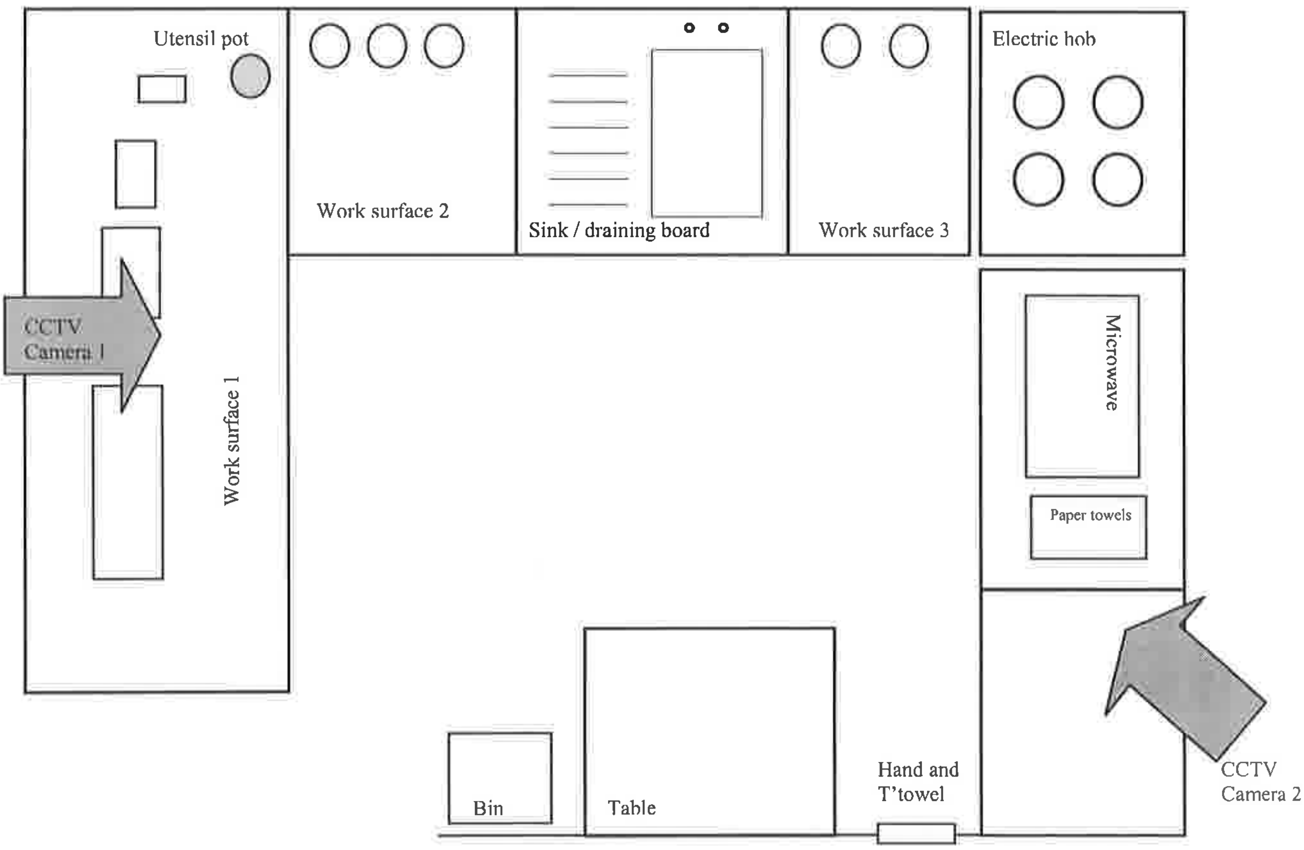


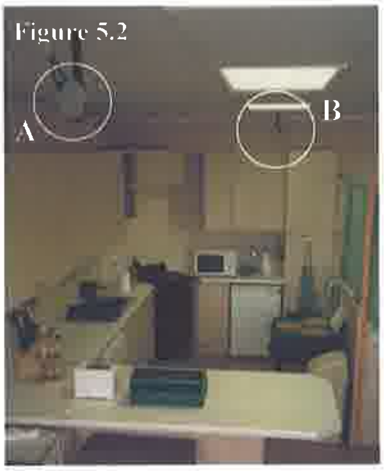
Table 5.2 A complete list of equipment, utensils and cleaning materials provided in the model domestic kitchen.

See Fig 5.1.	Part of the Kitchen.	Equipment / Food Storage.	Sign on the door during food preparation session.
✖	Units and draws.	Not used.	*'Do Not Open'*
A	Top unit 1.	Foil and cling-film and sandwich bags.	*'Foil, Clingfilm'*
B	Top unit 2.	Coffee jar, salt, oil and dry ingredients.	*'Ingredients'*
C	Top unit 3.	Food	*'Ingredients'*
D	Base unit 1.	Saucepans x 4, colander and plastic and metal sieves, heat proof mixing bowls / pudding basins.	*'Saucepans, mixing bowls, sieves and colander'*
E	Base unit 2.	500ml Bleach; 1x Domestos multi-surface spray; 1x Dettox (anti-bacterial spray); 1x Mr. Muscle cleaner; 1x Cream cleaner; 1x Washing-up liquid.	*'Washing up liquid and cloths etc.'*
		New, unused cleaning aids: J-cloth, sponge cloth, normal and non-stick scourer; thick weave cloth; fine weave cloth.	
		Pump moisturising soap; anti-bacterial soap pump; bar of soap; hand cream.	
F	Base unit 3.	Grater, 3x measuring jugs (different sizes), lemon squeezer, colander, 2x plastic chopping boards, 2x wooden chopping boards, 1x glass chopping board; baking tray; roasting tray.	*'Grater, measuring jugs, lemon squeezer, chopping boards'*
G	Base unit 4.	Crockery and glasses and serving bowls etc.	*'Crockery / serving bowls'*
H	Draw 1.	Cutlery drawer: 4x knives, 4x forks, 4x dessert spoons and 4x tea spoons, 2x metal table spoons, 1x metal straining spoon, 2x potato peelers (different sorts); 1x egg separator, 1x masher, complete set of metal measuring spoons and cups (metric and imperial), rolling pin, timer.	*'Cutlery'*
I	Draw 2.	Heat-proof serving mats, spare T-towels.	*'Serving mats, spare T-towels'*
Sink / Draining board.		Washing up bowl, rack, dish drainer, washing up brush, sink tidy, sink mat.	-
Utensil pot or Draw 1 (H).		Wooden and plastic spoons, tin opener, plastic solid spoon, plastic frying spatula, plastic straining spoon, plastic tongs, plastic spatula, turner spatula, plastic solid spoon.	-
Work surface 1.		Utensil pot, set of 3 sharp knives, toaster, spice rack, bread bin.	-
Work surface 2.		Air tight food containers: (1) rice; (2) sugar; (3) tea bags	-
Work surface 3.		Mug tree with 4x mugs, kettle.	-

5.4.1.2 CCTV.

The 'model' kitchen was provided with two ceiling mounted CCTV video cameras (Panasonic Digital, WV-CP412) (see Figure 5.2) which encompassed wide fields of view of all preparation areas (see Figure 5.3 and Figure 5.4). CCTV cameras were attached to a switcher unit (Baxall Desk Switcher DS1/2) and 2 video recorders (Sharp VC-MH711HM) and a television (Panasonic 16" TV). Issues relating to the video recording of consumer meal preparations have been addressed in section 5.4.6.3.

Figure 5.2	**Model domestic kitchen with Cameras A and B.**
Figure 5.3	**Field of view from Camera A.**
Figure 5.4	**Field of view from Camera B.**



5.4.2. Rationale for selection of recipes for meal preparations.

The meal selection for all parts of this study was based upon a review of literature detailing foods commonly reported as vehicles of food poisoning, a review of reported contributory factors associated with incidents of food poisoning, and recent trends of meal consumption and food preparation habits.

A review of published microbiological surveys of foods, epidemiological data indicating reported food sources of foodborne illness and most frequently implicated foods of foodborne illness has been carried out (see Chapter 2.0 and Appendix 2.1). It was determined that pathogenic micro-organisms are prevalent in common food sources that are frequently brought into the home for food preparation (see Chapter 2.0 and Appendix 2.1). Overall, findings indicated that large proportions of chicken and poultry are contaminated with *Campylobacter* and *Salmonella* (Appendix 2.2). It is also noted that large proportions of red meat and associated products are contaminated with *Salmonella* and *Listeria* (see Appendix 2.1). Although contamination of *E.coli* 0157:H7 in minced beef appeared to be substantially less than for other pathogens, the nature and severity of consequential illness from such a pathogen gives significant cause for concern. Similarly, although only small proportions of eggs were found to be contaminated with *Salmonella*, millions of eggs are used each day in the UK (British Egg Association, 2000) so the proportion contaminated is not unsubstantial and presents a significant cause for concern regarding consumer food preparation and consumption. It is concerning to find that nearly a quarter of RTE cooked meats may be contaminated with *Listeria*, up to a fifth may be contaminated with *Staphylococcus aureus* and small proportions contaminated with *Salmonella* or *Campylobacter* (see Appendix 2.1). Such foods require no further heat treatment prior to consumption, so pathogenic contamination presents substantial risks to consumers if consumed.

A review of previous research and epidemiological literature indicates that the majority of factors that contribute to outbreaks of foodborne disease are based on implementation of food safety malpractices such as cross contamination and time temperature control for cooking, cooling or storage of foods (Appendix 2.3). Food safety behaviours that constitute frequently reported contributory factors will form the basis of the analysis of chosen recipes, development of observational checklists and risk based scoring system.

Consumers' food consumption patterns, food choice and purchase behaviour has been evaluated in Chapter 2.0. Despite changing consumption patterns in recent years, the majority of consumers still partake in home-cooking practices. Raw meat and poultry form a basis to a large proportion of British consumers' diets, as do consumption of eggs and egg-based products. Home-preparation and consumption of traditional favourites, such as a Roast chicken dinner is still popular with at least 50% adults (Harrison *et al.* 2001b). However, as a result of increased travel and media exposure to different cultures around the world, UK consumers have become substantially more cosmopolitan with their eating habits (MINTEL, 1993). Expansion of the ethnic restaurant sector has increased awareness and desire for ethnic foods (MINTEL, 1991) and there has been a growing trend to continue to cook these foods within the home. Consequently, there has been an increased interest in home-cooked foreign cuisine (Paulson-Box and Williamson, 1990).

5.4.3 Criteria for selection of recipes for consumer meal preparation sessions.

In addition to the inclusion of foods frequently implicated as vehicles for food poisoning and common sources of foodborne pathogens, the selection of recipes were also based on the following criteria (Griffith and Worsfold, 1994b; Worsfold and Griffith, 1997b):

- The recipes should include a wide range of food preparation practices that provide an opportunity for the handling of raw and cooked foods.
- Meal preparations should include food-handling techniques that are potentially hazardous unless executed correctly.
- An element of consumer judgement should be included in the recipes about the length of cooking period and about appropriate hygienic handling techniques.
- Each meal should include process steps known to be important in food safety.
- Recipe choices needed to be consistent with current consumption patterns.
- The recipes should be sufficiently appealing to engage the interest of all participants.
- The ingredients required for all recipes should be widely available all year, be inexpensive and available from major supermarkets.
- Excessive demands on the cook in terms of time, experience or equipment should not be made.

Recipes for meal preparation sessions were judged according to the criteria stated above, and were selected and adapted from commonly used cookery books (for example Illsley, 1993). Therefore instructions were considered to be typical of those found in cookery books. The final choice of recipes and food preparation sessions can be seen in Table 5.3. For copies of the selected recipes see Appendices 5.1, 5.2, 5.3.

Table 5.3 Recipe choices for meal preparation sessions.

Meal preparation session 1:	Home-made Chicken Korma and Chocolate Mousse
Meal preparation session 2:	Home-made Beef burger, Chicken salad and Egg / ham sandwich.
Meal preparation session 3:	Traditional Roast chicken dinner with sausage meat, stuffing and vegetables and Zabaglione.

5.4.4 Methods for recording observed food safety behaviours.

The application of HACCP principles to domestic food preparation has been discussed and utilised by Worsfold (1994). Such research was used as a starting point for this study. Other workers have also employed the use of HACCP principles for analysing potential hazards during food preparation in the home (Peri, 1993; Michanie *et al.* 1987; Michanie *et al.* 1988; Schmitt *et al.* 1997; Zotola and Wolf, 1981).

5.4.4.1 Design and development of observational checklists.

A HACCP based approach has been utilised in this study for the identification of potential hazards and risks that may occur during meal production. This structured approach was used to identify food preparation steps that are important for ensuring safety of prepared food products. Such actions formed the basis of observational checklists used to record observed food safety behaviours.

Detailed observational checklists were devised to record the frequency of implemented specific food safety malpractices. It was decided that food safety *malpractices* were to be recorded on the observational checklists as opposed to implementation of safe food-handling behaviours. This was because microbiological risks are associated with *failure* to implement correct food-handling behaviours. Furthermore, there is a need to determine implementation of malpractices to inform future food safety initiatives that aim to improve such behaviours. All food preparation actions considered were related to prevention of pathogenic contamination and prevention of growth and survival of pathogens (Dillon and Griffith, 1997). Specific, generic food-handling malpractices with associated hazards, and appropriate, realistic control measures and a means for observational assessment are outlined in Table 5.4. Risks associated with observed actions have been discussed in Chapter 2.0 and section 5.4.5.

Observational checklists were designed specifically for each meal preparation session using a consistent, predetermined format to maximise accuracy for recording food safety malpractices. To facilitate the development of such checklists for each meal, preliminary pilot observations of food preparation sessions were carried out, and appropriate amendments were made. An example of an observational checklist can be found in Appendix 5.4

Table 5.4 Identification of generic food safety malpractices with associated hazards, risks and control measures.

Food-handling concepts.	Specific food safety malpractices.	Hazards associated with malpractices.	Realistic control measures.	Observational assessment.	Evidence.
Washing and drying of hands after handling raw chicken (RC) / meat (RM) and / or associated packaging (RCP, RMP) and / or raw egg (RE) / raw eggs shells (RES).	Inadequate washing and drying of hands immediately after handling RC / RM and / or RCP, RMP and / or RE / RES. *OR* Failure to wash and / or dry hands immediately after handling RC / RM and / or RCP, RMP and / or RE / RES (before contamination of equipment, utensils or preparation environment). *OR* Failure to wash and / or dry hands after handling RC / RM and / or RCP, RMP and / or RE / RES.	Potential for indirect cross contamination of pathogenic organisms to other surfaces / foods during food preparation.	Adequate, immediate washing and drying of hands after handling RC / RM and / or RCP, RMP and / or RE / RES – without touching the tap handle or any other surface or object before washing and drying. The process of adequate washing and drying included: the use of hot water, soap or detergent and drying using a clean hand towel or paper towel (Griffith *et al.* 1999a).	Adequate hand-washing / drying assessed by observing hand-washing immediately (i.e. without potentially contaminating the tap handle or anything else) using soap or detergent, rubbing hands together to produce a lather, and rinsing lather away. Use of paper towel or unused / clean towel for drying.	Appendix 5.6; ACMSF, 1996; 1993a; Acuff *et al.* 1986; Chen *et al.* 2001; Coates *et al.* 1987; Humphrey *et al.* 1994; Pether and Gilbert, 1971; Michaels, 1999; Michaels *et al.* 2001b; Redmond *et al.* 2001; Taylor and Holah, 2000.
Use of chopping boards / knives / utensils after raw chicken and before ready to eat (RTE) foods / fruit / vegetables.	Failure to use of separate chopping boards / knives / utensils for preparation of RC / RM and / or RCP, RMP and / or RE / RES and before RTE foods / fruit or vegetables *OR* Inadequate *OR* no washing and drying of chopping boards / knives / utensils after preparation of RC / RM and / or RCP, RMP and / or RE / RES and before RTE foods / fruit or vegetables	Potential for direct and indirect cross contamination of pathogenic organisms to other surfaces / foods during food preparation.	Preparation of all RTE foods, fruit / vegetables before any RC / RM and / or RCP, RMP and / or RE / RES are handled or prepared. Use of separate chopping boards / knives / utensils for preparation of RC / RM and / or RCP, RMP and / or RE / RES and then RTE foods, fruit / vegetables. Adequate washing and drying of chopping boards / knives / utensils after preparation of RC / RM and / or RCP, RMP and / or RE / RES and before preparation of RTE foods, fruit / vegetables. The process of adequate washing includes the use of hot water and detergent, abrasive scrubbing action and lathering of detergent followed by rinsing. Adequate drying includes use of paper towel or clean T'towel.	Observe use of separate utensils for preparation of raw and RTE foods. If the same utensils are used for preparation of raw foods, before RTE foods, observe cleaning of utensils using detergent and hot water (note use of hot or cold tap handle / length of time water has been in washing up bowl), use of scrubbing action and lathering of detergent whilst washing, followed by rinsing.	Appendix 5.6; ACMSF, 1996; Acuff *et al.* 1986; Bradford *et al.* 1997; DeBoer and Hahne, 1990; POST, 1997; Redmond *et al.* 2001; Zhao *et al.* 1998.
Potential contamination of the preparation environment *(continued on next page).*	Washes RC / RM. Potential contamination of preparation environment with RC / RM and / or RCP, RMP and / or RE / RES. Potential contamination of preparation environment with utensils contaminated with RC / RM and / or RCP, RMP and / or RE / RES.	Potential for direct and indirect cross contamination of pathogenic organisms to other surfaces / foods during food preparation.	Refrain from washing RC / RM during food preparation. Prevention of contact between RC / RM and / or RCP, RMP and / or RE / RES and / or potentially contaminated utensils with kitchen work surfaces, washing up draining area and other surfaces in the kitchen. Dispose of RCP / RMP / RES immediately after use, without contact with bin lid surface. If contact between potentially contaminated utensils or RC / RM and / or RCP, RMP and / or RE / RES does occur, the potentially contaminated surface should be cleaned adequately using an uncontaminated cloth / paper towel with hot water and detergent, followed by application of a multi-surface bleach spray, rinsing and drying with a disposable paper towel (Griffith *et al.*1999b).	Observe failure to wash RM / RC. Observe no direct contact between RC / RM and / or RCP, RMP and / or RE / RES and utensils contaminated with RC / RM and / or RCP, RMP and / or RE / RES and preparation environment. In an event of potential contamination of the preparation environment, observe the cleaning of the contaminated area (wiping of area using an uncontaminated cloth / paper towel with hot water and detergent, followed by application of Domestos multi-surface spray cleaner, followed by rinsing and drying with a disposable paper towel.	Appendix 5.6; ACMSF, 1993a; ACMSF, 1996; Bradford *et al.* 1997; DeBoer and Hahne, 1990; Griffith *et al.* 1999b; Humphrey *et al.* 1994; Redmond *et al.* *2001*.

Table 5.4 *(continued)*.

Food-handling concepts.	Specific food safety malpractices.	Hazards associated with malpractices.	Realistic control measures.	Assessment.	Evidence.
Potential contamination of the preparation environment *(continued)*.	Failure to wash and dry utensils potentially contaminated with RC / RM and / or RCP, RMP and / or RE / RES immediately after use.	Potential for direct and indirect cross contamination of pathogenic organisms to other surfaces / foods during food preparation.	Wash and dry utensils potentially contaminated with RC / RM and / or RCP, RMP and / or RE / RES immediately and adequately after use, using hot water, soap or detergent, a scrubbing action followed by rinsing and drying with a clean hand towel or disposable paper towel.	Observe immediate and adequate (Griffith *et al.* 1999a) washing up (followed by drying) of potentially contaminated utensils immediately after use.	Appendix 5.6; ACMSF, 1993a; ACMSF, 1993b; ACMSF, 1996; Redmond *et al.* 2001; Scott and Bloomfield, 1990.
Heating.	Ensure size of food product (e.g. size of chopped chicken pieces, depth of sausage and stuffing balls, depth and diameter of burgers) are not too big to prevent adequate heat penetration. Failure to preheat frying pan / oven / grill before cooking. Failure to heat food product efficiently.	Survival of pathogens.	Thorough cooking of food products is achieved. Preheating of oven / frying pan / grill before cooking and where appropriate ensuring chopped pieces of RC or RM or depth of food products is not too big for adequate heat penetration.	Observe size of prepared product ready for heating. Observe preheating of frying pan/ grill / oven. Observe length of time food product is heated for. Observe visual indicators of cooking efficacy (e.g.) boiling water, preheating of frying pan, grill or oven, steam, colour change of food product when appropriate.	Appendix 5.6; ACMSF, 1993a; ACMSF, 1996 ACMSF, 1993b Acuff *et al.* 1986; DoH, 1993a; DoH and MAFF, 1996; Food Safety and Hygiene Working Group, 1997; Roberts, 1985.
Post-heating handling.	Potential contamination of end products with utensils or hands during the last 5 minutes of heating, after removal from heat or prior to storage. Potential contamination of end products with potentially contaminated utensils or potentially contaminated hands during the last 5 minutes of heating, after removal from heat or prior to storage.	Potential for indirect cross contamination of pathogenic organisms to heated, RTE food products.	Prevention of handling, touching or tasting end products with hands or used utensils.	Observe any direct contact between hands and / or utensils and food product at all times after removal from the heat. Observe previous hand actions and use of utensils prior to contact with the heated food product.	Appendix 5.6; Chen *et al.* 2001; Pether and Gilbert, 1971; Redmond *et al,* 2001.
Post-heating cooling.	End product is covered during cooling, remains in saucepan / frying pan / oven / grill for cooling, is not stirred during cooling, is not cooled using cold water (for relevant foods).	Germination of spores, growth of pathogens.	Rapid cooling of food products to <10°C within 90 minutes of removal from the heat. Transfer heated products onto a plate / into small bowls, if possible stir (using an unused utensil), immerse in cold water (e.g. for a boiled egg) or rinse under running cold water (e.g. rice or pasta), remove from bone / carcass (e.g. for a roasted joint or chicken).	Observe cooling efficacy according to implementation / failure of implementation of specific practices appropriate to each food product. For example, cooling of roasted chicken will require removal of chicken meat from the bone, spread out on a plate at room temperature for no longer than 30 minutes with no covering.	Appendix 5.6; ACMSF, 1993a; DoH, 1993a; Food Safety and Hygiene Working Group, 1997; Sprenger, 1995; USDHHS,PHS, FDA, 1999.
Post-heating storage.	End product is refrigerated within 30 minutes of removal from the heat, is not transferred to a separate container, is not covered, is stored below raw ingredients, is left at room temperature.	Growth of pathogens.	Refrigerate cooked products 30 minutes after removal from the heat, on the top shelf of the fridge, covered.	Observe refrigeration of all heated food products after 30 minutes of heating, place onto top shelf of refrigerator and ensure products are suitably covered.	Appendix 5.6; ACMSF, 1993b; Abdul-Raouf *et al.* 1993; DoH, 1995; Humphrey and Whitehead, 1993; Richert *et al.* 2000.

5.4.4.2 Time-temperature measurements of heated and cooled food products.

An assessment of heating efficiency was required for food products that required cooking during meal preparation sessions. However, it was considered that intervention during observed food preparation sessions to obtain exact end-point cooking temperatures (using a probe thermometer) would be too intrusive and may influence participants' food preparation behaviour. Therefore, indirect evaluations of heating adequacy were required using time-temperature measurements.

Each of the food products that required heating in the selected recipes was prepared repeatedly in-situ on five occasions and time-temperature measurements of the heated food products were made. The internal temperature of each of the food products was taken and recorded during heating procedures using a handheld Digitron T208 / T228 thermometer with a general purpose penetration probe (A005T) at regular intervals until the target temperature (75°C) had been achieved for 30 seconds (DoH and MAFF, 1996). The length of time for the target temperature to be achieved for each of the heated products can be found in Appendix 5.5. Such times were included in observational checklists as an assessment of heating adequacy.

Time-temperature measurements were also determined for cooling procedures for each of the heated products to ensure that heated products could be cooled to <10°C within 90 minutes (Sprenger, 1995). A number of variables were required for each food product to achieve the required temperature within 90 minutes. Methods used for cooling each product can be found in Appendix 5.6. Variables required for adequate cooling for each of the cooked food products were included in the observational checklists.

5.4.4.3 Microbiological validation of observational checklists.

To validate the effectiveness of implementation of control measures at required stages of the food preparation process, (to obtain a microbiologically safe food product), a microbiological analysis of all food products chosen for consumers to prepare in the model domestic kitchen was carried out. Each food product (Chicken Korma, Chocolate Mousse, Home-made beef burger, Egg and ham sandwich, Chicken salad, Roast chicken, Sausage meat and Zabaglione) was prepared in the model domestic kitchen by the researcher on five separate occasions. Food products were analysed after immediately after serving (ready for consumption) and after cooling of products ready for storage. Standard microbiological methods were followed (see Appendix 5.7) (Roberts *et al.* 1995b). The latest guidelines for the microbiological safety of RTE foods were consulted to distinguish acceptable and unacceptable levels of microbiological safety of food products (Gilbert *et al.* 2000).

Implementation of appropriate control measures at identified control points during preparation of all food products resulted in the preparation of foods that were of a satisfactory / acceptable quality according to PHLS guidelines (Gilbert *et al.* 2000) (see Appendix 5.6). No *Staphylococcus aureus*, *Salmonella* or *Bacillus cereus* were detected during analysis of all food products analysed. Aerobic plate counts (APCs) ranged from 0.1×10^1 to 6.5×10^2 for cooked products, and 0.4×10^1 to 1.6×10^3 for cooled products (post-heating). *Enterobacteriaceae* counts ranged from no growth to 1.7×10^1 for cooked products, and no growth to 4.5×10^2 for cooled products. It is noted that the highest APCs and *Enterobacteriaceae* counts were detected from the chicken salad.

5.4.5 Design and development of generic, quantitative risk based scoring system.

In order to quantitatively assess consumer food safety behaviours in this study, the scoring system developed by Griffith and Worsfold (1994a) was taken as a useful base and adapted to ensure that the quantitative scores allocated to malpractices reflected the associated risk. As in the Griffith and Worsfold study, in this study, HACCP principles were used for hazard and risk identification within the food preparation processes of selected recipes (see Appendices 5.1, 5.2 and 5.3). Use of a simple logic decision tree (Dillon and Griffith, 1995) aided determination of food safety malpractices and control measures that were critical to food safety. This approach facilitated the classification of food safety malpractices into three categories: high risk actions, medium risk actions and low risk actions (see Table 5.5).

The concept of awarding demerit points according to observed malpractices was retained from the Griffith and Worsfold study. However, a logarithmic scale (1000, 100, 10) was used to score food safety malpractices and thus provided a greater scope for measuring differences in behavioural performance than the previous quantitative study. The scoring system in this study was designed to be weighted towards high risk actions, thus, the higher the total risk score attained after a meal preparation session, the more cumulative food safety malpractices had been made or the fewer control measures implemented. Allocation of demerit points / risk scores occurred according to the frequency of food safety malpractices that had been recorded on observational checklists (see section 5.4.4.1).

Information presented in sections 5.4.5.1, 5.4.5.2 and 5.4.4.3 and Table 5.5 illustrates the classification of risk score ratings associated with food preparation practices. As previously mentioned, a simple logic decision making tree (Dillon and Griffith, 1995) was used to aid identification of high, medium and low risk actions. For additional background literature detailing microbiological risks identified in the following sections, see section 2.4.5 in Chapter 2.0).

Table 5.5 Classification of risk ratings associated with food preparation practices.

Risk score rating.	Definition of risk score rating.	Demerit points / risk score.	Food safety malpractices.	Evidence to indicate that microbiological risks are associated with stated food safety malpractices.
High risk score.	A high-risk score is allocated for failure to implement a realistic control measure which can eliminate, prevent or reduce a food safety hazard to an acceptable level.	1000	a. Potential contamination of RTE foods during food preparation directly or indirectly (via unwashed / dried or inadequately washed / dried equipment or utensils) with RC / RM and / or RCP, RMP and / or RE / RES. Potential contamination of heated end product with potentially contaminated (either unwashed / dried or inadequately washed / dried) hands or / and potentially contaminated (either unwashed / dried or inadequately washed / dried) utensils.	ACMSF, 1995; 1993a; 1993b; 1996; Brown *et al.* 1988; Coates *et al.* 1987; DeBoer and Hahne, 1990; Farber and Hughes, 1995; Gangar *et al.* 2000; Guzewich and Ross, 1999; IFH, 1998a; Humphrey *et al*, 1994; DoH and MAFF, 1996; Michaels and Ayers, 2000b; USDHHS, PHS, FDA, 1999; Pether and Gilbert, 1971; Redmond *et al.* 2001; Taylor and Holah, 2000; WHO, 1996.
			b. Failure to heat food product containing RC, RM or RE adequately.	ACMSF, 1995; Bryan, 1996; Hayes *et al.* 1999; Humphrey *et al.* 1989; DoH and MAFF, 1996; Turney *et al.* 1994; USDHHS, PHS, FDA, 1999; WHO, 1996.
Medium risk score.	A medium risk score is allocated for failure to implement a realistic control measure at a control point when microbiological factors can be controlled and preventative or control actions are taken because of good practice.	100	a. Failure to wash and dry hands immediately and adequately after handling RC / RM and / or RCP, RMP and / or RE / RES.	ACMSF, 1993a; 1995; 1996; Brown *et al.* 1988; Coates *et al.* 1987; Guzewich & Ross, 1999; Michaels and Ayers, 2000b; IFH, 1998a; Pether & Gilbert, 1971; Redmond *et al.*2001.
			b. Failure to use separate or adequately washed and dried utensils for preparation of raw meat / poultry / eggs to foods, that will be subject to further heat treatment before consumption	ACMSF, 1993a; 1993b; 1995; 1996; IFH, 1998a; Redmond *et al.* 2001; WHO, 1996.
			c. Failure to adequately clean preparation environment after potential contamination with RC / RM and / or RCP, RMP and / or RE / RES or potentially contaminated utensils.	ACMSF, 1995; 1996; Bradford *et al.* 1997; De Boer and Hahne, 1990; Redmond *et al.* 2001; Scott and Bloomfield, 1990a; WHO, 1996.
			d. Washing of RC / RM.	Griffith *et al.* 1999b.
			e. Failure to wash and dry potentially contaminated utensils immediately after use.	De Wit *et al.* 1979; Humphrey *et al.* 1995; DoH and MAFF, 1996; Scott and Bloomfield, 1990a.
			f. Contact between heated food product and (not potentially contaminated) hands and / or used (but not potentially contaminated) utensils.	Bryan, 1996; DoH and MAFF, 1996; Sprenger, 1995; USDHHS, PHS, FDA, 1999.
			g. Leaving food for storage at room temperature.	Abdul-Raouf *et al.* 1993; Bryan, 1988; Bryan, 1996; Humphrey *et al.* 1989; Humphrey and Whitehead, 1993; Gill and Newton, 1980; Khodr *et al.* 1994; Richert *et al.* 2000; Weagant *et al.* 1994.
Low risk score	A low risk score is allocated for failure to implement correct food-handling actions to control minor food safety issues, where the small risk of a hazard is identified (Dillon and Griffith, 1997).	10	a. Failure to wash fruit and vegetables prior to use.	FSAC, 1993; MAFF, 1995; POST, 1997; USDHHS, PHS, FDA, 1999.
			b. Failure to implement actions to increase cooling time of RTE food product.	ACMSF, 1993a; Bryan, 1996; DoH, 1993a; Farber and Hughes, 1995; HAS, EHD, 1997; MAFF, 1995; DoH and MAFF, 1996; Ryno and Leftwich, 1981; Snyder, 1999c; USDHHS, PHS, FDA, 1999;
			c. Ensure size of food product is not too big to prevent adequate heat penetration.	ACMSF, 1995; FSAC, 1993.
			d. Failure to preheat oven / frying pan / grill prior to use.	FSAC, 1993; MAFF, 1995; USDHHS, PHS, FDA, 1999;
			e. Failure to cover RTE food product for storage.	Farber and Hughes, 1995; FSAC, 1993; Sprenger, 1995.
			f. Failure to store RTE food product on top shelf of refrigerator.	Farber and Hughes, 1995; FSAC, 1993; MAFF, 1995; Sprenger, 1995.

Key: RTE=ready-to-eat foods; RC=raw chicken; RCP=raw chicken packaging; RM=raw meat; RMP=raw meat packaging; RE=raw egg; RES=raw egg shells.

5.4.5.1 Identification of high risk actions.

Identification of high risk actions was based upon the determination of critical control points in the food preparation processes of the selected recipes. A critical control point has been defined as '*an operation (practice, procedure, process etc.) at which control should be exercised to achieve a quantifiable reduction in a hazard, or its stabilisation, that leads to an acceptable, safe food product'* (Notermans *et al.* 1995, p95). Thus, if appropriate control isn't implemented, a RTE food product may contain pathogenic micro-organisms, which, if ingested, may pose a direct risk and cause subsequent illness (FSIS, USDA, 1998c).

In the food industry, a critical control point is a process step that can be controlled, monitored and documented (ICMSF, 1988; NACMCF, 1998). For example, the process of heating poultry to ensure that vegetative pathogens are destroyed (see 2.4.5.3) can be controlled using temperature controlled equipment, monitored using thermometer(s) and documented on appropriate records. However, it is recognised that in the food industry, actions related to cross contamination are controlled by implementation of good hygiene practices and physical separation of preparation areas for raw and cooked foods, utensils and personnel (Griffith, 2000b). Such actions cannot be monitored or consequently documented, and therefore in the food industry cross contamination actions related to hand-washing and the transfer of organisms from raw meat / poultry and eggs to RTE foods are not classified as critical control points. However, in this study, it is possible to monitor and document such actions performed during food preparation in the model kitchen using CCTV and observational checklists.

In this study, high risk actions are considered to be malpractices in the food preparation process that have the potential to lead to the contamination of a RTE food that requires no further heat treatment before consumption. Such actions were allocated high risk scores (1000) per malpractice and include the following:

a) *Failure to prevent direct or indirect cross contamination of pathogenic micro-organisms from raw meat / poultry or eggs to RTE foods, cooked end-products, fruits or vegetables that require no further heat treatment before consumption.*

   Chopping boards are believed to be a significant source of cross contamination in consumer kitchens due to the common practice of cutting salad vegetables on a board previously used to cut raw meat (Gangar *et al.* 2000). Research has shown than there is an 81% risk that RTE foods prepared using unwashed / inadequately washed utensils (previously used for preparation of raw chicken) will result in pathogenic contamination with organisms such as *Salmonella* and *Campylobacter* (Redmond *et al.* 2001). To control such risks, a variety of measures can be implemented, for example, RTE foods can be prepared before handling foods such as raw meat / poultry / eggs, or all RTE foods can be prepared using separate utensils to those used to prepare raw meat / poultry / eggs or utensils can be washed adequately (De Boer and Hahne, 1990; IFH, 1998a; USDHHS, PHS, FDA, 1999) using detergent, an abrasive scrubbing action, followed by rinsing (Acuff *et al.* 1986; Dawkins *et al.* 1984; Redmond *et al.* 2001) and drying using a disposable paper towel or 'clean' t-towel (Griffith *et al.* 1999a).

Research has shown that direct contact between hands and raw meat / poultry and egg results in a high risk of pathogenic contamination of the hands (De Boer and Hahne, 1990; Chen *et al.* 2001; Humphrey *et al.* 1994; Redmond *et al.* 2001). After handling raw chicken, 73-100% hands have been found to be contaminated with bacteria such as *Campylobacter* (De Boer and Hahne, 1990; Redmond *et al.* 2001). Pathogens such as *E.coli, Salmonella* and *Campylobacter* have been found to survive on the fingertips for significant periods of time (Coates *et al.* 1987; Pether and Gilbert, 1971) and when contaminated hands come into contact with food products, a transfer of pathogenic organisms is facilitated (Brown *et al.* 1988; De Boer and Hahne, 1990; Pether and Gilbert, 1971; Redmond *et al.* 2001). Thus, consumption of such contaminated foods that require no further heat treatment, poses a direct risk to health. To overcome the risk of pathogenic transfer of micro-organisms effective hand-washing and hand drying practices as defined at the beginning of this thesis and suggested by Griffith *et al.* (1999a), Michaels, (1999) and Michaels *et al.* (2001b) should be followed.

b) *Failure to adequately heat food products containing raw meat / poultry / eggs.*

Research has shown that undercooking of food products such as poultry (ACMSF, 1996; Acuff *et al.* 1986), meat (ACMSF, 1995; Turney *et al.* 1994) and eggs (Hayes *et al.* 1999; Humphrey *et al.* 1989) may lead to human infection of foodborne pathogens. Furthermore, epidemiological data has indicated that undercooking of foods is a contributory factor for up to 50% of reported outbreaks of foodborne disease (see Appendix 2.3). To overcome the risk of undercooking, it is recommended that to achieve thorough cooking, manufacturers instructions should be adhered to (ACMSF, 1996; FSA, 2002b; MAFF, 1995) and time-temperature combinations (such as 75°C for 30 seconds) should be achieved (DoH and MAFF, 1996). It is also recommended that, where possible, a thermometer should be used to assess the end-point temperature of a food products (FSIS, USDA, 1998a; USDA, FSIS, 2000), as opposed to subjective measurements such as assessment of meat colour (Snyder, 1998).

5.4.5.2 Identification of medium risk actions.

Identification of medium risk actions was based on identification of control points in the food preparation processes of selected food preparation recipes. A control point has been defined as '*any point, step, or* *procedure at which biological, physical or chemical factors can be controlled*' (NACMCF, 1992, p3). In addition, a control point has been considered to be an operation at which preventative and / or control actions are taken as a result of good manufacturing practices (Bryan *et al.* 1991). Failure to implement appropriate control at identified control points in the food preparation recipes should not, in isolation, cause pathogenic contamination to the end food product. However, failure to implement appropriate safe food-handling behaviours at such points in a food preparation process may contribute to a critical control point (see section 5.4.5.1) at a later stage of food preparation.

In this study, medium risk actions have been considered to be malpractices in the food preparation process that may lead to pathogenic contamination of the kitchen environment and that are associated with failure to implement good hygiene practice. Such actions were allocated medium risk scores (100) per malpractice and include the following:

a) *Failure to wash and dry hands immediately and adequately after handling raw meat / poultry / eggs.*

Effective hand-washing and hand drying is considered to be an important control measure for preventing the transmission of foodborne diseases in food-handling environments (Coates *et al.* 1987; Humphrey *et al.* 1994; Guzewich and Ross, 1999; IFH, 1998a; Michaels, 1999; Paulson *et al.* 1999; Taylor and Holah, 2000). In isolation, no direct risk to a RTE food product and human health is presented by the process of inadequately washing and drying hands. However, because there are potential risks of bacterial transfer when handling such foods such as raw meat / poultry and eggs to hands (see section 5.4.5.1), and from unwashed / inadequately washed hands to kitchen surfaces (Chen *et al.* 2001; Redmond *et al.* 2001; Scott and Bloomfield, 1990a; Weklinski, 2001) and food products (see section 5.4.5.1) failure to implement adequate hand-washing and hand drying is considered to be 'bad practice' which warrants a medium risk score. The process of adequate hand-washing and hand drying has been described by several workers, and has also been defined at the beginning of this thesis.

b) *Failure to use separate or adequately washed and dried utensils for preparation of raw meat / poultry / eggs to foods, that will be subject to further heat treatment before consumption.*

The microbiological risks and control measures associated with prevention of transfer of pathogenic micro-organisms from unwashed / inadequately washed and dried utensils (such as chopping boards and knives) used for preparation of raw meat / poultry and eggs and other food products have been discussed in section 5.4.5.1. Although cross contamination of pathogenic bacteria to foods that require cooking before consumption present no direct risk to health, failure to implement safe practices (outlined in section 5.4.5.1) to prevent bacterial transfer is considered to be 'bad practice'. Indeed, numerous sources have recommended control measures to avoid the potential risks for microbiological contamination in this manner (ACMSF, 1993a; 1993b; 1995; 1996; IFH, 1998a; DoH and MAFF, 1996; USDHHS, PHS, FDA, 1999). Such control measures have been outlined in section 5.4.5.1.(a).

c) *Failure to adequately clean the food preparation environment after potential contamination with RC / RM and / or RCP, RMP and / or RE / RES or potentially contaminated utensils.*

It is commonly known that direct and indirect cross contamination of pathogenic micro-organisms can result during food preparation between raw food products (such as raw meat, poultry and eggs) and kitchen surfaces (ACMSF, 1995; POST, 1997; Scott, 1996; Scott and Bloomfield, 1990a; Worsfold and Griffith, 1996b). Indeed, the role of kitchen work surfaces for cross contamination of pathogenic micro-organisms has previously been demonstrated (DeWit *et al.* 1979). Indeed, research has suggested that there is a 73-100% risk of contamination with *Campylobacter* after direct contact between raw chicken and a kitchen work surface (DeBoer and Hahne, 1990; Redmond *et al.* 2001). Furthermore, a 14% risk of contamination with *Campylobacter* has been determined between raw chicken packaging and a kitchen work surface (Redmond *et al.* 2001). It has also been found that utensils used to prepare foods such as raw chicken (DeBoer and Hahne, 1990; Redmond *et al.* 2001) and raw eggs (Humphrey *et al.* 1994) can become contaminated with pathogenic micro-organisms. Research has suggested that the placement of contaminated utensils (e.g. spatulas, knives) onto a work surface may result in a 8% risk of contamination with *Campylobacter* (Redmond *et al.* 2001). To overcome such microbiological risks of contamination during food preparation, such malpractices should be avoided, and contaminated kitchen work surfaces should be cleaned adequately following procedures outlined by Griffith *et al.* (1999b)

d) *Washing of raw meat / poultry.*

Previous experimental research has shown that micro-organisms are likely to be transferred in water aerosols to locations around the kitchen sink when raw chicken is washed under running tap water (Griffith *et al.* 1999b). Furthermore, Redmond *et al.* (2001) found that 100% run off water from washed raw chicken pieces was contaminated with *Campylobacter*. Wet environments are known to encourage survival of pathogens and also facilitate cross contamination of such pathogens around the domestic kitchen (Scott and Bloomfield, 1990a). Thus, although the practice of washing raw meat / poultry may not directly effect a direct risk to human health, implementation of the malpractice may provide a source of further cross contamination in the kitchen. Therefore, such an action was allocated a medium risk score. Prevention washing of raw meat / poultry will alleviate the microbiological risks of cross contamination associated with the malpractice.

e) Failure to wash and dry potentially contaminated utensils immediately after use.

The microbiological risks associated with contamination of utensils from raw meat, poultry and eggs have previously been discussed (see section 'c' of 5.4.5.2). It is reported that unwashed contaminated utensils in the domestic kitchen can provide additional opportunities for cross contamination during food preparation (Griffith *et al.* 1999b; Scott and Bloomfield, 1990b). It has therefore been considered that adequate washing of such utensils should occur immediately after use. Such a malpractice has been allocated a medium risk score. Prevention of this malpractice can be from washing and drying of utensils immediately after preparation of raw meat, chicken and eggs using methods outlined in section 5.4.5.1 (a).

f) Contact between end food product and hands or used utensils.

Risks associated with the handling of RTE foods have been discussed by Bryan (1996), who discussed the potential for organisms such as *Staphylococci* to reach cooked products via hands during food preparation. Thus, it has been recommended that bare hand contact with ready-to-eat foods should be minimised (USDHHS, PHS, FDA, 1999). It has also been recommended '*never to allow ....used utensils to come into contact with cooked foods*' (DoH and MAFF, 1996, p12) thus, preventing any risk of indirect cross contamination during food preparation.

g) Refraining from leaving food at room temperature for storage.

Storage of food products above refrigeration temperature and below the recommended hot holding temperature of 63°C (DoH, 1995) encourages proliferation of bacterial cells, germination of spores and possible toxin production to potentially dangerous levels (Adams and Moss, 2000). Indeed, inadequate temperature control during storage is frequently implicated as a cause of foodborne illness (Knabel, 1995) (see Appendix 2.3). Experimental findings have illustrated that transferred organisms can grow on RTE foodstuffs held at ambient temperatures (Abdul-Raouf *et al.* 1993; Bradford *et al.* 1997; Humphrey *et al.* 1989; Richert *et al.* 2000; Zhuang *et al.* 1995). Therefore it is recommended that RTE food products (DoH, 1995), raw eggs (ACMSF, 1993b) raw meat (ACMSF, 1995) and raw poultry (ACMSF, 1996) are not left at room temperature for extended periods of time.

5.4.5.3 Identification of low risk actions.

Low risk actions were identified as those malpractices that present little risk to the consumer in terms of food safety, yet are advantageous to control (Dillon and Griffith, 1995). Therefore, a low risk score was allocated according to failure to implement correct food-handling actions that control minor food safety issues, where the small risk of a hazard is identified (Dillon and Griffith, 1997).

a) Failure to wash fruit and vegetables prior to use.

Fresh produce are not common vehicles for foodborne disease compared with other types of foods (Li-Cohen and Bruhn, 2001). However, fruits and vegetables grown close to the soil may be contaminated with various foodborne pathogens (Beuchat, 1998). Research has shown that washing salad vegetables such as lettuce leaves and cucumber under running tap water can reduce total bacterial counts by 10 fold (Houang *et al.* 1991), and standard washing under tap water can remove ~93% of bacterial microflora from salad vegetables such as lettuce leaves (Adams *et al.* 1989). Thus, it is recommended that raw fruits and vegetables should be thoroughly washed in water to remove soil and other contaminants before being cut (FSAC, 1993; USDHHS, PHS, FDA, 1999).

b) Failure to implement actions to increase cooling time of RTE food product.

Fast cooling of cooked food for storage is required to reduce the time spent at critical temperatures, and hence, reduce the risk of bacterial growth (Farber and Hughes, 1995). Inadequate cooling has been associated with 11-53% reported foodborne disease outbreaks (see Appendix 2.3), and so there is a need to ensure the cooling period after heating is as short as possible. In the food industry, cooling is usually associated with large amounts of food and therefore requires the use of blast chillers and thus can be associated with requiring critical control to ensure food safety (Sprenger, 1995). However, given the small quantities of foods that are being prepared this study, the same level of risk is not applicable. It has been recommended that food should cooled to below 10°C in less than 90 minutes (Sprenger, 1995). It is possible for consumers to achieve this by employing food safety behaviours discussed in section 2.4.5.4.

c) Size of food product is big to allow adequate heat penetration. d) Failure to heat equipment prior to use.

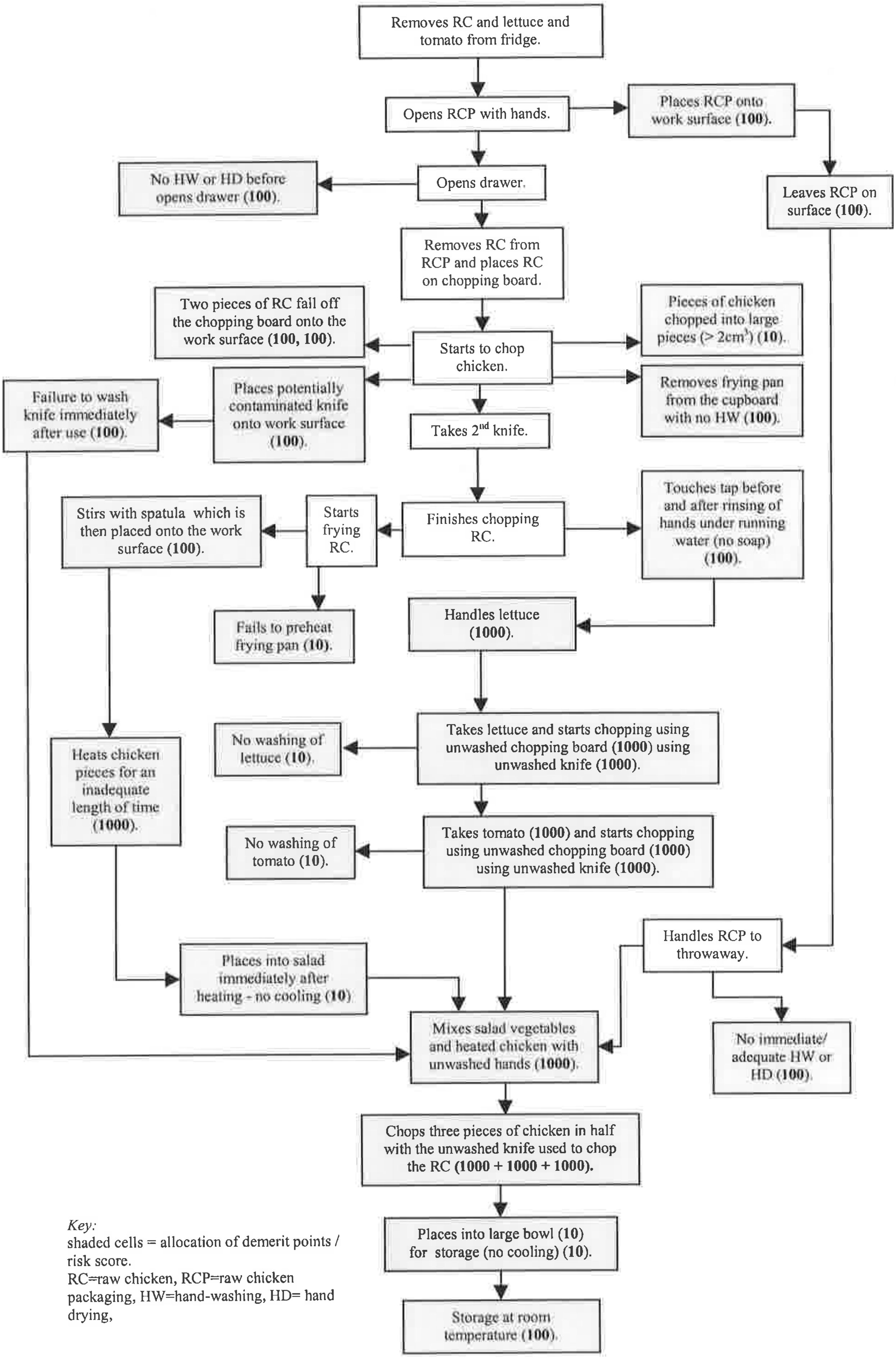
As mentioned in section 5.4.5.1 (b) it is important that raw meat and poultry products are subject to sufficient heat treatment to destroy all pathogenic micro-organisms before consumption. Factors that may influence cooking efficacy include the size of the food product to be cooked and whether the heating appliance (a cooker, frying pan or grill) is preheated to the required temperature before use. The ACMSF (1995) has reported that the thickness of beef-burgers may influence the survival of pathogens such as *E.coli* 0157. Furthermore the DoH (1998) has indicated that the thickness of a burger should be accounted for during the cooking process. It has also been stated that large joints of meat require special attention to ensure that the centre receives sufficient heat treatment (MAFF, 1995). To aid the process of adequate heating, it is recommended that ovens and grills, in particular, are preheated to the temperature specified upon instructions before cooking (DoH, 1998; MAFF, 1995; USDHHS, PHS, FDA, 1999). Specific time-temperature recommendations for cooking of different thickness of meat products, using different heating methods can be found in 'Food Safety; Questions and Answers' (FSAC, 1993).

e) *Failure to cover RTE food for storage.* f) *Failure to store RTE food product on top shelf of refrigerator.*
It is necessary to store cooked / RTE and raw foods separately in the refrigerator (cooked at the top and raw at the bottom) (ACMSF, 1996; Anon, 2002a) to prevent cross contamination of juices from raw meats (containing pathogenic micro-organisms) dripping onto RTE foods (Anon, 2002a; FSAC, 1993). Furthermore, it is recommended that cooked / RTE foods are covered for storage, thus preventing any risk of contamination from other foods (Anon, 2002a).

5.4.5.4 Design of risk based scoresheets.

The design of risk based scoresheets were based upon data collected in observational checklists and were tailored for each meal preparation session. An example of the descriptions of awardable demerit / risk scores per food safety malpractice can be found in Appendix 5.8, and an example of a scoresheet used for recording risk scores can be found in Appendix 5.9. Figure 5.5 illustrates the potential application of high, medium and low risk scores in a food preparation process where many food safety malpractices were implemented.

Figure 5.5 Example of the application of risk scores to a food preparation process (part of a home-made chicken salad recipe).



Key:
shaded cells = allocation of demerit points / risk score.
RC=raw chicken, RCP=raw chicken packaging, HW=hand-washing, HD= hand drying,

5.4.6 Piloting of observed meal preparations in the model domestic kitchen.

The piloting process not only included an assessment of a small sample of consumers' food safety behaviours using the devised observation technique, but also of the whole research process. This included, liaison with the Market Research Agency, participant recruitment, use of telephone and food preparation protocols, participant understanding of recipes and organisation of the model kitchen in terms of arrangement and suitability of the equipment / utensils etc. Furthermore an evaluation of the devised observational checklists and risk based scoresheets was made.

5.4.6.1 Recruitment of consumers for meal preparations.

Consumers were recruited using a local Market Research Agency. Telephone recruitment interviews were used by field researchers to screen potential participants for willingness to participate, and suitability. Recruitment criteria included the following:

- All recruits were screened to ensure that they prepared a meal more than twice a week.
- Vegetarians were excluded from recruitment, as all of the meals chosen for preparation in the model kitchen were based upon handling of raw meat / poultry.
- Persons working in key industries such as marketing, market research journalism, broadcasting, professional food preparation or who had participated in previous UWIC food research projects were excluded from recruitment.

For this pilot study, no participant quotas for age or SEG were required. Furthermore there was no set recruitment quota, so recruitment of consumers who fulfilled the criteria stated above continued until 30 participants attended the meal preparation sessions in the model kitchen. Supermarket vouchers were offered as incentives for participation in the research (£15 per meal preparation). A copy of the recruitment questionnaire can be found in Appendix 5.10.

After willing consumers had been recruited for the food preparation sessions, names, addresses and phone numbers of recruits were forwarded to the researcher at UWIC. Each of the recruits was telephoned and given a detailed explanation of what was required during the food preparation sessions. For a copy of the telephone protocol see Appendix 5.11. Each participant was subsequently sent an information pack with letter confirming date / time arrangements prior to attending the cooking session (see Appendix 5.12). Participants were also telephoned 24 hours before the cooking session to confirm arrangements.

5.4.6.2 Protocol for observations of food preparations in model domestic kitchen.

Once individual participants had arrived in UWIC they were met by the researcher and taken to the model kitchen. Before starting any food preparation, all participants were given a full explanation of where the equipment, utensils, kitchenware, cleaning materials and food was stored. A recipe card detailing instructions for meal preparation was provided and participants were instructed to prepare the meal 'as they would in their own home', and to use the recipe as a guide, if required. Participants were left to prepare the meal in the model kitchen on their own and progress was checked at 20 minute intervals or when required. Participants were told to serve one portion of the meal as if for consumption, and leave the rest of the food stored as if for consumption the following day. Participants were also instructed to 'leave the kitchen as they would leave it in their own home' after food preparation using any cleaning agents or procedures that they would normally carry out. The protocol followed for introduction to food preparation sessions can be found in Appendix 5.13.

5.4.6.3 Pilot observations of consumer food safety behaviour during food preparation.

To pilot the observation technique in the model kitchen, 30 participants preparing one of the three chosen meals were observed. Consumers were recruited according to methods in section 5.4.6.1 and observations of meal preparations were made using CCTV.

Participants were aware that they may be videoed, however they were unaware that their food hygiene habits were subject of observation. All participants were informed that all information collected from the study was of a confidential nature. The Colchester Avenue Campus at UWIC has a comprehensive video surveillance security system that is obvious on approaching and entering the premises. The monitors are visible on the reception desk where the participants signed in to the building and signs are visible in reception informing people of the use of CCTV. In addition, a sign was placed in the model kitchen denoting that video cameras were in operation and that activities could be recorded. If participants enquired as to the use of the video cameras in the model kitchen they were informed that the cameras were in operation.

Food safety malpractices were recorded using developed observational checklists (see section 5.4.4) and scored using the developed generic risk based scoring system (see section 5.4.5).

5.4.7 Assessment of *intra*-observer reliability.

For this study, 15 video recordings of consumer food preparation sessions (5 of each meal) were watched on repeated occasions (time 1 and time 2) by the researcher. Observed food safety malpractices were recorded using observational checklists, and subsequently scored using the risk based scoring system. Risk scores were compared for the first and second observation for each food preparation session and a reliability coefficient between the two sets of data was determined. Statistical analysis for determination of a reliability coefficient is described in 5.4.8.2.

5.4.8 Analysis of data.

5.4.8.1 Consumer food safety study database.

A Microsoft Access '97 database was specifically designed by the researcher to store all of the data collected from observation sessions, including recruitment details and recorded behaviours using the observational checklists and risk based scoresheets (see Appendix 5.14a for main database window). Detailed forms (Appendix 5.14b) were setup for each of the checklists and scoresheets. Where possible, validation rules and text were applied to the field, thus limiting the values that could be entered and thus maximising the accuracy of data entry. In addition, inclusion of default values, value lists with combo boxes and programmed short cuts aided efficiency of data entry. The 'Practical_ID' was considered to be the primary key – a value unique to each food preparation session (this had particular relevance to data collected in Chapters 6.0 and 8.0). A one-to-many relationship was created, using a central table detailing practical ID's, participant numbers, study and meal types and demographic variables of participants. Design of such a relational database facilitated queries to be conducted between all tables, and allowed a broad scope for data analysis for this study, and for further work. When required, data was obtained using queries, and then imported into Microsoft Excel '97 and SPSS 9.0 for Windows for appropriate analysis.

5.4.8.2 Statistical analysis of intra-observer reliability.

The variability between food safety risk scores obtained from repeated observations (time 1 and time 2) of 15 meal preparation sessions was determined using a One Way Analysis of Variance (ANOVA). Measures of variance between and within observations made at Time 1 and Time 2. The resultant reliability coefficient is expressed as a value between zero and one, where zero indicates no reliability and one represents no measurement error and perfect reliability (Streiner and Norman, 2001).

5.4.8.3 Analysis of pilot-observation data.

Observation data collected from risk based scoresheets was used as a basis for data analysis. Quantitative results from the pilot study were expressed in terms of risk scores (representing frequency of implementation of food safety malpractices). A descriptive analysis of observational data occurred using counts, and percentage implementation of observed food safety behaviours derived from food safety risk scores.

5.5 RESULTS.

5.5.1 Evaluation of recruitment process and observation of meal preparations.

Overall, working with the Market Research Agency for recruitment of participants for this part of the study was acceptable and the recruitment process was carried out satisfactorily. Telephone recruitment resulted in recruitment of 39 consumers to achieve the required 30 participants who attended the individual meal preparation sessions. Thus, resulting in the need to recruit 30% more consumers than required quotas for future studies.

Pilot observations of meal preparations were carried out successfully. Protocols were adhered to and facilitated consistent organisation of participants. No amendments were necessary to the recipes as all participants reported to understand the methods. Furthermore, it appeared that positioning of equipment and utensils was appropriate. All participants indicated that no additional equipment / utensils were required in the kitchen for meal preparations. Observational checklists were used to record all of the observed food safety malpractices and there were no problems regarding the application of the scoring system to observed behaviours.

5.5.2 Determination of *intra*-observer reliability for observed food preparation sessions.

A One-Way ANOVA enabled an *intra*-reliability coefficient of 0.9 to be determined between risk scores obtained from observations of consumer food preparation sessions at time 1 and time 2. A coefficient of >0.75 is considered to have excellent agreement (Bowling, 2000).

5.5.3 Pilot observation results: quantitative assessment of overall food safety behaviours using food safety risk scores.

5.5.3.1 Participant risk scores.

Total risk scores (representing all observed food safety malpractices) obtained from observed consumer food preparation sessions are presented in Table 5.6. The highest mean risk score (12,765) and maximum risk score (24,670) attained were both associated with Meal 2 (Burger, Salad, Sandwich). This suggests that that a more complex meal requiring preparation of foods such as raw chicken, raw mince and raw eggs creates more opportunities for cross contamination and thus increased potential for attaining a higher risk score.

Table 5.6 Summary of participant total risk scores (*n*=30).

Different meal preparations.	*n*	Mean risk score.	Minimum risk score.	Maximum risk score.	Standard deviation.
Meal 1. (Home-made Chicken Korma and Chocolate Mousse).	10	4,160	1,780	8,010	1,728
Meal 2. (Home-made Chicken salad, Beef-burgers and Egg and Ham Sandwich).	10	12,765	1,850	24,670	6,471
Meal 3. (Traditional Roast chicken dinner and Zabaglione).	10	4,982	2,960	7,000	1,323

Data presented in Table 5.7 shows that the mean number of times that low risk actions were implemented in each of the three different meal preparations were relatively consistent, ranging from 6.5-8.0. Furthermore, similar numbers (26.8-34.2) of medium risk actions were implemented across different meal preparations. However, data shows that the mean number of high risk actions implemented during preparations of Meal 2 (Burger, Salad, Sandwich) (9.4) was considerably higher than for Meal 1 (Korma, Mouuse) and Meal 3 (Roast chicken, Zabaglione) (1.4-1.5). This compares with the pattern of mean risk scores in Table 5.6, whereby the highest mean total risk score was attained for Meal 2 (Burger, Salad, Sandwich) which required a more complex meal preparation than the other meals. These findings show that the numbers of high risk food safety malpractices implemented are reflected in total risk scores.

Table 5.7 Mean numbers of times that participants implemented high, medium and low risk actions during meal preparations (*n*=30).

Different meal preparations.	*n*	Mean numbers of times that participants implemented ....high risk actions.	......medium risk actions.	......low risk actions.
Meal 1. (Home-made Chicken Korma and Chocolate Mousse).	10	1.4	26.8	8.0
Meal 2. (Home-made Chicken salad, Beef-burgers and Egg and Ham Sandwich).	10	9.4	33.0	6.5
Meal 3. (Traditional Roast chicken dinner and Zabaglione).	10	1.5	34.2	7.4

Results presented in Table 5.8 reiterate findings indicated above. In Table 5.8 it can be seen that a larger number of high risk actions were implemented by persons who attained higher risk scores. For example, 0.8 high risk actions were implemented per person in meal preparations that attained total food safety risk scores of 0-5,000, and 12.6 and 22.0 high risk actions were implemented per person who scored between 15,001-20,000 and 20,001-25,000 respectively. Data presented in Table 5.8 also shows that the number of low risk actions implemented per person (6.3-8.3) remained relatively consistent and the number of medium risk actions showed no overall increase or decrease.

Table 5.8 Frequency of implementation of high, medium and low risk actions according to banded total scores (*n*=30).

Bands of total risk scores attained by participants.	*n*	Frequency of occurrence of……. ……….high risk actions per person.	……. medium risk actions per person.	………. low risk actions per person.
0-5,000	14	0.8	26.0	7.4
5,001-10,000	9	2.9	36.3	7.0
10,001-15,000	3	8.3	35.0	6.3
15,001-20,000	3	12.6	39.3	8.3
20,001-25,000	1	22.0	26.0	7.0

5.5.4 Pilot observation results: descriptive results derived from food safety risk score allocations.

5.5.4.1 Descriptive results: implementation of food safety malpractices on a least one occasion during meal preparations.

Quantified implementation of food safety malpractices observed during meal preparations can be found in Table 5.9. Failure to wash and dry hands immediately and adequately after raw chicken, raw meat and / or raw eggs on at least one occasion occurred during all meal preparations. Other actions that may facilitate the cross contamination of pathogens from raw to RTE foods or surfaces in the kitchen environment were implemented in the majority of food preparation sessions for all meals. In 77% of meal preparations participants failed to use separate or adequately washed and dried chopping boards and / or knives for preparation of raw meat / poultry and RTE foods / fruit / vegetables. Opportunities for direct and / or indirect cross contamination from raw poultry, meat and / or eggs to the preparation environment were observed in 97% of meal preparations. In addition to this, potential contamination of RTE end products was observed in all meal preparations.

Overall, 70% of participants failed to implement adequate cooking practices. Nearly all participants failed to implement at least one of the required practices for adequate cooling and although overall storage practices for all meals were slightly better, 73% of participants still failed to implement adequate practices.

Table 5.9 Implementation of food safety malpractices at least once during meal preparations.

Food safety malpractice.	Meal 1: Korma (n=10)	Meal 2: Burger (n=10)	Meal 3: Roast (n=10)	Overall (n=30)
Failure to wash and dry hands adequately and immediately after handling RC, RM, RE, RCP, RMP and / or RES.	10 (100)	10 (100)	10 (100)	30 (100)
Failure to implement safe use of chopping boards and knives.	8 (80)	8 (80)	7 (70)	23 (77)
Potential contamination of preparation environment with RC, RM, RE, RCP, RMP, RES or CU.	9 (90)	10 (100)	10 (100)	29 (97)
Potential contamination of end product with H, U, CU, CH.	10 (100)	10 (100)	10 (100)	30 (100)
Inadequate cooking efficacy.	10 (100)	5 (50)	6 (60)	21 (70)
Inadequate cooling practices.	10 (100)	9 (90)	10 (100)	29 (97)
Inadequate storage practices.	8 (80)	6 (60)	8 (80)	22 (73)

Key: RC=raw chicken; RCP=raw chicken packaging; RM=raw meat; RMP=raw meat packaging; RE=raw egg; RES=raw egg shells; CU=contaminated utensil; H=hands; U=utensils; CH=contaminated hands.

5.5.4.2 Descriptive analysis of hand-washing and hand drying practices.

Frequency of implementation of hand-washing and hand drying malpractices after handling raw chicken, raw meat and raw eggs (with respective packaging and shells) has been tabulated in Table 5.10. Overall, 57% participants failed to wash and dry their hands on more than 10 occasions during meal preparations, and one participant failed to do so on 27 occasions. Concurring with overall risk scores indicated in section 5.5.3.1, quantified hand-washing and hand drying practices were worse for Meal 2 (Burger, Salad, Sandwich), where 80% participants implemented hand-washing and hand drying malpractices on more than 10 occasions.

Table 5.10 Frequency of implementation of hand-washing and hand drying malpractices (medium risk actions).

Food safety malpractice.		Meal 1: Korma n=10	Meal 2: Burger n=10	Meal 3: Roast n=10	All meals n=30
Number of times participants failed to wash and dry their hands adequately and immediately after handling raw chicken, raw meat and / or raw eggs and respective packaging / shells per meal preparation session.	0 times	0 (0)	0 (0)	0 (0)	0 (0)
	1-4 times	3 (30)	0 (0)	0 (0)	3 (10)
	5–9 times	5 (50)	2 (20)	3 (30)	10 (33)
	10 -14 times	2 (20)	4 (40)	6 (60)	12 (40)
	15 or more times	0	4 (40)	1 (10)	5 (17)
	Minimum no. of times	2	1	5	1
	Maximum number of times	10	27	20	27

Data presented in Table 5.11 denotes the proportions of participants who failed to implement adequate hand-washing and hand drying practices for all raw chicken, meat (with associated packaging) and eggs (and egg shells). It can be seen that overall, the largest proportion of participants (71%) failed to wash and dry their hands after handing raw eggs and raw egg shells, this was particularly apparent for Meal 2 (Burger, Salad, Sandwich). A large proportion (64%) of participants also failed to wash and dry their hands appropriately after handling raw chicken and raw chicken packaging. This occurred during all meals, but particularly during preparation of Meal 3 (Roast chicken, Zabaglione).

Table 5.11 Failure to wash and dry hands immediately and adequately after handling raw chicken / raw meat and respective packaging and raw eggs and raw egg shells (medium risk actions).

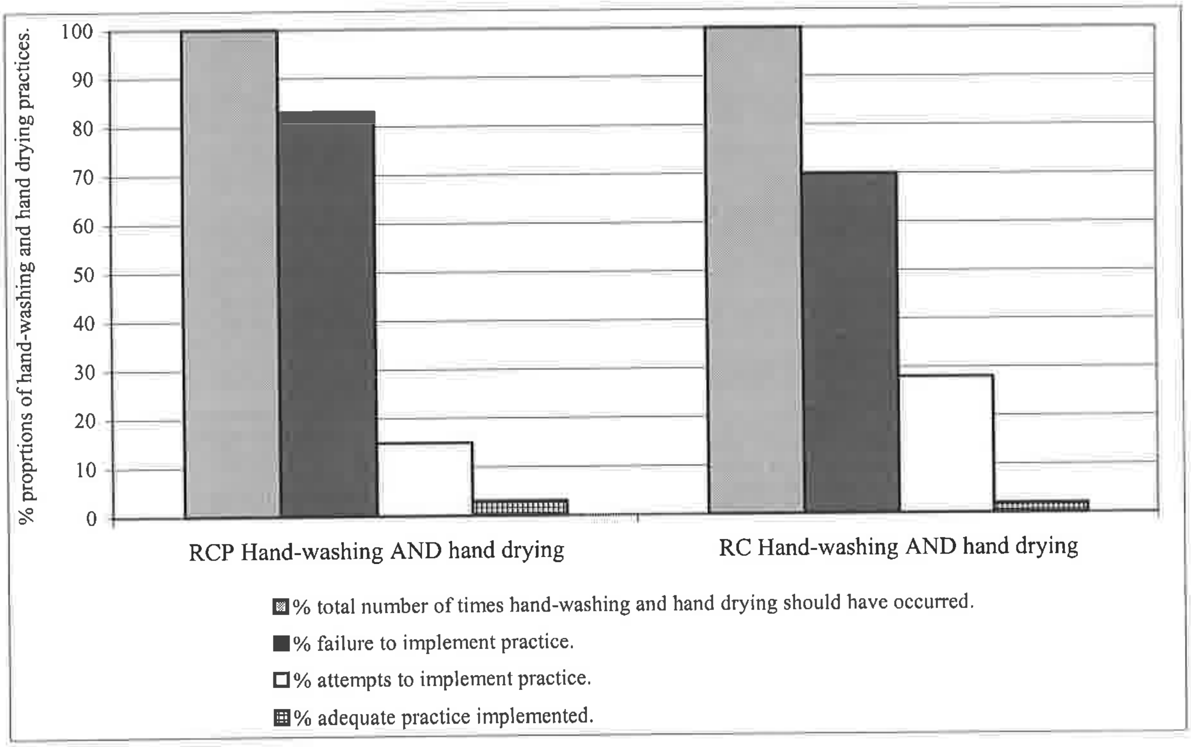
Food safety malpractice.	% participants who implemented HW and HD malpractices at least once during food preparation (e.g. obtained a risk score of at least 100 for each malpractice).				
Failure to wash and dry hands immediately and adequately after handling…..	Meal 1: Korma (*n*=10)	Meal 2: Burger (*n*=10)	Meal 3: Roast (*n*=10)	**All meals.**	*n*
…..raw chicken and raw chicken packaging.	50	50	90	**64**	*30*
…..raw chicken only.	40	50	10	**33**	*30*
…..raw chicken packaging only.	0	0	0	**0**	*30*
…..neither raw chicken or raw chicken packaging.	10	0	0	**3**	*30*
…..raw minced beef and minced beef packaging.	-	50	-	**50**	*10*
…..raw minced beef only.	-	20	-	**20**	*10*
…..raw minced beef packaging only.	-	30	-	**30**	*10*
…..neither raw minced beef or minced beef packaging.	-	0	-	**0**	*10*
…..raw sausage meat and sausage meat packaging.	-	-	30	**30**	*10*
…..raw sausage meat only.	-	-	60	**60**	*10*
…..raw sausage meat packaging only.	-	-	0	**0**	*10*
…..neither raw sausage meat or sausage meat packaging	-	-	10	**10**	*10*
…..raw eggs and raw egg shells.	60	90	60	**71**	*30*
…..raw eggs only.	30	10	30	**23**	*30*
…..raw eggs shells only.	10	0	0	**3**	*30*
…..neither raw eggs or raw egg shells.	0	0	10	**3**	*30*

Failure to wash and dry hands immediately and adequately after handling raw chicken or raw chicken packaging was one of the most frequently performed hand-washing and hand drying malpractices during all meal preparations. Further analysis using quantitative data from observational checklists has been carried out to determine frequency of failure, attempts and adequacy of hand-washing and hand drying practices (see Table 5.12 and Figure 5.6).

Table 5.12 Efficacy of hand-washing and hand drying practices immediately after handling raw chicken packaging and raw chicken during preparation of Chicken Korma, Chicken salad and Roast chicken (medium risk actions).

	Meal 1	Meal 2	Meal 3	No. of participants who prepared meals	Total no. of times hand-washing / drying should have occurred	Failure to implement practice *n* (% of total)	Attempts to implement practice *n* (% of total)	Adequate practice implemented *n* (% of total)
Hand-washing immediately after handling raw chicken packaging.	✓	✓	✓	30	40	33 (82)	5 (13)	2 (5)
Hand drying immediately after handling raw chicken packaging.	✓	✓	✓	30	40	36 (90)	3 (7)	1 (3)
Hand-washing AND hand drying immediately after handling raw chicken packaging.	✓	✓	✓	30	40	33 (82)	6 (15)	1 (3)
Hand-washing immediately after handling raw chicken.	✓	✓	✓	30	98	69 (70)	17 (18)	12 (12)
Hand drying immediately after handling raw chicken.	✓	✓	✓	30	98	79 (80)	6 (7)	13 (13)
Hand-washing AND hand drying immediately after handling raw chicken.	✓	✓	✓	30	98	69 (70)	27 (28)	2 (2)

Figure 5.6 Adequacy of hand-washing and hand drying practices immediately after handling raw chicken packaging and raw chicken during preparation of Chicken Korma (*n*=10), Chicken salad (*n*=10), Roast chicken (*n*=10).



Observation results show that there were 40 occasions that raw chicken packaging was handled (1.3 times per food preparation session) and 98 occasions that raw chicken was handled (3.3 times per food preparation session). Immediate and adequate hand-washing and hand drying practices were required after each occasion when raw chicken packaging and raw chicken were handled. However, as illustrated in Figure 5.6, hand-washing and hand drying was not attempted for the majority of occasions, attempts were made for a smaller number of occasions and adequate practice was observed for the least number occasions after handling raw chicken and raw chicken packaging. It is noted that although hand-washing and hand drying was required more frequently after handling raw chicken, failure to attempt to wash and dry hands occurred less frequently after handling raw chicken (70% occasions) than raw chicken packaging (83% occasions). Adequate hand-washing and hand drying was observed for a minimal, comparable proportion of occasions for raw chicken and raw chicken packaging.

5.5.4.3 Descriptive results indicating use of chopping boards and knives during food preparation.

Chopping boards and knives were used in all meal preparations for preparation of raw chicken / raw meat and RTE foods, fruit and vegetables. Results in Table 5.13 indicate that unsafe use of knives was more prevalent during Meal 1 and unsafe use of chopping boards was more prevalent in Meal 2. For preparation of a roast chicken (in Meal 3) there was less need to use a chopping board and knife, and consequently failure to implement appropriate usage of such utensils was less.

Table 5.13 Failure to implement safe use of chopping boards / knives (medium and high risk actions).

Food safety malpractice.	Meal 1: Korma (n=10).	Meal 2: Burger (n=10).	Meal 3: Roast (n=10).	Overall (n=30).
Overall failure to implement safe use* of chopping boards (medium and high risk actions).	6 (60)	7 (70)	3 (30)	15 (50)
Failure to implement safe use* of knives (medium and high risk actions).	8 (80)	5 (50)	2 (20)	16 (53)

* 'Safe use' refers to the use of separate or adequately washed and dried utensils (knives or chopping boards) between preparation of raw meat / poultry and RTE foods.

To identify the extent of potential cross contamination from use of chopping boards and knives during food preparation, the number of foods prepared using the same unwashed or inadequately washed and dried chopping boards and knives has been determined (see Table 5.14). Similar numbers of foods were prepared using unwashed and inadequately washed knives and chopping boards. The maximum number of foods prepared using unwashed / inadequately washed knives and chopping boards was seven foods. It was observed that between 47-50% participants did not prepare foods using the same unwashed or inadequately washed chopping board or knife (respectively). However, in combination, only 23% participants implemented safe use of knives and chopping boards during food preparation.

Table 5.14 Number of foods prepared using the same unwashed / inadequately washed / dried chopping boards and knives.

Food safety malpractice.		Meal 1: Korma (*n*=10) maximum 4 foods	Meal 2: Burger (*n*=10) maximum 14 foods	Meal 3: Roast (*n*=10) maximum 10 foods	All meals (*n*=30) 28 foods
Use of chopping boards.					
Failure to implement safe use of chopping boards.	0 foods	4 (40)	3 (30)	7 (70)	14 (47)
	1-4 foods	6 (60)	3 (30)	3 (30)	12 (40)
	5-9 foods	-	4 (40)	0 (0)	4 (13)
	10 foods or more	-	0 (0)	-	0 (0)
	Minimum	0	0	0	0
	Maximum	3	7	4	7
Use of knives.					
Failure to implement safe use of knives.	0 foods	2 (20)	5 (50)	8 (80)	15 (50)
	1-4 foods	8 (80)	1 (10)	2 (20)	11 (37)
	5-9 foods	-	4 (40)	0 (0)	4 (13)
	10 foods or more	-	0 (0)	-	0 (0)
	Minimum	0	0	0	0
	Maximum	4	7	4	7

* 'Safe use' refers to the use of separate or adequately washed and dried utensils (knives or chopping boards) between preparation of raw meat / poultry and RTE foods.

5.5.4.4 Descriptive results indicating potential contamination of the kitchen environment during meal preparations.

Data presented in Table 5.15 shows that larger proportions of participants potentially contaminated the food preparation environment with utensils contaminated with raw chicken or raw meat than with raw chicken / meat packaging. Direct contamination from raw chicken and raw meat occurred on 40% of all piloted food preparation sessions – most frequently during handling of the raw chicken carcass during preparation of Meal 3 (Roast chicken, Zabaglione). Raw egg or raw egg mixture contaminated the preparation environment for between 37-45% meal preparations.

The number of times that the preparation environment was potentially contaminated from raw chicken, raw meat (and associated packaging), raw eggs, (and raw egg shells) and potentially contaminated utensils during meal preparations can be seen in Table 5.16. Results showed that 40% participants potentially contaminated the preparation environment between 1-4 times, 37% participants did so between 5-9 times and 20% participants did so on mode than 10 occasions. Overall, the maximum number of times the kitchen environment was potentially contaminated was on 13 occasions during the preparation of Meal 3 (Roast chicken, Zabaglione). Only one participant (3% sample) did not potentially contaminate the preparation environment during meal preparation.

Table 5.15 Medium risk actions that may result in contamination of the preparation environment with raw chicken / meat / egg, or respective packaging or with potentially contaminated utensils.

Potential contamination of the preparation environment with.........	Meal 1: Korma *n*=10	Meal 2: Burger *n*=10	Meal 3: Roast *n*=10	Accumulation of all meals.	*n*
	% participants who implemented medium risk malpractices at least once during food preparation (e.g. obtained a risk score of at least 100 for each malpractice).				
.... raw chicken*.	4 (40)	2 (20)	6 (60)	**12 (40)**	*30*
.... raw minced beef*.	-	4 (40)	-	**4 (40)**	*10*
.... raw sausage meat*.	-	-	4 (40)	**4 (40)**	*10*
.... raw egg*.	3 (30)	5 (50)	3 (30)	**11 (37)**	*30*
.... raw egg mixture*.	5 (50)	-	4 (40)	**9 (45)**	*20*
.... utensils contaminated with raw chicken*.	4 (40)	6 (60)	2 (20)	**12 (40)**	*30*
.... utensils contaminated with raw minced beef*.	-	10 (100)	-	**10 (100)**	*10*
.... utensils contaminated with raw sausage meat*.	-	-	5 (50)	**5 (50)**	*10*
.... utensils contaminated with raw egg*.	3 (30)	3 (30)	2 (20)	**8 (27)**	*30*
.... raw chicken packaging*.	6 (60)	6 (60)	6 (60)	**18 (60)**	*30*
.... raw minced beef packaging*.	-	2 (20)	-	**2 (20)**	*10*
.... raw sausage meat packaging*.	-	-	5 (50)	**5 (50)**	*10*
.... raw egg shell*.	6 (60)	4 (40)	5 (50)	**15 (50)**	*30*

*= followed by no adequate cleaning procedures as defined by Griffith *et al.* (1999a; 1999b).

Table 5.16 Frequency of potential contamination of the preparation environment during meal preparations (medium risk actions).

Food safety malpractice		Meal 1: Korma *n*=10	Meal 2: Burger *n*=10	Meal 3: Roast *n*=10	All meals *n*=30
Number of times participants potentially contaminated the preparation environment with RC, RM, RE, RCP, RMP, RES and / or CU.	0 times	1 (10)	0 (0)	0 (0)	1 (3)
	1-4 times	7 (70)	3 (30)	2 (20)	12 (40)
	5-9 times	1 (10)	5 (50)	5 (50)	11 (37)
	10 times or more	1 (10)	2 (20)	3 (30)	6 (20)
	Minimum	0	3	2	0
	Maximum	12	11	13	13

Key: RC= raw chicken; RM= raw meat; RE= raw egg; RCP= raw chicken packaging; RMP=raw meat packaging; RES= raw egg shells; CU=contaminated utensils.

5.5.4.5 Descriptive results indicating general food preparation malpractices.

Data presented in Table 5.17 indicates that no raw meat was 'washed' before use. However, 30% raw chicken fillets and 70% of raw chicken carcasses were washed during preparation before heating. It is noted that fewer participants washed the lemon for the Zabaglione in Meal 3, than washed the raw chicken carcass.

Table 5.17 Washing of ingredients before use.

Food safety malpractice.	Meal 1: Korma n=10	Meal 2: Burger n=10	Meal 3: Roast n=10	All meals.	n
	n (%) participants who implemented food safety malpractice on at least one occasion.				
• Washes raw chicken prior to cooking**.	3 (30)	0 (0)	7 (70)	**10 (33)**	*30*
• Washes raw sausage meat prior to cooking**.	-	-	0 (0)	**0 (0)**	*10*
• Raw minced beef is washed prior to cooking**.	-	0 (0)	-	**0 (0)**	*10*
• Failure to wash salad vegetables before use*.	-	5 (50)	-	**5 (50)**	*10*
• Failure to wash fruit for egg based dessert*.	5 (50)	-	5 (50)	**5 (50)**	*10*

**when a participant obtained a medium risk score of at least 100 for each malpractice.

*when a participant obtained a low risk score of at least 10 for each malpractice.

Observation results found in Table 5.18 show that overall more than half of participants washed potentially contaminated utensils immediately after use. However, it can be seen that 70% of utensils potentially contaminated with raw egg and 60% utensils potentially contaminated with raw chicken were not washed immediately after use, and thus present increased opportunities for cross contamination during food preparation.

Table 5.18 Cleaning of potentially contaminated utensils after use (medium risk actions).

Food safety malpractice.	Meal 1: Korma n=10	Meal 2: Burger n=10	Meal 3: Roast n=10	All meals.	n
	% participants who implemented medium risk malpractice on at least one occasion. (e.g. obtained a risk score of at least 100 for each malpractice).				
• Failure to wash and dry utensils contaminated with raw chicken immediately after use.	6 (60)	6 (60)	0 (0)	**12 (40)**	*30*
• Failure to wash and dry utensils contaminated with raw minced beef immediately after use.	-	3 (30)	-	**3 (30)**	*10*
• Failure to wash and dry contaminated utensils with raw egg immediately after use.	7 (70)	0 (0)	3 (30)	**10 (33)**	*30*
• Failure to wash and dry utensils contaminated with raw sausage meat immediately after use.	-	-	4 (40)	**4 (40)**	*10*

5.5.4.6 Descriptive results indicating assessment of heating adequacy.

Data presented in Table 5.19 denotes a quantitative assessment of the efficacy prepared food products have been heated. Overall, 36% of food products cooked in the model domestic environment received inadequate heat treatment. None of the egg based Chocolate Mousse desserts made in Meal 1 were heated adequately, yet using the same heating method, 50% of the egg based Zabagliones were heated sufficiently. Nearly one third of eggs were boiled for an insufficient time and 30% meat products were heated inadequately. The only food product that was heated properly 100% of the time was fried chicken pieces, however only 40% of roasted chickens were heated for an adequate length of time.

Table 5.19 Assessment of heating adequacy and factors influencing heating adequacy.

Food safety malpractice.	*n* (%) participants who implemented food safety malpractice.
Meal 1: Chicken Korma / rice and Chocolate Mousse (No. participants=10).	
• Chicken pieces are cut into large uneven pieces*.	3 (30)
• Failure to heat chicken korma efficiently***.	1 (10)
• Failure to heat raw shell egg mixture efficiently for mousse***.	10 (100)
Meal 2: Home-made chicken salad, egg and ham sandwich and beef-burger (No. participants=10).	
• Frying pan is not preheated*.	1 (10)
• Failure to heat chicken efficiently***.	0 (0)
• Egg is not boiled for at least 12 minutes***.	3 (30)
• Home-made burgers exceed 2 cm depth*.	1 (10)
• Grill is not preheated*.	2 (20)
• Home-made beef-burger is not heated for 25 minutes***.	4 (40)
Meal 3: Traditional roast chicken with sausage meat, Home-made Zabaglione (No. participants=10).	
• Chicken cavity is stuffed with stuffing / sausage meat mixture*.	4 (40)
• Stuffing / sausage meat balls exceed thickness of 2" / 1.5cm*.	1 (10)
• Oven is not preheated for at least 12 ½ minutes*.	4 (40)
• Roast chicken is not heated for 90 minutes***.	6 (60)
• Sausage meat is not heated for 25 minutes***.	1 (10)
• Failure to heat raw shell egg mixture efficiently for Zabaglione***.	5 (50)

***when a participant obtained a high risk score of at least 1000 for each malpractice.
*when a participant obtained a low risk score of at least 10 for each malpractice.

5.5.4.7 Descriptive results indicating contamination of end products from H, U, CH, CU.

Results indicate that many of the end products prepared for consumption are frequently touched with hands, unclean utensils, and potentially contaminated hands and utensils. Data in Table 5.20 shows that 97% participants touched the end product with their hands and / or unclean utensils. Contact between end products (during assembly or whilst serving) and potentially contaminated hands or / and utensils was observed during meal preparations of 27% participants. This was particularly prevalent whilst serving food products for Meal 2 (Burger, Salad, Sandwich). A substantial amount of potential contamination of food products prior to storage was observed. All participants who prepared the Roast chicken potentially contaminated the cooked food with their hands, for example, when picking pieces of cooked chicken from the cooked carcass.

Table 5.20 Potential contamination of food products after removal from heat, during assembly and prior to storage where appropriate.

Food safety malpractice.	*n* (%) of participants who implemented food safety malpractice at least once during food preparation			
	Meal 1: Korma *n*=10	Meal 2: Burger *n*=10	Meal 3: Roast *n*=10	All meals. *n*=30
• Potential contamination of food product after removal from heat with utensils or hands**.	10 (100)	9 (90)	10 (100)	29 (97)
• Potential contamination of food product after removal from heat with contaminated utensils or contaminated hands***.	1 (10)	6 (60)	1 (10)	8 (27)
• Potential contamination of food product prior to storage with utensils or hands**.	6 (60)	9 (90)	10 (100)	25 (75)
• Potential contamination of food product prior to storage with contaminated utensils or contaminated hands***.	1 (10)	4 (40)	0 (0)	5 (17)

***when a participant obtained a high risk score of at least 1000 for each malpractice.
**when a participant obtained a medium risk score of at least 100 for each malpractice.

Data in Table 5.21 shows the frequency of contact between hands, unclean utensils, potentially contaminated hands and utensils and prepared food products. The maximum number of times that food products were in contact with hands or unclean utensils was 22 times in one food preparation session, and no participants were observed to refrain from touching foods that were ready for consumption or storage. Although 27% participants potentially contaminated prepared foods with unwashed / inadequately washed and dried contaminated hands and / or unwashed / inadequately washed utensils previously used for preparation of raw chicken meat or eggs for between 1-4 times during food preparation, one participant potentially contaminated the end product on 11 occasions.

Table 5.21 Frequency of potential contamination of end products during assembly and for storage.

Food safety malpractice		Meal 1: Korma *n*=10	Meal 2: Burger *n*=10	Meal 3: Roast *n*=10	All meals *n*=30
Potential contamination of end product from H, U after removal from heat / for serving or for storage (infinite frequency)**.	minimum	2	2	2	2
	0 times	0 (0)	0 (0)	0 (0)	0 (0)
	1-4 times	1 (10)	1 (10)	1 (10)	3 (10)
	5-9 times	5 (50)	4 (40)	3 (30)	12 (40)
	10-14 times	3 (30)	2 (20)	3 (30)	8 (27)
	15 or more times	1 (10)	3 (30)	3 (30)	7 (23)
	maximum	19	22	19	22
Potential contamination of end product after removal from heat / for serving or for storage from CH, CU (infinite frequency)***.	minimum	0	0	0	0
	0 times	8 (80)	3 (30)	9 (90)	20 (67)
	1-4 times	2 (20)	5 (50)	1 (10)	8 (27)
	5-10 times	0 (0)	1 (10)	0 (0)	1 (3)
	11-14 times	0 (0)	1 (10)	0 (0)	1 (3)
	15 or more times	0 (0)	0 (0)	0 (0)	0 (0)
	maximum	2	11	2	11

***when a participant obtained a high risk score of at least 1000 for each malpractice.
**when a participant obtained a medium risk score of at least 100 for each malpractice.

5.5.4.8 Descriptive results indicating cooling and storage practices.

Overall, 97% participants failed to initiate all of the required actions for adequate cooling of foods and 73% participants failed to implement necessary actions for safe storage of prepared RTE foods. Such malpractices were apparent for all meals. Data presented in Table 5.22 shows that many (63%) of the heated foods were covered during cooling and 40% of all of the foods were left in a warm oven, or saucepan / frying pan during the cooling process. When stirring of foods was required to encourage heat loss from foods (such as Chicken Korma) or cold water was required to speed the cooling process up (e.g. for boiled eggs, pasta or rice) substantial proportions of participants failed to implement appropriate practices. In addition, 50% of participants cooled the roast chicken on the bone and 20% of participants transferred cooked chicken and / or pasta from the heat straight into the chicken salad, allowing no cooling process at all.

Table 5.22 Cooling and storage practices after preparation and heating of food products.

Food safety malpractice.	*n* (%) of participants who implemented food safety malpractice at least once during food preparation			
	Meal 1: Korma *n*=10	Meal 2: Burger *n*=10	Meal 3: Roast *n*=10	All meals. *n*=30
• Food product covered for cooling*.	4 (40)	7 (70)	8 (80)	19 (63)
• Food product left in heated utensil / oven for cooling*.	4 (40)	2 (20)	2 (20)	8 (26)
• Cold water is not used for cooling*.	9 (90)	7 (70)	-	16 (80)
• No stirring during cooling*.	9 (90)	-	-	9 (90)
• Food product is refrigerated within 30 minutes of removal from heat*.	3 (30)	5 (50)	3 (30)	11 (37)
• Food product is not placed in a separate container for storage*.	3 (30)	0 (0)	1 (10)	4 (13)
• Food product is not covered for storage*.	6 (60)	1 (10)	1 (10)	8 (27)
• Food product is stored below raw ingredients in the fridge*.	1 (10)	0 (0)	0 (0)	1 (3)
• Food product is left at room temperature for storage**.	8 (80)	5 (50)	8 (80)	21 (70)

**when a participant obtained a medium risk score of at least 100 for each malpractice.
*when a participant obtained a low risk score of at least 10 for each malpractice.

In this study, participants were instructed to 'retain a second portion of the prepared food for meal the next day, then leave the food product in the kitchen how and where you would store it for this period time as you normally would at home'. However, 70% participants left cooked foods for storage at room temperature and 37% of participants failed to cover cooked foods for storage and many placed cooked foods into the fridge within 30 minutes of removal from the heat.

5.6 DISCUSSION.

5.6.1 Introduction

Design, development and organisation of the model domestic environment, observational checklists and a risk based scoring system has enabled a quantitative evaluation of consumer food safety behaviours. In the following discussion, the developed observational technique will be discussed and pilot observational data will be compared to findings from other consumer food safety observation studies.

5.6.2 Organisation of the model domestic kitchen.

The model domestic environment was designed to represent a domestic home kitchen and included equipment, utensils, crockery and cleaning materials that are commonly used in domestic homes. This created an environment where food preparations could take place in as 'naturalistic' an environment as possible – a factor that may enhance the validity of findings.

The use of non-concealed, yet non-prominent CCTV cameras used for observation of meal preparations in the model kitchen alleviated the potential for direct observer reactivity and consequential bias. Furthermore, videoed meal preparations were replayed for a detailed analysis of consumers' food safety behaviour.

5.6.3 Recruitment of participants.

Recruitment processes used for other consumer food safety observation studies have included attracting interest and subsequent willingness to participate from presentations given at local community groups (Worsfold and Griffith, 1997a) and asking for participation from students in University lectures (Mullen, 1997). In American studies, acquaintances of employees of Audits International were simply asked to be subjects observed meal preparations (Audits International, 1998; 1999; 2000). All of the recruitment processes undertaken for previous consumer food safety observational research have not screened consumers for suitability or used standardised or random research methods. Thus, for this study, recruitment of consumers was undertaken by professional market research company, and a recruitment questionnaire to screen potential participants for suitability. The recruitment questionnaire was designed to ensure that all participants were used to handling raw meat / poultry, were used to preparing food and were independent from any other food safety research / market research programme.

Use of the more structured and representative method of recruitment enabled a broad section of the population to be included in this study – as opposed to pocketed groups of society such as University students

(Mullen, 1997), those who attend community groups (Worsfold and Griffith, 1997a) or those who had an association with employees from a specific organisation (Audits International, 1998; 1999; 2000).

In this study, telephone recruitment interviews were conducted throughout the day until 9pm, so to include persons who worked during the day. The only consumers who were excluded from potential recruitment were those without telephones. However, given that the majority of households own a telephone (BT, 2002) and organisation of meal preparation sessions would be difficult without telephone contact, such an issue was not seen to be a problem.

Thirty percent more consumers were recruited than actually attended the meal preparation sessions. In an attempt to reduce over-recruitment requirements for future observational studies, it was considered that a face-to-face recruitment process could be used. Furthermore invitations could be given to recruits and free transportation could be offered to and from the meal preparation session (see Chapter 7.0 and 8.0).

5.6.4 Organisation of meal preparation sessions.

Use of the developed telephone and meal preparation protocols facilitated consistent organisation of meal preparation sessions. Meal preparations were carried out by participants who indicated familiarity with the required recipe methods. Informal feedback from all of the participants after the meal preparations indicated that recipes were clear and methods were understood and could be easily followed.

After all of the individual piloted meal preparations, all participants were asked if they had any problems finding equipment / utensils in the kitchen, and whether they thought that any other utensils etc. were needed. Responses were all positive and no additional equipment / utensils needed to be added to the model kitchen.

5.6.5 Observations of meal preparations in the model domestic kitchen.

5.6.5.1 Development and use of observational checklists.

To conduct an evaluation of domestic food safety behaviours it is necessary to devise an appropriate measuring instrument that can be used for recording of data (Worsfold, 1994). Thus, designed and developed observational checklists facilitated the recording of food safety malpractices during food preparation sessions. Use of detailed checklists provided a structured approach to this observational study and this reduced the potential for observer bias, and enhanced the reliability of the data collected (Malhotra and Birks, 2000).

Determination of an *intra*-observer reliability coefficient is a measurement of variation that occurs within an observer as a result of repeated exposure to the same stimulus (Streiner and Norman, 2001). An acceptable measure of *intra*-operator reliability was obtained after 15 videoed meal preparations were analysed on two separate occasions. Thus indicating that data recorded (by one researcher) from repeated observations (n=2) of the same food preparation sessions (n=15) yielded statistically consistent measurements. If observational checklists and the risk based scoring system were to be used by other researchers there would be a need to determine a measurement of *inter*-observer reliability to ensure that observed measurements were consistent between observers. *Inter*-observer reliability is relevant when more than one observer is carrying out the assessment (Breakwell *et al.* 1995). It is noted that no other consumer food safety observational studies have determined measurements of observer reliability.

5.6.5.2 Development and application of the risk based scoring system.

In this study, to quantify observed food safety behaviours recorded on observational checklists, numerical values have been allocated to food safety malpractices. Use of the risk based scoring system designed for this study has a generic application to all meal and recipe preparations. Application of the logarithmic scale (1000, 100, 10) to high, medium and low risk actions enabled numerical scores to be weighted towards high risk actions (see section 5.6.6). Since the initial development of the scoring system in this study, Audits International (1998; 1999; 2000) have also employed the method of quantifying what they have defined as 'critical, major and minor violations' during observed meal preparations. Such critical, major and minor violations, like in this study, have been allocated scores of 1000, 100 and 10 respectively (Audits International, 1998; 1999; 2000). Differences between such a scoring system and the one developed in this study are described below.

Unlike previous consumer food safety observation studies (Audits International, 1998; 1999; 2000; Jay *et al.* 1999a; Mullen, 1997), use of observational checklists and risk based scoring system developed in this study facilitated quantification of the *frequency* that food safety malpractices were implemented. Previous studies have only accounted for implementation of individual food safety malpractices. Given that the frequency of implementation of food safety malpractices may have important implications for the extent that a domestic kitchen may be contaminated, it is important to account for frequency of malpractices when quantifying food safety behaviour. Thus, repeated malpractices within the same meal preparation session could be accounted for and quantified. Furthermore, attainment of risk scores also provided data denoting a more simple implementation / failure of individual food safety actions, which allowed data from this study to be comparable with previous consumer food safety observational research. The capability of risk scores to provide quantitative data denoting frequency of actions had particular relevance for assessment of consistency of food safety behaviours (Chapter 6.0) and also for evaluation of the effectiveness of interventions (Chapter 8.0).

5.6.6 Pilot study: quantitative evaluation of food safety behaviours.

Quantitative total risk scores representing observed food safety malpractices indicated that all consumers implemented unsafe food preparation behaviours during meal preparations. The variability between different individuals' food safety malpractices during preparation the same meal (1, 2 or 3) was reflected in the overall risk scores obtained. Thus corresponding with previous research findings that indicate that some consumers implement a wide range of safe practices, whilst others do not (Anderson *et al.* 2000; Griffith *et al.* 1999a; Jay *et al.* 1999a; Worsfold, 1994). The standard of food preparation that was set by the risk based scoring system, based on the implementation of all control measures, was not an unrealistic ideal because in this pilot study a broad variability of total risk scores was attained, ranging from <2,000 to nearly 25,000. Thus, findings showed that some participants implemented the majority of the control measures necessary to ensure preparation of safe food, whereas others did not.

An analysis of a breakdown of total risk scores in terms of allocation of high, medium and low risk malpractices has shown that larger, total risk scores are mainly due to the implementation of a larger number of high risk malpractices that are critical to the safety of the end product (see section 5.4.5.1). Thus, the use of the logarithmic scale for scoring food safety malpractices was found to be effective for the assessment of food safety malpractices in terms of risk.

A comparison of total risk scores between observed meal preparations of Meal 1 (Korma, Mousse), Meal 2 (Burger, Salad, Sandwich) and Meal 3 (Roast chicken, Zabaglione) showed that larger risk scores were attained for preparation of Meal 2 (Burger, Salad, Sandwich). The complexity of Meal 2 (opposed to Meals 1 and 3) involved increased opportunities for cross contamination where critical control of food safety hazards was required. Because many of such critical control measures were not implemented, risk scores for Meal 2 (Burger, Salad, Sandwich) were greater than for other meals.

5.6.7 Observed consumer food-handling malpractices.

Observation data from this study has shown that many high, medium and low risk malpractices are implemented during domestic food preparation. Indeed, 100% of consumers who participated in this pilot study failed to implement all of the appropriate food safety practices during meal preparations. Overall results from this study concur with findings from previous consumer food safety observation studies (Anderson *et al.* 2000; Audits International, 1998; 1999; 2000; Griffith and Worsfold, 1994b; Jay *et al.* 1999a; Worsfold, 1994). Thus suggesting there is a need for improvement of domestic food hygiene practices to decrease the potential microbiological risks associated with foodborne disease.

Allocation of risk scores facilitated the determination of the number of participants who failed to implement food safety actions during food preparations. Commonly implemented generic food safety malpractices implemented were comparable to findings from other domestic food safety observational studies. Observed generic food safety malpractices and subsequent implications will be discussed in the following sections.

5.6.7.1 Hand-washing and hand drying.

Failure to wash and dry hands immediately and adequately when necessary occurred during all observed meal preparations. Such results concurred with the Australian consumer food safety observation study which reported that 'infrequent washing of hands and poor hand-washing technique' was the most frequently unhygienic practice observed during the course of study (Jay *et al.* 1999a). This is of concern as poor hand-washing practices are reported to increase the likelihood that individuals will contract foodborne illness in the home situation (Jay *et al.* 1999a). Larger proportions of consumers from this study and the Australian observation study implemented improper hand-washing and hand drying actions than in other studies. For example, in the UK, Worsfold and Griffith (1997a) found that 66% of consumers implemented hand-washing malpractices, and American data suggests that only 27-29% of consumers have neglected hand-washing actions (Anderson *et al.* 2000; Audits International, 2000). Discrepancies between findings may be due to methods of observation and consequential effects of social desirability bias due to direct observer reactivity. In addition, all previous observational research detailing such actions have failed to account for the adequacy of drying actions for decontamination of hands, whereas data collected for this study has accounted for hand drying actions, which were repeatedly and poorly implemented. The importance of hand drying has previously been reported (Michaels *et al.* 2001b) and results have suggested that more participants implement adequate hand-washing and adequate hand drying in isolation, than in combination. Many food safety interventions (FSA, 2002b; MAFF, 1995; Partnership for Food Safety Education, 1997) have only focussed upon hand-washing actions. Results from this study suggest that emphasis of both hand-washing *and* hand drying processes should be targeted in future consumer food safety education initiatives.

In this study, larger proportions of participants (64-71%) failed to wash and dry hands after handing raw chicken and raw egg compared with raw sausage meat (30%), or minced beef (50%). Given the microbiological risks associated with handling of particularly raw chicken it is suggested that food safety education is required to improve hand-washing and hand drying actions. Observation results showed that the majority of participants in this pilot study failed to wash and dry their hands, both after handling raw chicken, meat and eggs *and* the corresponding packaging. Such packaging may be a potential source of pathogenic contamination in the domestic kitchen (Harrison *et al.* 2001a), and it is suggested that food safety education initiatives are required to inform consumers about the risks of handling packaging as well as the raw foods.

It is reported that increased failure to implement hand-washing and hand drying after handling potentially contaminated foods or packaging increases the likelihood of transmitting infection (Pether and Gilbert, 1971). Given that the majority of consumers failed to wash and dry their hands (when necessary) between 5-14 times during food preparation, consumer food safety education initiatives are required to address and potentially reduce such an occurrence.

A common reason why adequate hand-washing was not achieved during food preparation was because many participants who attempted to wash their hands touched the tap handle before and after 'washing'. Indeed, such actions were observed on 43 occasions before and after 'washing' hands by 60% (18/30) of participants. Such a practice was particularly prevalent after handling the raw chicken carcass during preparation of the roast chicken. Other consumer food safety studies have not reported upon such an action, however, Chen *et al.* (2001) found that bacteria can be transferred from a contaminated hand, to a tap handle after just one contact (see Chapter 2.0 for transfer rates). Avoiding hand contact with contaminated tap handles may help to minimise the level of contamination onto the hand, and thus reduce the spread of bacterial contamination throughout the kitchen (Chen *et al.* 2001). It is suggested that touching the tap handle is to be avoided during the hand-washing process, and this should be focused upon in future food safety education initiatives.

5.6.7.2 Use of chopping boards and knives for preparation of raw meat / chicken and RTE foods.

In this pilot study selected recipe methods (see Appendices 5.1, 5.2 and 5.3) encouraged the use of chopping boards and knives during meal preparations, thus enabling observations of correct and incorrect practices to be made. Results from this study showed that marginally more consumers failed to use separate / adequately washed and dried knives for preparation of raw meat / chicken and RTE foods than did chopping boards. Cumulatively, 77% participants failed to use separate / adequately washed and dried knives *and / or* chopping boards for preparation of raw meat / chicken and RTE foods. Thus, at least a three-quarters of participants failed to use safe practices for preparation or raw and RTE foods when using knives *or* chopping boards during meal preparation sessions. Such participants may know about correct handling procedures, yet for some reason fail to implement the correct behaviours for knives and chopping boards all of the time. Indeed, other consumer food safety survey based research has indicated that the majority of consumers have demonstrated knowledge of this subject (ADA Conagra, 1999; Bloomfield and Neal, 1997; Lader, 1999). However this, and other observational research demonstrate that knowledge of correct food safety practices is not always translated into corresponding safe behaviours (Redmond and Griffith, 2003a).

Observed usage of utensils for preparation of raw and RTE foods in this study are not directly comparable with findings from other consumer food safety observational studies. Different studies have recorded food safety malpractices using different criteria which have largely dependent upon food preparation methods being observed. For example, Worsfold and Griffith (1997a) reported the proportion of consumers who prepared ingredients upon a 'dirty' board, and Anderson *et al.* (2000) did not observe food preparations requiring cutting actions of raw and RTE foods and thus were unable to report on such specific practices.

In this study, preparation methods of the different recipes appeared to influence use of utensils during meal preparations. For preparation of the Roast chicken there was less need to use a chopping board and knife, and consequently fewer consumers implemented unsafe practices. However preparation of the Chicken salad, Beef-burger and Sandwich required many cutting actions and consequently more unsafe practices were observed.

Given that substantial microbiological risks are attributed to malpractices associated with use of utensils during preparation of raw and RTE foods (as discussed in section 2.4.5.1 and 5.4.5.1) there is a need to target such food preparation actions in future food safety education initiatives.

5.6.7.3 Potential contamination of kitchen environment during food preparation.

Many studies assessing the microbial content of the domestic kitchen have isolated organisms from kitchen work surfaces (see section 2.6.2). This is not surprising given that in this study, only one consumer did not directly or indirectly potentially contaminate the preparation environment with raw foods, utensils used to prepare raw foods, or raw food packaging. Thus, 97% of meal preparations the preparation environment was potentially contaminated and for no such instances were appropriate cleaning practices then implemented. Indeed, during 17% (5/30) of meal preparations, the kitchen environment was potentially contaminated on >10 occasions. Although previous research has indicated that the domestic kitchen is potentially contaminated during preparation of raw meat, poultry, eggs, specific quantified methods of the extent of such potential contamination has largely been understudied. Nevertheless, several workers have observed cleaning procedures that consumers employ to attempt to decontaminate preparation work surfaces (Anderson *et al.* 2000; Jay *et al.* 1999a; Worsfold and Griffith, 1996b).

Results from this study have shown that between 37-45% consumers potentially contaminated the preparation environment with raw chicken, raw meat and raw egg. Humphrey *et al.* (1994), demonstrated that following the mixing of raw egg (for example, when preparing the Chocolate Mousse and Zabaglione), *Salmonella enteritidis* could be recovered from work surfaces up to 40 cm from the mixing bowl in droplets of egg. Thus providing a suitable environment for prolonged survival of the bacteria and therefore a source for further cross contamination of salmonellas within the kitchen. Similarly, other research has demonstrated direct and indirect cross contamination of pathogens from raw chicken to kitchen work surfaces (see section 5.4.5.2). Of further concern is the fact that moist surfaces with food debris aid the survival of pathogens (Gabis and Faust, 1988) therefore, direct contact between raw foods and kitchen work surfaces should be avoided.

Potential contamination of the kitchen surface from utensils contaminated with raw meat, poultry or eggs occurred on between 27-100% occasions. Variability of implementation of this malpractice may have been due to different methods employed for the preparation of different meals. Although the contamination rate associated with placement of a contaminated utensils onto a work surface is relatively low (Redmond *et al.* 2001), data suggests that implementation of such a malpractice does constitute a food safety risk in the domestic kitchen, especially if not followed by adequate cleaning practices. Previous research indicates that substantially fewer (18%) consumers placed raw food packaging onto the work surface during food preparation (Worsfold and Griffith, 1997a). Differences between data from this study and previous data may be due to different recipe methods required for food preparation.

One of the most frequent hygiene malpractices observed in the Australian consumer food safety observation study was not removing packaging from the food preparation area during food preparation (Jay *et al.* 1999a). Whole RCP is reported to be a source of contamination of *Campylobacter* and *Salmonella* in the domestic kitchen (see section 2.4.4.1), and microbiological risks associated with placement of RCP onto a work surface have previously been described (see section 5.4.5.2). It is suggested that there is a need to incorporate the risks of contamination from RCP in the domestic kitchens in future food safety education initiatives.

5.6.7.4 Observed general food safety malpractices.

General food safety malpractices discussed in this section include washing of raw meat / poultry, washing of salad vegetables and fruit, and failure to wash potentially contaminated utensils immediately after use. Washing of raw meat and poultry were allocated medium risk scores. Observational results showed that no participants washed raw sausage meat and raw minced beef during meal preparations, however, nearly all (70%) participants 'washed' raw chicken carcasses under running water before roasting, and a third (30%) of participants 'washed' raw chicken fillets during preparation of a Chicken Korma. 'Washing' raw chicken is considered to be an action that is superfluous to the requirements of safe food preparation (Griffith *et al.* 1999b), and it is considered that the process of holding raw chicken under running water merely increases the microbiological risks of contamination within the domestic kitchen.

Observation results showed that 50% participants failed to wash salad vegetables (for the Chicken Salad and accompanying beef burger) and fruit (orange for the Chocolate Mousse and lemon for the Zabaglione). Data from this study corresponds with findings from Worsfold and Griffith (1997a) who observed 41% consumers fail to wash vegetables during food preparation. Similarly, Anderson *et al.* (2000) reported that washing of vegetables during food preparation was inadequate.

Overall, between 30-40% of participants failed to wash and dry potentially contaminated utensils immediately after use. Thus providing a further source of contamination in the kitchen environment (Griffith *et al.* 1999b; Scott and Bloomfield, 1990b). Such findings reiterate the need for consumers to be educated about the microbiological risks associated with specific cross contamination actions in the domestic kitchen.

5.6.7.5 Heating efficacy.

Observation results have shown that a large proportion of consumers failed to heat foods for the required lengths of time, and no consumers used meat thermometers provided to determine end-point cooking temperatures. Variability between heating efficacy for different foods suggested that there is an association between heating methods used and heating efficacy. Inadequate heating was particularly prevalent for heating of raw egg mixtures over a pan of boiling water (for Chocolate Mousse and Zabaglione). This is concerning as research has indicated that undercooking of eggs can permit survival of pathogens (see section 5.4.5.1). Roasted chickens and grilled beef-burgers were also frequently undercooked during this study. However, 96% participants fried chicken pieces and heated the Chicken Korma for a sufficient length of time.

Variability of cooking efficacy has also been determined by other workers, Anderson *et al.* (2000) observed that, according to Fight BAC! Standards (Partnership for Food Safety Education, 1997) many subjects (82%) undercooked chicken and 46% undercooked a meatloaf. However, contrary to such findings, Griffith *et al.* (1998) reported that most participants (85%) heated foods in accordance with guidelines provided. Similarly the Audits International studies (1998; 1999; 2000) reported that only 18-24% consumers failed to heat products adequately. Collectively, results from this study and previous research illustrate the need for consumer food safety education to reduce the occurrence of undercooking of foods.

5.6.7.6 ***Potential contamination of end products.***

In this study, all consumers touched cooked food products with their hands and / or unclean utensils. This practice occurred on more than 15 occasions for 23% of (7/30) meal preparation sessions. Thus presenting repeated risks of contamination from transient organisms from the skin (such as *Staphylococcus aureus*) and the possibility of the introduction of other pathogens present from raw foods. Data from this study has also revealed that more than a third of consumers potentially contaminated cooked food products with potentially contaminated, unwashed / inadequately washed hands and / or utensils that had previously been used for preparation of raw meat, poultry or eggs. Repeated implementation of such actions substantially increases the risk of contamination and subsequent potential for foodborne illness if such foods are consumed. In agreement with findings from this study, American data also determined that consumers' hands were frequent transfer agents for cross contamination to RTE foods (Anderson *et al.* 2000). However, contrary to such findings, and findings of the present study, Worsfold and Griffith (1997a) found that only 8-9% of consumers potentially contaminated cooked foods from 'handling' and / or from unclean utensils. Nevertheless, such food safety behaviours require improvement to minimise the risk of foodborne illness.

5.6.7.7 ***Cooling and storage.***

To date, very limited information has been obtained denoting the methods that consumers employ to cool and store cooked foods in the home. In this study, 97% of consumers failed to implement all of the food safety behaviours required to decrease the cooling period of cooked foods. This concurs with research undertaken by Anderson *et al.* (2000) who indicated that many consumers failed to cool foods quickly by implementing improper practices. An assessment of individual cooling practices showed that 63% of consumers covered the food product during cooling, thus slowing the cooling process. This action was performed particularly frequently (80% occasions) during cooling of roasted chicken carcasses, where in most cases, participants covered the entire cooked carcass with foil during the 'cooling' process. Observation results also showed that a quarter of participants either left food products in the saucepan (often with the lid on), in the frying pan that the food had been cooked in, or under a previously hot grill or oven. Such findings concur with research conducted by Worsfold (1994).

As participants were only present in the model domestic kitchen for a short period of time, observation of food storage practices was limited. However, participants were asked to 'retain and store a second portion of the foods they prepared, as if to be consumed the following day'. Overall, 73% of participants left foods to be stored at room temperature. Given the limitations of the research project, it is not possible to provide information concerning whether such food products would have been placed in the refrigerator at a later time for storage. However, Worsfold (1994) found that cooked foods were stored at room temperature on average for ~2 hours after heating, thus providing opportunities for growth of pathogenic micro-organisms present.

In addition to food being left at room temperature, a variety of low risk food safety malpractices were observed that contribute to inadequate storage of food. Thirty-seven percent of participants placed food into the refrigerator within 30 minutes of removal of the heat. Thus potentially increasing the temperature of the refrigerator. Conventional refrigerators are not designed to chill food rapidly and the introduction of hot foods may cause the temperature to rise so that all foods within the cabinet are above 5°C (Worsfold and Griffith, 1997a). Fifty percent of participants stored the roasted chicken on the bone and 30% stored the sausage meat in the neck of the roasted chicken. Both such practices are not considered to be adequate food safety behaviours (see section 5.4.5.3). Only one participant stored the cooked food below raw meat, such an action may have been influenced by the research situation, given that only two portions of each meal were required for preparation and limited foods were provided in the refrigerator, unlike in a 'normal' fridge which would probably be stocked with a larger amount and greater variety of foods. To date, no other consumer food safety observation studies have reported specific actions related to the storage of leftover foods. However, research conducted by Audits International (1998; 1999; 2000) indicated that between 24-29% of consumers have demonstrated 'improper treatment of leftovers'. Similarly, Anderson *et al.* (2000) reported that consumers did not store leftover foods 'properly'. In view of this, and of findings from this study, it is suggested that educational efforts are required to improve such behaviours.

5.7 CONCLUSIONS.

It can be concluded that organisation of a model domestic kitchen with CCTV, and use of observational checklists and a risk based scoring system were effective for the evaluation of consumer food safety behaviours. The model kitchen provided a controllable, yet naturalistic, environment equipped with sufficient domestic utensils and equipment to facilitate home preparation practices. Unlike in previous consumer food safety observation studies, such an approach facilitated measurement of *intra*-observer, and potentially *inter*-observer reliability of data collection. Furthermore, observed meal preparations in the model kitchen facilitated a consistent evaluation of food-handling behaviours, thus providing a suitable, controlled environment for the collection of data detailing consumer food safety behaviours.

The types of food that were selected for meal preparations were representative of home cooking ingredients that are commonly implicated in incidence of foodborne disease. Furthermore, food preparation processes in the selected meal preparations included opportunities for handling raw and cooked foods, actions that were potentially hazardous unless implemented correctly, elements of judgements for cooking procedures and process steps that are known to be important to food safety.

Use of HACCP principles facilitated hazard and risk identification during meal preparation processes. Detailed observational checklists were developed to record the frequency of food safety malpractices implemented in each meal. Such checklists facilitated a consistent recording of food safety behaviours and enhanced the validity of findings. Development of the risk based scoring system was based on identification of high, medium and low risk actions allocated numerical values on a logarithmic scale (1000, 100, 10). The scoring system that was designed and piloted in this study could easily be modified for observation of meals with different foods and different preparation methods. Indeed, use of the scoring system to quantify food safety malpractices implemented in three different meals in this pilot study illustrated the potential generic application of the system.

An analysis of total risk scores from the pilot study showed that a larger number of high risk actions had been implemented by persons who attained risk scores >15,001, when compared to those who attained risk scores of <15,000. Thus, it can be concluded that risk scores allocated to observed food safety malpractices reflected the associated risk presented by the malpractices implemented during food preparation. Furthermore, use of a risk based quantitative approach has enabled comparisons to be made between overall and specific behaviours between and within meal preparations.

Pilot observation results showed that all consumers implemented food safety malpractices during meal preparations and overall findings are comparable to previous consumer food safety observational research. Actions relating to cross contamination were particularly poorly performed. Specific hand-washing and hand drying actions require targeting in food safety education attempts and additionally consumers need to be informed about the microbiological risks of the contamination of raw meat and poultry packaging. Furthermore, many participants failed to implement appropriate food safety behaviours associated with using the same utensils for preparation of raw meat / poultry and RTE foods. Thus there is an imperative need for targeted food safety education to attempt to improve such behaviours.

Results showed that the food preparation process largely influences the number of food safety malpractices implemented. Increased opportunities for cross contamination in selected recipes resulted in increased malpractices being implemented. In addition, heating efficacy of foods appeared to be influenced by the heating method used. It is therefore suggested that future food safety education initiatives should target specific heating methods, as opposed to treating adequate heating as a generic practice. Observed cooling and storage practices of cooked foods implemented by consumers were considered to be inadequate. Previous research has indicated confusion regarding knowledge of 'correct' cooling and storage practices (Redmond and Griffith, 2003a), and observations in this chapter of such behaviours were testament to that confusion. Future food safety education of such issues needs to address and alleviate such misunderstandings.

Baseline food-handling data collected from pilot study observations confirmed the need for food safety education initiatives. Determination of actual food safety malpractices provides information that can help identify specific behavioural objectives and behavioural determinants for targeted food safety education interventions.

The developed observational technique with risk based scoring has facilitated more detailed information about consumer food safety behaviour than any other previous consumer food safety studies. Furthermore, the model kitchen and recording instruments facilitate the assessment of the reproducibility and consistency of food safety malpractices implemented in domestic food preparation (Chapter 6.0) and provide quantitative measurements for the evaluation of behavioural change related to intervention effectiveness (Chapter 8.0).

CHAPTER 6.0

RELIABILITY AND REPRODUCIBILITY OF THE OBSERVATIONAL TECHNIQUE.

6.1 INTRODUCTION.

Following the design, development and piloting of the observational technique for assessment of consumer food safety behaviours, there was a need to evaluate the reliability and reproducibility of the observational technique.

6.2 REVIEW OF LITERATURE.

Reliability concerns the extent that a measurement is repeatable and consistent (Martin and Bateson, 1995). Research is reliable to the extent that its components are consistent with one another and it can be replicated and yield similar outcomes (Cowan, 2002; Kay, 1994). It has been reported that any measurement that is used in life should be reliable, if not, it is useless (Coolican, 1999), and thus there are a variety of forms of reliability that can be calculated.

Forms of reliability applicable to consumer food safety research have previously been discussed (Redmond and Griffith, 2003b). Forms that are applicable to observational research in this thesis include intra-observer reliability (see Chapter 5.0) and test-retest reliability. Test-retest reliability is an assessment of the stability or consistency of a measure (e.g. the reproducibility of the responses on a scale) over a period of time (Bowling, 2000). Use of this approach assumes that there is no substantial change in the construct being measured between occasions of assessment (Trochim, 2001).

Observation study settings may occur in natural (uncontrolled) or artificial (controlled) environments, both of which have advantages and disadvantages. It has been reported that observations carried out in the natural environment are more realistic than in a laboratory, however, extraneous variables are poorly controlled in the natural environment and replication of collected data is more difficult (Coolican, 1999).

Concerns regarding the reliability of observational data include excessive variance between observers or observational situations, observer bias, inaccurate recording of observed behaviours (Gittelsohn *et al.* 1997). For this study, an additional consideration pertains to the reproducibility of food safety behaviours implemented in familiar home kitchens and the model domestic kitchen. When undertaking observational research in a model / laboratory environment of sorts, there is a need to compare observed behaviours in both environments to ensure that data collected in the model environment is truly representative of behaviours under investigation.

The use of a single observation to identify behaviours that are risk factors for poor outcomes assumes that the behaviour is largely habitual (Curtis *et al.* 1993). To date, no published research has been carried out regarding the consistency of food safety behaviours implemented during domestic food preparation. In addition, none of the published observational studies (Anderson *et al.* 2000; Jay *et al.* 1999a; Worsfold and Griffith, 1997b) have assessed methods and techniques used for collection of actual consumer food safety behaviours in terms of reliability. However, several observation studies in under-developed countries have examined the variability and repeatability of hygiene behaviours related to child defecation and stool disposal (Cousens *et al.* 1996; Curtis *et al.* 1993). Results suggested that repeatability of behaviours pertaining to such parameters were moderate (Cousens *et al.* 1996).

It has been suggested that before the observational technique can be utilised for evaluation of intervention effectiveness, (see Chapter 8.0) therefore, there is a need to determine the reliability of the method used for measuring such behaviour (Cousens *et al.* 1996). A classic intervention study requires assessment of behaviour before and after intervention (Ovretveit, 1998) and the observational technique and risk based scoring system developed in Chapter 5.0, has potential for obtaining outcome measurements representing actual food safety behaviours before and after intervention (see Chapter 8.0). Thus, the reliability of the technique for measuring food safety behaviours in the model domestic kitchen is required, as is the consistency of implementation of specific food safety behaviours over time. Use of such data will not only validate single observations made during meal preparations in the model kitchen as being representative of participant behaviours, but also validates the use of the technique as a credible means for evaluation of the effectiveness of food safety education interventions.

6.3 AIMS AND OBJECTIVES.

6.3.1 Aims.

- Determine the reproducibility of consumer food safety behaviours between observed meal preparations carried out in the model domestic kitchen and consumer home kitchens.
- Assess the reliability of the observation technique as a tool for measurement of food safety behaviours.

6.3.2 Objectives.

- Observe repeated food preparations in the model domestic kitchen and in consumer home kitchens, and record food safety malpractices using an observational checklist and risk based scoring system developed in Chapter 5.0.
- Compare consumers *overall* food safety performance in the model domestic kitchen and consumer home kitchens using risk scores.
- Compare the failure to implement *specific* food safety behaviours in the model domestic kitchen and consumer home kitchens using risk scores.
- Evaluate the variability of total food safety risk scores between participants during repeated meal preparations in the model domestic kitchen.
- Assess test-retest reliability to determine if consumer food safety practices are repeatable when the same meal is prepared more than once in the model domestic kitchen.
- Assess the familiarity effect of meal preparations in the model domestic kitchen.
- Determine the consistency of composite food safety malpractices observed during repeated preparations of the same meal in the model domestic kitchen.

6.4 METHODS.

6.4.1 Introduction.

Use of the observation technique and risk based scoring system provided a means to assess the representativeness of observational data detailing consumers' food safety behaviours collected in the model domestic kitchen. Furthermore, such data provided a means to determine the reliability of the observational technique.

6.4.2 Assessment of the reproducibility of food safety behaviours observed in the model domestic kitchen and consumer home kitchens.

To assess the consistency of data collected from observed meal preparations in the model domestic kitchen, repeated observations of food safety behaviours were made in the model domestic kitchen and in consumers' home kitchens

6.4.2.1 Recruitment of participants.

Participants were randomly recruited in Cardiff using the methods and recruitment questionnaire used in Chapter 5.0 (see section 5.4.6.1 and Appendix 5.10). Participants for this part of the study were recruited to participate in five repeated meal preparation sessions in the model kitchen and possibly five repeated meal preparations in their own home kitchen.

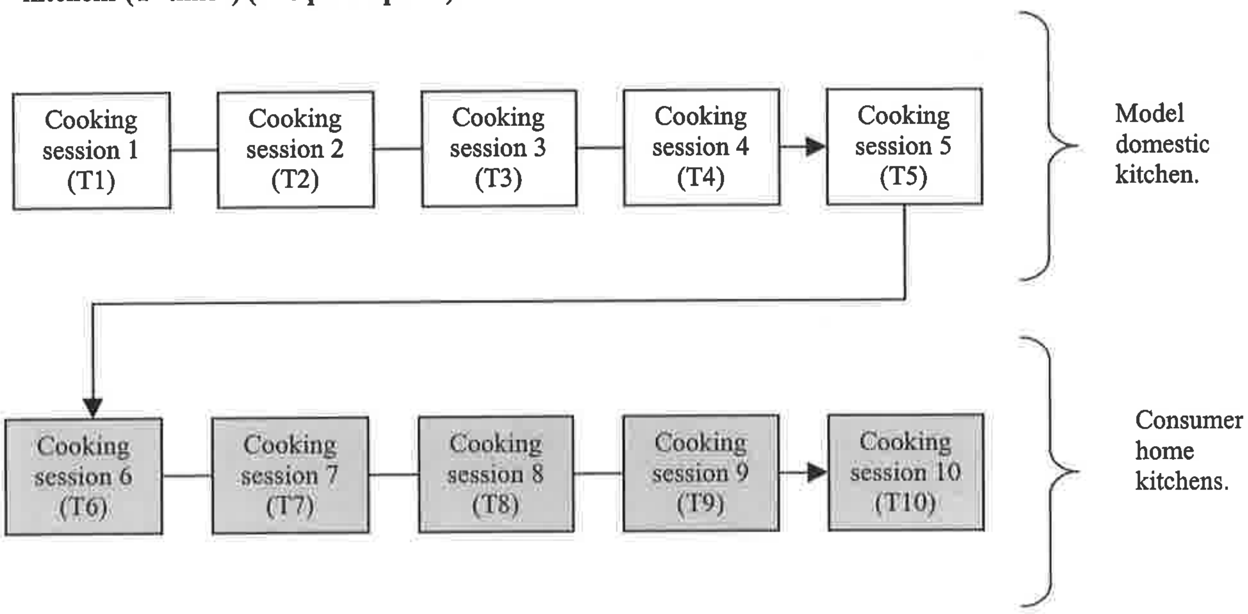
6.4.2.2 Organisation of repeated meal preparation sessions.

Each participant was recruited to prepare the same meal on five separate, consecutive occasions in the model domestic kitchen and a further five separate, consecutive occasions in their home kitchens (see Figure 6.1). The meal selected for repeated meal preparation sessions was Chicken Korma and Chocolate Mousse (Appendix 5.1).

The protocol for meal preparations undertaken in the model domestic kitchen was as developed and utilised in Chapter 5.0 (see section 5.4.6.2 and Appendix 5.13). For meal preparations in consumer home kitchens food was delivered to consumer homes between 12-24 hours before the arranged meal preparation session, and participants were instructed to 'not get anything ready beforehand'. Participants used all of their own utensils, equipment and kitchenware. The recipe card used in the model domestic kitchen was provided for each meal preparation session in consumer homes. Meal preparation commenced once the researcher arrived and direct observations were made by the researcher whilst being present in each of the home kitchens.

Participants were offered a £15 supermarket voucher incentive for the first meal preparation session and £10 voucher for each of the subsequent nine meal preparation sessions.

Figure 6.1 Repeated meal preparation sessions in the model domestic kitchen and consumer home kitchens (T=time*) (*n*=8 participants).



* Maximum length of time between T1 and T10 was 10 weeks (~one cooking session per week).

6.4.2.3 Recording of observed food safety behaviours.

Observational checklists for the Chicken Korma and Chocolate Mousse were used to record observed food safety malpractices implemented by consumers in the model domestic kitchen and in home kitchens. In consumer home kitchens observed food safety malpractices were memorised by the researcher during meal preparations, no data was written down or noted during observations or whilst at participant homes. This was achievable, as the researcher had substantial experience of observation of specific food safety malpractices and recalling such information for the observational checklists. Observational checklists developed in Chapter 5.0 were simplified to record failure or implementation of key food safety malpractices that could be remembered by the researcher, as opposed to accounting for frequencies of all actions implemented. Such observational checklists were also used to record food safety malpractices during observed meal preparations using CCTV (see section 5.4.1.2) in the model domestic kitchen. Risk based scoresheets were devised according to the risk based scoring system developed in Chapter 5.0. The observational checklist used for this part of the study can be found in Appendix 6.1 and corresponding scoresheet can be found in Appendix 6.2.

As in the pilot study (see section 5.4.6.3) participants who prepared meals in the model kitchen were aware that they may be videoed, however they were unaware that their food hygiene habits were subject of observation.

6.4.2.4 Analysis of data.

All observational data was entered into the Consumer Food Safety Access '97 database (see section 5.4.8.1) that had been specifically developed for this study. Each meal preparation was assigned a unique 'Practical_ID' and 'Participant_No.'. Analysis of data occurred using Excel '97 and SPSS for Windows 9.0. The following statistical analysis of the data was undertaken:

⇒ Assessment of consistency of overall food safety behaviours between observed and repeated meal preparations undertaken in the model domestic kitchen and consumer home kitchens (n=8 participants).

Mean risk scores from repeated meal preparations in the model domestic kitchen (n=5) and home kitchens (n=5) were determined for each participant (n=8). The percentage change of mean risk scores between meal preparations from both locations was also determined.

A t-test (two way, paired two sample for means) was carried out to see if there was a statistically significant difference between mean participant risk scores obtained from meal preparations carried out in the model domestic kitchen and the home. A two-tailed t-test was used to allow for differences in either direction.

⇒ Comparison of risk scores for composite food safety malpractices implemented during repeated meal preparations in the model domestic kitchen and participant homes (n=8 participants).

Mean risk scores representing key, composite food safety malpractices (see Appendix 6.3) obtained from meal preparations in the model domestic kitchen and home kitchens were compared.

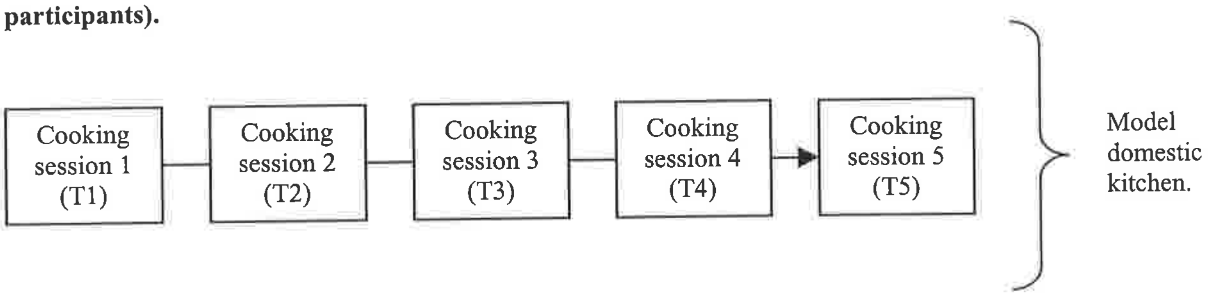
6.4.3 Assessment of the reliability of the observation technique.

To assess the reliability of the observational technique and to provide an indication of repeatability of food safety malpractices, repeated observations of preparation of the same meal were carried out in the model domestic kitchen. Participants were recruited as in section 6.4.2.1.

6.4.3.1 Organisation of repeated meal preparation sessions.

Each participant was recruited to prepare the same meal (Chicken Korma and Chocolate Mousse) (see Appendix 5.1) on five separate, consecutive occasions (at regular intervals) in the model domestic kitchen (see Figure 6.2). The protocol for meal preparations undertaken in the model domestic kitchen was as developed and utilised in Chapter 5.0 (see section 5.4.6.2 and Appendix 5.13). Participants were offered a £15 supermarket voucher incentive for the first meal preparation session and £10 voucher for each of the subsequent four meal preparation sessions.

Figure 6.2 Repeated meal preparation sessions in the model domestic kitchen (T=time*) (n=11 participants).



* Maximum length of time between T1 and T5 was 5 weeks (~one cooking session per week).

6.4.3.2 Recording of observed food safety behaviours.

Repeated meal preparations were observed in the model domestic kitchen using CCTV (see section 5.4.1.2). Detailed observational checklists developed in Chapter 5.0 (accounting for frequency of all actions) were used to record observed actions (see Appendix 5.4) and risk based scoresheets (devised in Chapter 5.0) were used to quantify food safety malpractices (see Appendix 5.8 and 5.9).

6.4.3.3 Analysis of data.

All observational data was entered into the Consumer food safety Access '97 database (see section 5.4.8.1). Each meal preparation was assigned a unique 'Practical_ID' and 'Participant_No.'. Analysis of data occurred using Excel '97 and SPSS for Windows 9.0. The following statistical analysis of the data was undertaken:

⇒ Evaluation of the variability *between* participants during repeated meal preparations (n=11).

The variability of total risk scores obtained from repeated meal preparations was determined using a One Way Analysis of Variance (ANOVA) with 'participant numbers' as the group variable. This approach was used to assess the degree that participants' mean total risk scores from repeated meal preparations varied in relation to the between participant variation.

⇒ Assessment of test-retest reliability (n=11).

Determination of a test-retest reliability coefficient enabled the stability of total food safety risk scores (representing all observed food safety malpractices) to be assessed over the period from Time 1 (T1) to Time 2 (T2). It was important to assess such reliability of food safety malpractices within the first two meal preparations in the model domestic kitchen as this is likely to represent the scenario in a before and after intervention study (as in Chapter 8.0). A standard reliability coefficient was determined using a One Way ANOVA whereby the dependent variable was 'total risk scores' and the independent variable was 'participant numbers'. Thus, measures of variance were provided between participants (i.e. P to Z) and within participants (i.e. from T1-T2). Such values were used to calculate the test-retest reliability coefficient using the following calculation:

$$\text{Reliability} = \frac{\text{Participant Variability}}{\text{Participant Variability + Measurement Error}}$$

(Streiner and Norman, 2001, p106)

The resultant reliability coefficient is expressed as a value between zero and one, where zero indicates no reliability and one represents no measurement error and perfect reliability (Streiner and Norman, 2001).

⇒ Familiarity effect of meal preparations in model domestic kitchen.

Determination of a familiarity effect is an assessment of whether a participants' food safety behaviours change as they get used to / familiar with the model domestic kitchen over time. Such familiarity may be associated with a learning effect in terms of knowing where equipment / utensils are stored and perhaps relaxing during meal preparation in an environment that is representative, yet different from their home. Determination of a familiarity effect is important for eliminating the potential for order effect of meal preparations carried out in the model kitchen and then participant homes as shown in Figure 6.1. To determine a familiarity effect during repeated meal preparations (n=5) of the Chicken Korma and Chocolate Mousse in the model domestic kitchen over time, (Time 1 to Time 5), a One Way ANOVA was carried out. The dependent variable in the calculation was 'risk scores' and the independent variable was 'time'. Thus, it was hypothesised that mean total risk scores and risk scores representing composite food safety malpractices from repeated meal preparations, over time, are equal. Such findings gave an indication of repeatability of consumers' food safety malpractices during preparation of the same meal on five occasions.

⇒ Determination of consistency of composite food safety behaviours during repeated meal preparations.

Counts of food safety malpractices (derived from risk scores) were grouped according to composite food safety malpractices. Mean counts of actions indicate the frequency that malpractices are implemented. The coefficient of variation (standard deviation / mean x 100) was determined to provide a standardised measure of dispersion (Argyrous, 2000) which enabled assessment of the consistency of different behaviours over time (T1 to T5).

6.5 RESULTS.

6.5.1 Introduction.

Repeated meal preparations in the model domestic kitchen and consumer home kitchens has enabled the reproducibility of food safety behaviours to be assessed and evaluated in terms of the representativeness of the data collected from the model domestic kitchen as opposed to consumer home kitchens. In addition, repeated meal preparations in the model domestic kitchen has enabled assessment of the reliability of the observational technique and consistency of composite food safety malpractices over time.

6.5.2 Assessment of reproducibility of observed food safety behaviours between repeated meal preparations undertaken in the model domestic kitchen and consumer home kitchens.

The meal preparations of eight participants, (80 observations), were assessed in the model kitchen and home kitchens using the observational technique and risk based scoring system developed in Chapter 5.0. Results showed that using a t-Test (two tail, paired two sample for means) there was no significant difference (t_7 = 1.42, p>0.05) between mean total risk scores (representing all observed food safety malpractices) obtained from repeated meal preparations carried out in the model domestic kitchen and home kitchens.

For this part of the study the maximum total risk score attainable from observed meal preparations in both model and home kitchens was 6,550 demerit points. Data presented in Figure 6.3 illustrates the mean total risk scores (n=5) for each of the participant's (n=8) meal preparations. It can be seen that mean risk scores ranged from 2,326 to 3,536 in the model kitchen (representing 36-54% of the maximum total risk score attainable) and from 2,176 to 2,744 from meal preparations undertaken in home kitchens (representing 36-42% of the maximum risk score attainable). Figure 6.3 also illustrates that consumers who participated in this study implemented a similar number of food safety malpractices.

The percentage change from mean risk scores from preparations undertaken in the model kitchen and home kitchens has been determined (see Table 6.1). Percentage change ranged from -32% to +16%, and it was observed that 63% (5/8) participants implemented fewer food safety malpractices during meal preparations in their own kitchen, and 37% (3/8) participants implemented fewer food safety malpractices in the model kitchen. Overall, a mean percentage change of -7% was determined between preparations in the model kitchen and home kitchens. This accounted for a difference of 260 demerit points, which represents only 4% of the total score attainable during meal preparation. Overall, this suggests that participants' food safety behaviours are reproducible between the model kitchen and home kitchens.

Figure 6.3 A comparison of mean risk scores (representing all food safety behaviours) obtained from participants' repeated meal preparations in the model domestic kitchen and own home kitchens.

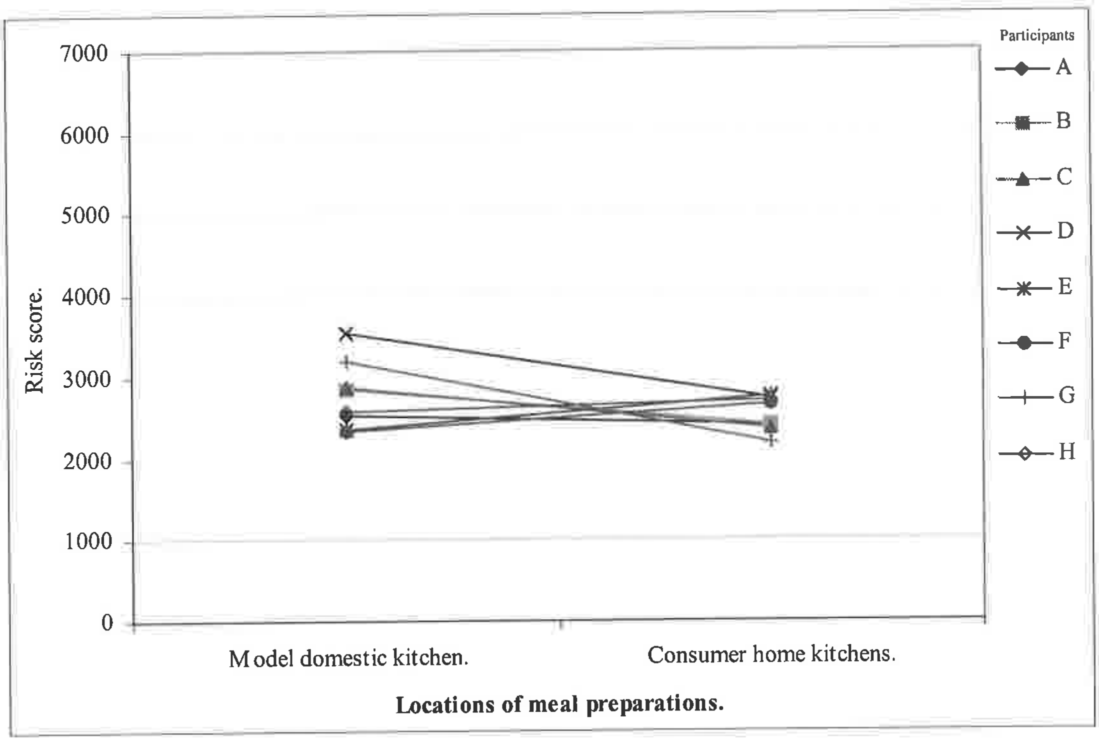


Table 6.1 Comparison of mean risk scores for comparable food safety malpractices implemented in the model domestic kitchen and participant home kitchens (*n*=8 participants).

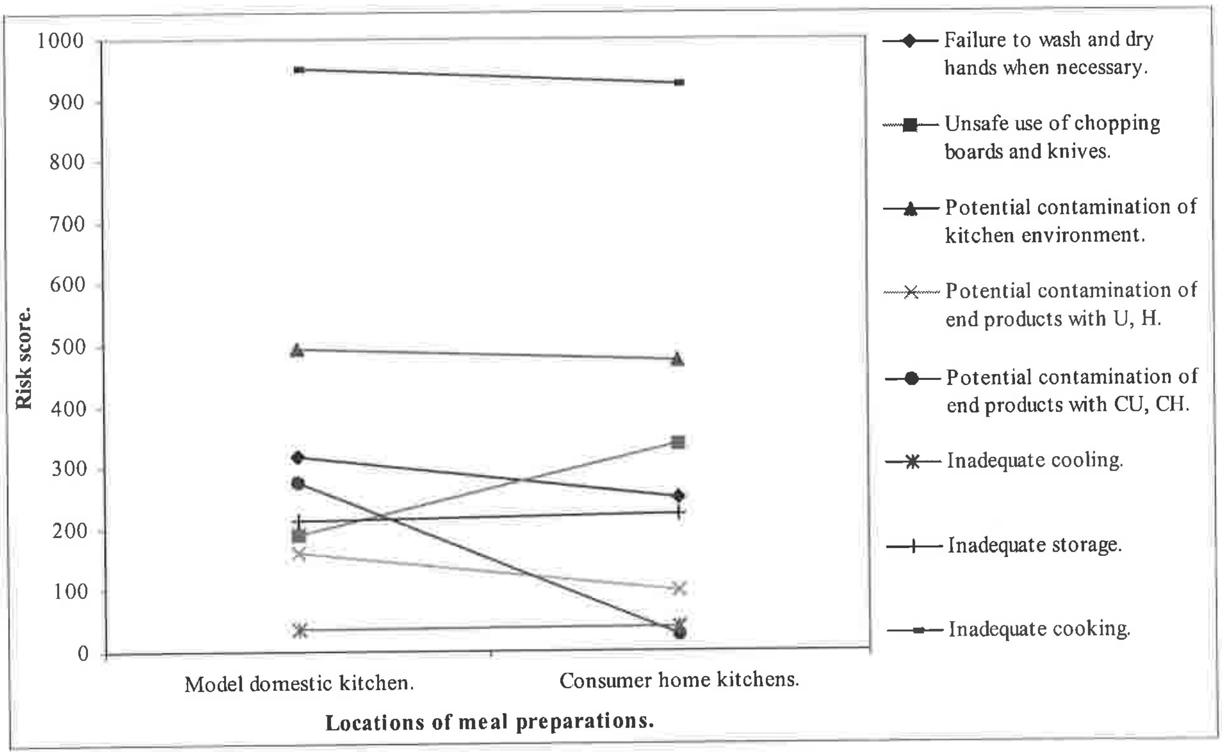
Participant.	Mean risk scores (*n*=5 meal preparations). Model domestic kitchen (T1-T5).	Participant home kitchens (T6-T10).	% change of mean risk score between model kitchen and home kitchens.
A	2526	2410	-5%
B	2848	2400	-16%
C	2872	2362	-18%
D	3536	2734	-23%
E	2356	2744	16%
F	2326	2644	14%
G	3200	2176	-32%
H	2590	2692	4%
Mean risk scores.	2782	2520	-7%

Table 6.2 Comparison of risk scores for generic food safety malpractices during preparation of a Chicken Korma and Chocolate Mousse in the model domestic kitchen and participant homes (*n*=8).

	▲ Composite food safety malpractices.	*Minimum – Maximum risk score possible.*	Mean risk score model kitchen (% of maximum score). (*n*=40 meal preparations by 8 participants).	Mean risk score home (% of maximum score). (*n*=40 meal preparations by 8 participants).
I	Failure to wash and dry hands when necessary.	*0 - 400*	318 (80)	247 (62)
II	Failure to implement safe use of chopping boards and knives.	*0 –600*	188 (31)	335 (56)
III	Potential contamination of preparation environment.	*0 – 700*	493 (70)	475 (68)
IV	Potential contamination of end products with U, H.	*0 - 200*	160 (80)	98 (49)
V	Potential contamination of end products with CU, CH.	*0 - 2000*	275 (14)	25 (1)
VI	Inadequate cooking efficacy.	*0 – 2000*	950 (48)	925 (46)
VII	Inadequate cooling practices.	*0 – 90*	35 (39)	38 (42)
VIII	Inadequate storage practices.	*0 – 360*	213 (59)	222 (62)

Key: ▲ For specific actions that make up composite food safety malpractices see Appendix 6.3; CU=contaminated utensil; H=hands; U=utensils; CH=contaminated hands.

Figure 6.4 Comparison of mean risk scores for composite food safety behaviours▲ during preparation of Chicken Korma / Rice in the model domestic kitchen and participant homes (*n*=8 participants).



▲ For specific actions that make up composite food safety malpractices see Appendix 6.3.

The reproducibility of composite food safety behaviours during preparation of the Chicken Korma and Chocolate Mousse has been determined from meals prepared in the model kitchen and consumer home kitchens. Mean risk scores obtained for all of the composite behaviours can be seen in Figure 6.4, which illustrates the relative reproducibility of composite food safety malpractices in both environments. Data presented in Table 6.2 indicates that the most reproducible composite food safety behaviours between the model kitchen and participant kitchens are actions related to temperature control including cooking, cooling and storage practices and potential contamination of the preparation environment. The mean risk score associated with failure to wash and dry hands adequately when necessary was greater in the model kitchen than in consumer homes. Conversely, the mean risk score representing failure to implement safe use of chopping boards and knives was greater in consumer homes than consumer home kitchens than the model kitchen. The largest difference in mean risk scores obtained from meal preparations in the two environments was for potential contamination of end products with potentially contaminated utensils / hands. Such an action was implemented more frequently in the model kitchen.

6.5.3 Variability between participants' food safety behaviours after repeated meal preparations of the same meal.

An assessment of variability *between* participants' food safety behaviours was determined using an One Way Anova. Results indicated there was a significant difference ($F=_{10,\,44}$ 4.164, $p<0.01$) between individual's ($n=11$) mean total risk scores. Data presented in Figure 6.5 shows that the variability between participants appears to be greater at Time 1 and Time 2 than after Time 3.

Determination of the Coefficient of Variation (CV) for total risk scores obtained from participant meal preparations enabled a comparison of values representing the consistency of individuals food safety malpractices when the same meal is repeated on five separate and consecutive occasions (see Table 6.3). CV's (expressed as comparable percentage) ranged from 11% to 33%. The lower the CV, the more consistent overall implementation of food safety malpractices. Thus, repeated meal preparations showed that participants 'P' and 'S' implemented the most consistent food safety behaviours and participant 'W' the most variable food safety behaviours.

6.5.4 Assessment of test-retest reliability.

Assessment of test-retest reliability has been undertaken using mean total risk scores from meal preparations carried out at Time 1 and Time 2 (see Figure 6.5), thus representing the scenario of a classic before and after intervention effect study. The test-retest reliability coefficient determined was 0.79. This value is considered to be reliable in a behavioural sciences setting, and thus provides an indication of a reliable measure of food safety behaviours implemented in the model domestic kitchen.

Figure 6.5 Total risk scores obtained from repeated meal preparations (T=time) (*n*=11 participants).

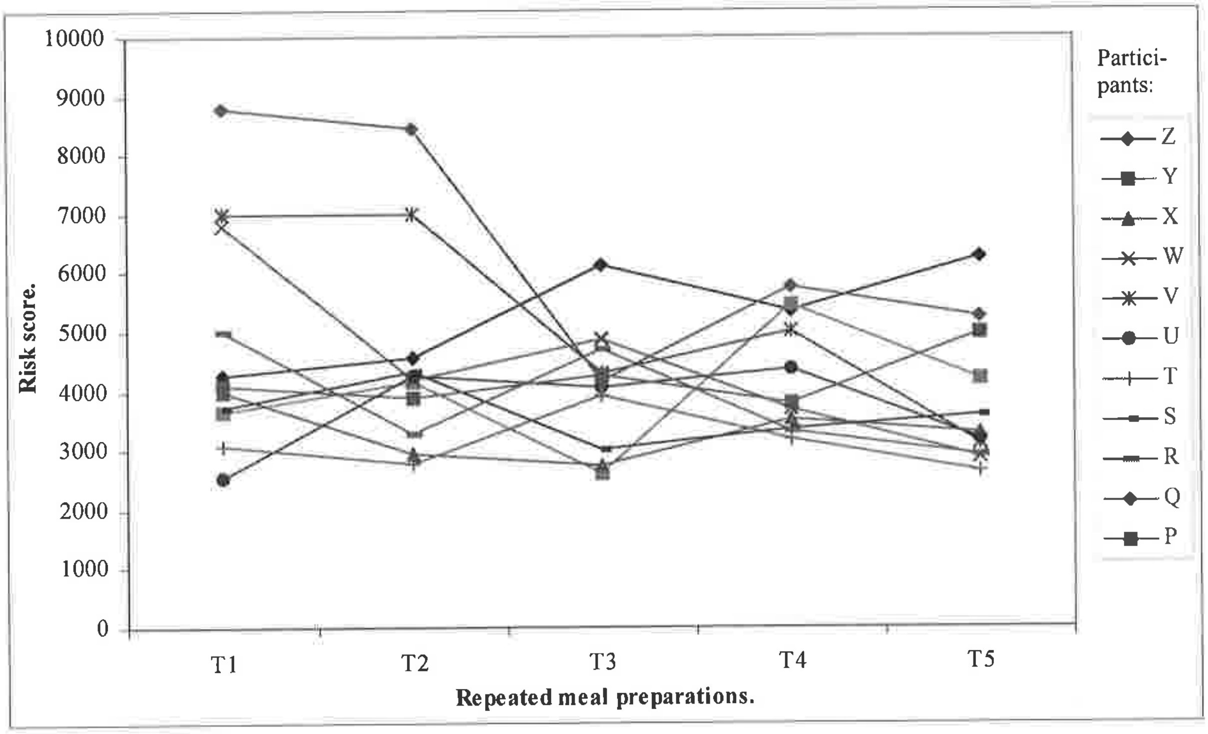


Table 6.3 Total risk scores derived from repeated meal preparations of Chicken Korma and Chocolate Mousse in the model domestic kitchen (*n*=11 participants).

Risk scores.	Participants.										
	Z	Y	X	W	V	U	T	S	R	Q	P
Time 1.	4240	3640	3980	6780	6980	2550	3090	3720	5000	8770	4080
Time 2.	4550	4140	2930	4180	7010	4270	2780	4320	3290	8450	3870
Time 3.	6110	2600	2730	4860	4290	4070	3920	3010	4700	4150	4270
Time 4.	5350	5440	3510	3680	5010	4370	3160	3360	3300	5740	3770
Time 5.	6240	4190	3290	2860	3100	3170	2640	3590	2900	5250	4980
Mean.	5298	4002	3288	4472	5278	3686	3118	3600	3838	6472	4194
SD*.	898	1027	492	1482	1709	793	497	484	944	2038	480
Minimum.	4240	2600	2730	2860	3100	2550	2640	3010	2900	4150	3770
Maximum.	6240	5440	3980	6780	7010	4370	3920	4320	5000	8770	4980
CV**.	17	26	15	33	32	22	16	13	25	31	11

*Standard deviation.

**Coefficient of Variation (%).

6.5.5 Familiarity effect of meal preparations in model domestic kitchen.

Overall, no significant differences ($F=_{54}0.79$, $p>0.05$) were identified between total risk scores (representing overall food safety behaviours) obtained from five, repeated meal preparation sessions. In addition, no significant differences ($p>0.05$) (with Bonferroni correction) were determined between each of the composite behaviours during the same time scale. Thus indicating that risk scores (and so food safety behaviours) do not improve or worsen as a result of becoming more familiar with the model domestic kitchen. In addition, determination of no familiarity effect also suggests no order effect was apparent between repeated meal preparations during the assessment of food safety behaviours in the model domestic kitchen and participant home kitchens (see 6.5.2).

6.5.6 Consistency of composite food safety malpractices implemented in the model domestic kitchen during repeated meal preparations.

Data presented in Table 6.4 and Figure 6.6 illustrate counts of composite food safety malpractices implemented during repeated meal preparations in the model domestic kitchen. Food safety malpractices most consistently implemented included inadequate cooking, inadequate cooling and storage practices followed by failure to wash and dry hands when necessary. Risk scores representing such composite behaviours were associated with a lower Coefficient of Variation and smaller standard deviations than risk scores representing other malpractices. The food safety malpractice associated with the biggest Coefficient of Variation was potential contamination of end products with contaminated utensils / hands. Indeed, none of the participants (n=11) implemented such an action during all five observed meal preparations.

Figure 6.6 Line graph of mean counts of composite food safety malpractices implemented during repeated meal preparations (T=time) (n=11 participants).

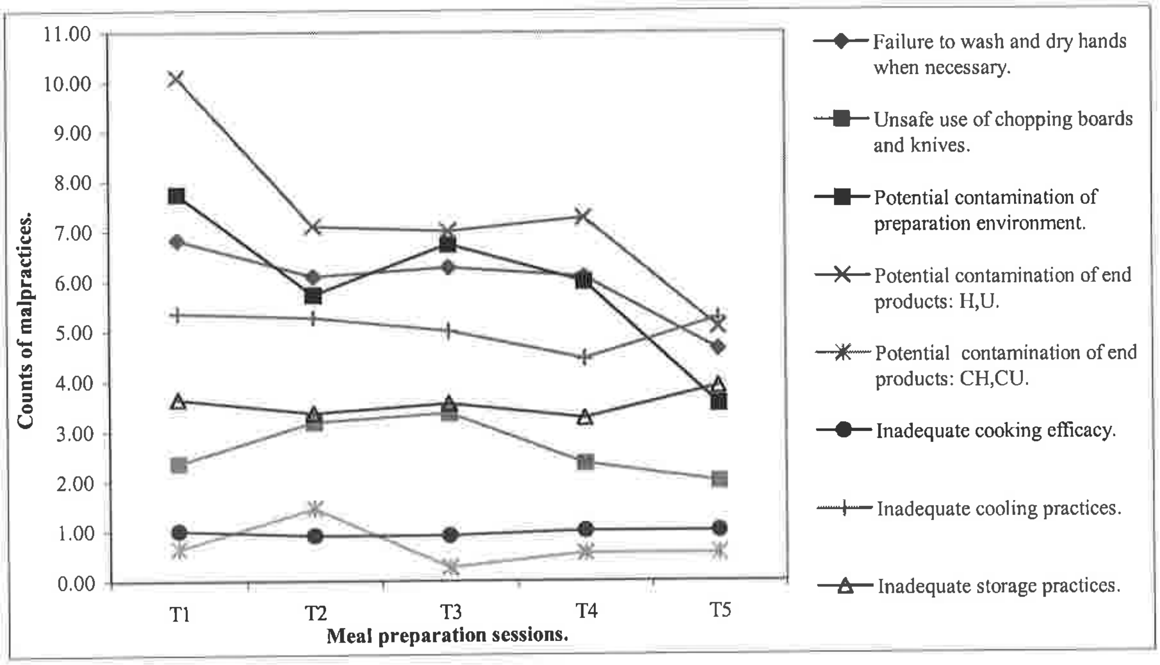


Table 6.4 Counts of food safety actions implemented to make up composite food safety behaviours during repeated meal preparations (*n*=11 participants).

	Composite food safety malpractices▲.	I Failure to wash and dry hands when necessary.	II Failure to implement safe use of chopping boards and knives.	III Potential contamination of preparation environment.	IV Potential contamination of end products: H,U.	V Potential contamination of end products: CH,CU.	VI Inadequate cooking.	VII Inadequate cooling practices.	VIII Inadequate storage practices.
Counts of food safety malpractices from Participants P –Z.	Time 1.	6.82	2.36	7.73	10.09	0.64	1.00	5.36	3.64
	Time 2.	6.09	3.18	5.73	7.09	1.45	0.91	5.27	3.36
	Time 3.	6.27	3.36	6.73	7.00	0.27	0.91	5.00	3.55
	Time 4.	6.09	2.36	6.00	7.27	0.55	1.00	4.45	3.27
	Time 5.	4.64	2.00	3.55	5.09	0.55	1.00	5.27	3.91
Mean.		5.98	2.65	5.95	7.31	0.69	0.96	5.07	3.55
Standard deviation.		0.81	0.59	1.55	1.79	0.45	0.05	0.37	0.25
Minimum.		4.64	2.00	3.55	5.09	0.27	0.91	4.45	3.27
Maximum.		6.82	3.36	7.73	10.09	1.45	1.00	5.36	3.91
Coefficient of Variation (%).		13.52	22.11	26.05	24.48	64.86	5.17	7.32	7.02

▲ For specific actions that make up composite food safety malpractices see Appendix 6.3.

6.6 DISCUSSION.

6.6.1 Introduction.

Use of repeated observations of meal preparations and the risk based scoring system facilitated the determination of reliability of the observational technique and reproducibility of food preparation behaviours between the model domestic kitchen and participant home kitchens. In addition, repeated meal preparations in the model kitchen provided data to indicate the consistency of implementation of composite food safety malpractices. It is noted that no previous literature detailing the consistency or reproducibility of consumer food safety practices is available, so the following discussion is largely based upon results and implications of the findings of this chapter.

6.6.2 Reproducibility of food safety malpractices between the model domestic kitchen and home kitchens.

Determination of the representativeness of observational data collected in the model domestic kitchen was considered to be very important for validation of the observational technique. Use of simplified checklists and the risk based scoring system enabled consistent collection of quantitative measurements of food safety malpractices. No significant difference between mean risk scores representing all food safety malpractices was identified between meal preparations observed in the model domestic kitchen and participant home kitchens. This suggests that overall implementation of food safety malpractices and habits related to food safety are reproducible between familiar home kitchens and the model kitchen. These findings concur with previous research that has suggested that behaviours' persons carry out in their natural environment are consistent with behaviours carried out in a similar environment in a different setting (Bloor *et al.* 1998).

It is of note that no familiarity effect was observed between the five repeated meal preparations undertaken in the model domestic kitchen. Given that no significant difference was determined between meal preparations in the model kitchen and participant home kitchens it can be assumed that no order effect was apparent between observed meal preparations in both environments.

Assessment of the reproducibility of composite food safety behaviours indicated that some behaviours may be marginally more reproducible than others in differing environments. Cooking, cooling, storage and potential contamination of the preparation environment with raw foods, corresponding packaging and potentially contaminated utensils were the most reproducible behaviours observed. Thus, findings suggest that some behaviours are more habitual than others. Risk scores representing failure to wash and dry hands immediately and adequately after handling raw chicken, raw chicken packaging, raw egg and / or raw egg shells were found to be slightly greater in participant home kitchens than in the model kitchen. Nevertheless, data collected from both environments suggest that hand-washing and hand drying actions need improvement during meal preparation in the domestic kitchen.

Failure to use separate or adequately washed and dried chopping boards, knives and or utensils for the preparation of raw chicken and then vegetables occurred more frequently in participant homes than in the model kitchen. This may have been due to the provision of a wide variety of chopping boards and knives in the model kitchen to accommodate for all participants' needs. Whereas in home kitchens, participants may not have owned and consequently been able to use such an array of equipment / utensils. It is noted however, that all participants who prepared meals in the model kitchen were instructed to use the same numbers and types of utensils and equipment that they would usually use at home. A consideration for future research in the model domestic kitchen may be to ask participants specifically how many chopping boards and knives (amongst other utensils) they own and use at home prior to the meal preparation session, and only provide them with as many for use during food preparation in the model kitchen.

Potential contamination of end products occurred more frequently in the model kitchen than in participant homes. It was noted that during the end of meal preparations in the model kitchen, participants tended to spend longer arranging and presenting the served food, particularly with their hands and consequently increasing the potential for contamination of the end product. At the end of meal preparations in participants' homes such practices were not observed as frequently.

6.6.3 Variability between participants' food safety behaviours during repeated meal preparations in the model domestic kitchen.

A significant difference was identified between individual participants' food safety risk scores during repeated meal preparations. This not only indicates that the observational technique and risk based scoring provide a good, discriminating measure of individuals' food safety behaviours but also reiterates the need for targeted interventions. Variability identified between individual participants food safety behaviours indicates that all consumers do not implement the same food safety malpractices. Malpractices that need targeting for food safety education purposes can be identified using the observational technique. It was noted that the variability between participants was greater during the first two of the repeated meal preparations than during the third session, however, given the small sample size it not possible to draw definitive conclusions from such an observation.

Consistency of food safety malpractices implemented by individuals (n=11) within repeated meal preparations has been determined and results have shown that coefficient of variation (CV) values ranged from 11-33%. When considering that acceptable CVs ranging from 24-32% denote precise, reproducible data from highly prescribed laboratory based experiments (Davidson *et al.* 1999) findings from this study, involving less controllable, non-laboratory based variables and human factors, indicate that food safety behaviours that individual consumers implement are consistent over time.

6.6.4 Assessment of test-retest reliability of observational research method.

Previous observational research detailing consumer food preparation behaviours has largely been based upon single observations of meal preparations (Anderson *et al.* 2000; Worsfold, 1994) and no studies identified to date have assessed the reliability of the observational research method used. Assessment of the reliability of a research method is an important component in the research process and indeed, determination of reliability is reported to increase the credibility of findings (Cowan, 2002). The potential use of the observation technique developed in this thesis for the evaluation of intervention effectiveness (see Chapter 8.0), further reaffirmed the importance of assessment of the reliability of this research method and measurement scale. Thus, determination of a test-retest reliability coefficient provided validation of the research method for collection of reliable data during the number of meal preparations necessary to implement a classic before and after intervention study (Ovretveit, 1998). A reliability coefficient of 0.79 was determined. Although reliability coefficients from controlled, laboratory based experiments would usually be expected to be higher, the reliability coefficient determined in this study (0.79) is considered to be extremely reliable (Bowling, 2000), particularly from research carried out in a behavioural science setting.

6.6.5 Assessment of a familiarity effect.

Assessment of any potential change in food safety risk scores (representing all food safety malpractices and composite malpractices) indicated that no significant differences for overall implementation of malpractices and composite malpractices were observed over the five repeated meal preparation sessions. Thus suggesting that behaviours did not get better or worse over time, and there was no learning or familiarity effect during repeated meal preparations in the model domestic kitchen.

6.6.6 Consistency of individual behaviours.

In the field of consumer food safety the overall consistency of implemented food safety malpractices remains unstudied. Results from this study indicate that composite behaviours related to temperature control such as cooking, cooling and storage remained extremely consistent during repeated preparation of the same meal, with CV's ranging from 5% to 7%. Such values represent extremely consistent implementation of behaviours and would be considered to represent extremely reproducible variables in highly prescribed laboratory based experiments. Actions related to cross contamination, such as failure to implement adequate and immediate hand-washing and hand drying actions when necessary, unsafe use of chopping boards / knives for preparation of raw chicken and vegetables, and potential contamination of the preparation environment were found to be less consistent than composite behaviours relating to temperature control. However, such actions were associated with CV's of between 13% and 26%, which as noted earlier are lower than acceptably reproducible data collected in a controlled laboratory situation collected by Davidson *et al.* (1999). Potential contamination of end products with potentially contaminated hands and utensils occurred on an infrequent basis and thus resulted with a greater CV of 64%. Nevertheless, overall results suggest that overall composite behaviours in repeated meal preparations are consistent.

6.7 CONCLUSIONS.

It can be concluded that no significant difference in mean risk scores (representing all observed food safety behaviours) was determined between meal preparations undertaken in the model domestic kitchen and consumer home kitchens. Thus indicating that overall food safety malpractices under investigation may be habitual and reproducible between different environments. In addition it can be concluded that overall, observations of consumer food safety malpractices in the model kitchen are representative of practices implemented in the home.

A significant difference between participant's total food safety risk scores from repeated meal preparations was determined. This indicated that use of the observational technique and risk based scoring system provides a good, discriminating measure of food safety behavioural performance in the model domestic kitchen. Such a finding has implications for the need for targeted food safety interventions, as it highlights the notion that not all consumers implement the same food safety malpractices.

An assessment of test-retest reliability showed that use of the observational technique and risk based scoring system developed in Chapter 5.0 provides a reliable measurement of food safety behaviours over the period of time necessary to collect observational data for a classic intervention effect study.

No significant differences in total risk scores or risk scores representing composite behaviours were determined during repeated meal preparations in the model domestic environment. Thus it can be concluded that increased meal preparations in the model kitchen were not subject to a familiarity effect. Food safety behaviours did not worsen or improve during the course of five meal preparations.

Observation results indicated that important composite food safety malpractices such as inadequate cooking, cooling and storage, failure to wash and dry hands when necessary, unsafe use of chopping boards and knives, potential contamination of the preparation environment and potential contamination of end products with unclean utensils or hands, were consistent over the period of five repeated meal preparations of a Chicken Korma and Chocolate Mousse. Thus, it may be concluded that single observations of meal preparations in the model domestic kitchen are a true representation of food safety malpractices that may be implemented when the same meal is prepared on more than one occasion.

Further research is required to determine the consistency of generic food safety behaviours implemented during repeated preparations of different meals in the model domestic kitchen. In addition, the reproducibility of generic food safety malpractices between different meal preparations needs to be assessed. Recommendations for future consumer food safety research can be found in Chapter 9.0.

CHAPTER 7.0

DESIGN, DEVELOPMENT AND APPLICATION OF A SOCIAL MARKETING APPROACH TO FOOD SAFETY EDUCATION.

7.1 INTRODUCTION.

A contemporary approach to health education, known as 'social marketing', has been reported to be successful in improving health-related behaviours. To date such an approach has not been applied to a food safety education initiative in the UK. This chapter utilises data collected from Chapters 3.0, 4.0 and 5.0, as well as from this chapter, to develop a social marketing food safety education initiative. For an outline of the social marketing process see Appendix 7.1.

7.2 REVIEW OF LITERATURE.

Mishandling of food in the epidemiology of foodborne disease (as described in Chapter 2.0) underscores the need for consumer education in food safety (Ehiri and Morris, 1996). However, effective food safety education strategies to bring about behavioural improvement of food safety practices have been lacking. Indeed, review of the effectiveness of Canadian food safety education found that only 7% of studies identified were consumer orientated (Campbell *et al.* 1998).

Many health and social problems have behavioural causes that are a result of every day, voluntary activities (MacFayden *et al.* 1999). Effective health communication strategies are required to bring about behavioural change to alleviate or at least reduce the risk of such problems. However, changing behaviour to improve peoples' lives is not an easy task (Andreason, 1995). Although traditional approaches to food safety education may raise awareness of food safety issues (Griffith, 2002) such approaches do not necessarily result in behavioural change. Indeed, numerous studies have shown that behavioural change rarely occurs simply from the provision of educational information, and use of the community-based social marketing approach is considered to be a preferable alternative to information based campaigns (McKenzie-Mohr, 1999).

Social marketing has been defined as '*the application of commercial marketing technologies to the analysis, planning, execution and evaluation of programmes designed to influence the voluntary behaviour of target audiences in order to improve their personal welfare and that of their society*' (Andreason, 1995, p7). Thus, social marketing is a social change strategy that provides a structured framework for the organisation of initiatives to promote voluntary behavioural change that is socially beneficial (Bryant and Salazar, 1998; Lefebvre and Rochlin, 1997). In addition, social marketing is a method for empowering people to be totally involved and responsible for their own well being (Lefebvre, 1992). Distinctive features and concepts of the social marketing approach include consumer orientation, exchange theory, audience segmentation and analysis, formative research, channel analysis, the marketing mix (product, price, promotion and placement) and process tracking (Lefebvre and Flora, 1988). The most fundamental social marketing concept is consumer orientation (Hastings and Haywood, 1991). Consumer orientation concerns an understanding of the consumers' reality without imposing preconceived ideas upon them (Lefebvre, 1995). Ultimately it is the consumer who guides decisions through the social marketing process, including problem definition, setting objectives to segment the market and achieving objectives by means of the marketing mix (Hastings and Haywood, 1991). Preparation of a strategic plan is critical for a successful social marketing campaign (Andreason, 1995) and indeed social marketing offers a logical planning process (MacFadyen *et al.* 1999). Bryant (1999a) has outlined six key phases to the social marketing process: initial planning, formative research, strategy development, programme development, programme implementation and tracking and evaluation.

The initial planning phase of social marketing requires identification of a segmented, target audience and specification of a realistic and measurable behavioural objective for the initiative. The population at large is composed of individuals with different ages, sexes, social classes, family influences, educational backgrounds and religious beliefs and thus, not everyone has the same perceptions, attitudes and behavioural traits (Hastings and Haywood, 1991). People are therefore grouped to relatively analogous audiences (Maibach and Holtgrave, 1995) to form a 'target audience'. Precise definition of the target audience enables variables that may affect the communication strategy to be grouped (Wright, 1999). The target audience can then be segmented according to demographic, geographic, psychographic and behavioural variables (Maibach and Holtgrave, 1995). Segmentation of the target audience can also be based upon parameters of health behavioural theories (Lefebvre, 1995). The Transtheoretical Model (TTM) is considered to be the most widely used model for segmentation in social marketing applications (Andreason, 1995). The model suggests that consumers move through five stages of change -pre-contemplation, contemplation, preparation, action and maintenance- (Prochaska and Diclemente, 1984) when improving health-related behaviours. Use of this model for audience segmentation to an appropriate 'stage of change' has been successful for a variety of health-related behavioural initiatives including smoking cessation (Prochaska and Diclemente, 1998), drug problems (Tejero *et al.* 1997) and cancer screening (McCormack-Brown *et al.* 1999).

An overarching concept at the basis of social marketing initiatives is that the programme planning is focussed upon achieving the stated behavioural objective (Lefebvre and Rochlin, 1997). Thus, specific behaviours that need to be adapted to fulfill the behavioural objective need to be identified (McCormack-Brown, 1998b). Furthermore, for evaluation purposes it is important that the desired behavioural change associated with the objective can be measured (Forthover, 1998).

Social marketing strategies are heavily influenced by what is learned from the targeted consumers (Andreason, 1995) and the formative research phase facilitates an in-depth analysis and understanding of consumers' psychological and social factors that influence the desired behavioural objectives (Bryant and Salzar, 1998). Indeed, as Hastings and Haywood (1991) have stated '*to communicate successfully, we have to understand our audiences' point of view – we have to climb into their skins and walk around in them'*. Formative research methods used for social marketing can include quantitative surveys that provide representative and generalisable data, and qualitative data from in-depth interviews and focus group discussions. Focus group research can provide meaningful information that is not available through other research techniques (Betts *et al.* 1996). Furthermore, it is reported that focus group findings can make risk communication more effective (Desvousges and Smith, 1988). Indeed, the focus group is unique from other research methods as it allows for group interaction and a greater insight as to why certain opinions are held (Kruegar, 1994). During formative research, information detailing perceived costs, barriers and benefits of implementation of the behavioural objective need to be identified to inform the developmental process of the communication strategy based on the notion of 'exchange theory'. Exchange theory is a concept that highlights the relationship between price and perceived benefit (Ling *et al.* 1992) and thus, the inclusion of messages based upon a voluntary exchange of costs for benefits (Lefebvre and Flora, 1988; McCormack-Brown, 1998c) features in many social marketing approaches. A problem frequently encountered by social marketers is that behavioural objectives often have invisible and intangible benefits (e.g. better health, decreased risk of illness), which are difficult to portray, and it is only the consumers' own actions that can generate such benefits (Andreason and Kotler, 1991).

In addition to the provision of information for intervention development, exchange theory and initial strategy development, formative research is required for the pre-testing (evaluation) of ideas, messages and methods with representatives of the target audience, before implementation of the initiative (Lefebvre and Flora, 1988). The process of pre-testing materials has been found to be effective for determining if newly developed health education materials are truly appropriate and will ultimately be understood (Salazar, 1998). Indeed, such feedback from consumers is crucial for communicating risks more effectively (Desvousges and Smith, 1988). It is considered that this step in the strategy development can '*save a campaign from misdirected approaches'* (Andreason, 1995, p92).

Strategy development of a social marketing initiative is centered around the marketing mix (Bryant and Salazar, 1998). Marketing is essentially about getting the right product, at the right price, at the right time presented in such a way as to successfully satisfy the needs of the consumer (Hastings and Hayward, 1991). Thus, the marketing mix refers to what are historically the four pillars of marketing programmes – the four P's –'Product, Price, Promotion and Placement' (Lefebvre, 1992).

- ***Product:*** A product may be defined as a tangible, physical product (e.g. nutritional supplements, services (e.g. medical examinations) or behaviour(s) (e.g. breastfeeding, use of seatbelts, healthy eating) (Bryant, 1999b; Weinreich, 1996). In addition a product may be intangible such as good health or self-empowerment (Hastings and Haywood, 1991). To be marketed successfully, the product must be a solution to the problems that consumers consider to be important and of benefit that they truly want (Bryant and Salazar, 1998).

- ***Price:*** Price represents the costs that the consumer must accept to obtain the product (Kotler and Zaltman, 1971). Most frequent costs associated with public health programmes and healthy lifestyle practices are time, effort, embarrassment, loss of pride and dignity and the discomforts associated with giving up life-long habits (Bryant, 1999a).

- ***Promotion:*** This component of the marketing mix is the means by which the health promoter communicates the product to the consumer (Hastings and Haywood, 1991). The resultant communication strategy for a social marketing initiative should include the following four elements: the benefits to the target group; reasons why the target audience should respond and attend to the communication; the specific actions the audience should undertake in response to the communication;

the tone or image should be appropriate for the message and for the understanding of the target audience (Lefebvre, 1992). Additional requirements for development of effective promotional materials have been described in Chapter 2.0 and Chapter 4.0.

- ***Placement:*** Public health interventions require a variety of channels through which the messages, products and services can be delivered to the target groups. Identification of life-point-paths can also uncover potential channels to reach certain audiences (Lefebvre and Flora, 1988). Channel analysis is key to the development of a social marketing placement strategy. Such analysis intends to maximise the 'reach' and impact of promotional interventions. Communication channels selected for placement of interventions and messages should be ones the target audience come into contact with on a regular basis (life-point-paths) as well as those perceived to be credible (NFSD, 1999).

It is considered that social marketing may be the most developed approach to public health communication (Maibach and Holtgrave, 1995) and use of social marketing has proven to be an immensely powerful tool for effecting massive behavioural change (Andreason and Kotler, 1991; SMI, 2001) particularly in developing countries (Ling *et al.* 1992). Examples of the numerous successful social marketing applications in developed countries include smoking cessation (Crowell, 1999; Hastings *et al.* 1994), increased immunisations (Bryant and Salazar, 1998), nutritional supplementation (Bryant and Brown, 1995; Hammerschmidt *et al.* 1999; Lefebvre *et al.* 1995; Samuels, 1993), cancer screening (McCormack-Brown *et al.* 1999; USF / Best Start, 1998), physical activity (Fridinger, 1999), adolescent drinking (Macintosh *et al.* 1997) and water fluoridation and dental anesthesia (Hastings, 1999). Internationally, application of social marketing to food safety education has been limited, and social marketing food safety education initiatives have mainly been implemented in USA and developing countries. Indeed, in USA, Sutton *et al.* (1997) applied social marketing to food preparation behaviours at BBQ's. Target audiences were defined as younger men and messages were targeted according to segmentation into 'low-germ concerns' and 'high-germ concerns' (Sutton *et al.* 1997). More recently the social marketing approach has been adopted to increase the impact of the nationwide Food Thermometer Education Campaign in the USA (FSES, FSIS, USDA, 2001). In the UK, an investigation to assess the potential application of food safety to social marketing has been piloted in a small-scale study (Redmond *et al.* 2000). Findings from the pilot study showed that social marketing processes, principles and developmental techniques can be utilised for food safety education (Redmond *et al.* 2000). Nevertheless, to date, no food safety education initiatives based on a social marketing approach been implemented in the UK.

7.3 AIMS AND OBJECTIVES.

7.3.1 Aims.

- Apply and implement the principles and concepts of social marketing to food safety education.
- Design food safety interventions using the social marketing approach.
- Formulate a social marketing strategy for a targeted, community food safety education initiative.

7.3.2 Objectives.

- Determine a segmented, target audience, a behavioural objective and behavioural determinants as part of the initial planning of a consumer food safety social marketing initiative.
- Analyse quantitative research findings from Chapter 3.0 and Chapter 4.0 denoting responses from representatives from the target audience.
- Conduct qualitative formative research to ascertain an in-depth understanding of the target audience.
- Identify perceptions of the behavioural objective and determinants, components of exchange theory and perceptions of consumer food safety education.
- Implement a channel analysis to inform the placement strategy.
- Develop tailored food safety interventions using qualitative and quantitative formative research findings.
- Evaluate developed intervention materials using qualitative and quantitative methods.
- Formulate a social marketing strategy using the marketing mindset (product, price, promotion and placement).

7.4 METHODS.

7.4.1 Introduction.

A plan outlining the key design and developmental stages of the following social marketing based food safety initiative can be found in Appendix 7.1. To maximise the consumer orientated nature of the educational initiative, a selection of methods have been used for strategy development. Such methods include a review of previous research and epidemiological data, qualitative and quantitative formative research methods and qualitative and quantitative evaluation methods.

7.4.2 Initial planning of social marketing process.

7.4.2.1 Determination of target audience.

Determination of the target audience for the social marketing food safety education initiative was predominantly based on an analysis of previous observational data detailing consumers' food safety behaviour and microbiological contamination of the kitchen environment (see Redmond *et al.* 2001). The selected target audience included consumers who frequently implemented food-handling malpractices, who were found to contaminate the domestic kitchen with pathogenic micro-organisms, and who also demonstrated implementation of some safe food-handling behaviours. In addition, epidemiological data was reviewed to identify groups of consumers who were more vulnerable to risks of foodborne disease than others. Responses to the food safety education questionnaire from Chapter 4.0 were also analysed to determine consumer attitudes towards receptivity of food safety information. A review of approaches used to segment the target audience in previous social marketing initiatives was undertaken to select an appropriate means for audience segmentation for this social marketing initiative.

7.4.2.2 Determination of community in Cardiff to implement the food safety initiative.

Electoral divisions of Cardiff, South Wales were analysed to identify where the largest percentages of residents of a common SEG and age group lived. Such information was subsequently used to determine communities where participants from the target audience lived. Thus, such identified areas of Cardiff would form the locations where participants for the study would be recruited from and where intervention material for the food safety education initiative would be placed. Identification of a test sample and control sample was based on the two highest combinations of population group of age and SEG identified for study.

7.4.2.3 Determination of behavioural objectives and determinants.

Epidemiological data from England and Wales (Evans *et al.* 1998; Tirado and Schmidt, 2000) was examined to identify behaviours that have frequently contributed to outbreaks of foodborne disease in recent years. Observation findings from Chapter 5.0 of this thesis and previous research (Anderson *et al.* 2000; Griffith *et al.* 1999a; Redmond *et al.* 2001; Worsfold, 1994) provided information detailing actual consumer food safety behaviours. A review of such data was undertaken to determine the behavioural objective and behavioural determinants that would form the basis of the social marketing initiative. Food safety behaviours associated with high microbiological risks of contamination and potential for foodborne disease that were observed more frequently than others were chosen to be the determinants of the social marketing objective in this initiative.

7.4.3 Formative research: quantitative data.

7.4.3.1 Attitudes towards behavioural objectives and risks associated with behavioural determinants.

Data collected from the questionnaire entitled 'Attitudes and perceptions of food preparation practices' (see Chapter 3.0) was analysed according to responses from consumers similar to those from the selected target audience. Analysis provided quantitative data detailing attitudes and perceptions towards the behavioural objective, behavioural determinants and associated risks of food preparation in the domestic kitchen. See section 3.4 for methods used for analysis.

7.4.3.2 Attitudes and perceptions to food hygiene information sources.

Findings from the questionnaire entitled 'Attitudes and perceptions towards food safety education' (see Chapter 4.0) were analysed according to responses from consumers similar to those from the selected target audience. Analysis provided quantitative information regarding preferred sources of food safety information, organisations perceived to be most credible, most believed spokespersons, likelihood of picking leaflets up, perceptions of television cookery programmes and documentaries, and perceptions of the type of information regarding the risks and consequences of food poisoning. See section 4.4 for methods used for analysis.

7.4.4 Formative research: preliminary focus groups.

In this study, focus group discussions facilitated a thorough understanding of the target audience, in terms of psychological processes, perceptions of the behavioural objective and determinants, perceptions of aspects of food safety education as well as the identification of the life-point-paths.

7.4.4.1 Participant recruitment for preliminary focus groups.

Focus group participants were recruited using a local Market Research Agency (Beaufort Research Ltd, Cardiff). Face-to-face recruitment interviews were held by field researchers using a specified recruitment questionnaire (Appendix 7.2) and show cards (Appendix 7.3) in test and control communities to screen potential consumers for suitability. Additional recruitment criteria for targeting and segmenting the chosen population was required according to segmentation criteria presented in section 7.5.1. Recruited participants were given an 'invitation' (Appendix 7.4) to confirm dates and times of focus group arrangements. The Market Research Agency also sent personalised letters to participants to confirm arrangements and agreement for participation in the discussion group. Participants were also telephoned the day before the group as a further reminder. Transportation to each session was provided, if required, and an incentive (£20) was offered by the Market Research Agency for participation in the research.

7.4.4.2 Preliminary focus group co-ordination.

Three focus groups were co-ordinated on separate occasions and each lasted 90 minutes. Participants from two groups were residents from the test community and participants from one group were residents from the control community.

Each discussion group was held in a private house in Whitchurch, Cardiff, and consisted of between six and nine participants. Participants were seated facing each other in an open plan kitchen / dining room area. Each group was moderated by a non-biased, trained professional and co-moderated by the researcher from UWIC. A general plan was provided by UWIC as a basis for the 'discussion route' (see Appendix 7.5). Each focus group began with an open-ended discussion about general food safety issues. Perceptions of the risks of food poisoning, barriers, costs and benefits of the specific behavioural determinants, self-efficacy, values, risks and responsibility for safe food preparation and most and least common locations perceived for getting food poisoning were also identified. Furthermore, life-point-paths of the target audience were determined. Opinions and preferences for message design and intervention type were also determined using stimulus materials (see Appendices 7.6, 7.7, 7.8, 7.9). An article about the consequences of a food poisoning illness, hazards and risks was also read to the group (see Appendix 7.10). Discussions were recorded using audio-tapes and mini-discs which were transcribed by the researchers at Beaufort Research and UWIC.

7.4.4.3 Quantitative channel analysis.

To obtain quantitative data about the shops, amenities and other locations that consumers from the target audience frequented in Llanrumney, a simple, short questionnaire (see Appendix 7.11) was developed and distributed to participants in focus groups from the test community. In addition, the questionnaire was given to test participants after their first food preparation session (see Chapter 8.0). Completion of this questionnaire enabled definitive identification of locations where interventions should be placed within the test community.

7.4.4.4 Analysis of preliminary focus group data.

A detailed content analysis of all transcriptions was carried out by the researcher at UWIC. A manual categorisation of transcriptions involved a 'cut and paste' process whereby relevant and common food safety, and food preparation issues were highlighted in transcripts which were then grouped and pasted onto index cards. Such index cards were then organised and filed in an appropriate order.

7.4.5 Initial intervention development.

Intervention types, formats and terminology selected for promotional material development were predominately based upon qualitative data collected from focus groups (section 7.4.4) and also quantitative data collected from questionnaires (section 7.4.3). A preference for message formats, respected spokespersons, most favourable intervention sources and life-point-paths were identified. Highly focussed messages and interventions for the target audience were produced, (Appendices 7.12, 7.13) and findings were used to develop 'The Marketing Mix' which formed the basis of the food safety social marketing strategy.

The computer programs Adobe Photoshop 5.5, Microsoft Powerpoint 7.0 and Microsoft Publisher were used during the development and design process.

7.4.6 Formative research: evaluative focus group.

7.4.6.1 Participant recruitment for evaluative focus groups.

Participants from the test community who had participated in the preliminary set of focus groups (7.4.4) were telephoned by the market researcher and asked if they would participate in a second, follow-up discussion group. As before, participants were sent a standard letter from Beaufort Research confirming arrangements, and subsequently telephoned prior to the group as a reminder. Transport to the group and incentivisation occurred as described in section 7.4.4.1.

7.4.6.2 Evaluative focus group co-ordination.

The evaluative focus group took place after the preliminary focus groups had been analysed. The purpose of the evaluative group was to obtain additional information detailing the target audiences' perceptions of food safety intervention materials. In addition, the group was required to pre-test 'initial interventions' that had been designed and developed from data obtained from the preliminary focus groups.

For location and co-ordination of the evaluative focus group see section 7.4.4.2. The evaluative focus group discussion lasted 90 minutes and consisted of 10 participants from the test community all of whom had attended one of the previous focus groups. A discussion plan (see Appendix 7.14) was provided by UWIC for moderation of the discussion. The group was largely based on stimulus materials to determine appropriate size of wording for leaflets and posters, appropriate terminology of food safety descriptions, a comparison of pictorial and worded messages to promote food safety behaviours and appropriate pictures to be included in intervention material. Furthermore, an evaluation of actual material types devised from preliminary group discussions occurred (Appendicies 7.12 and 7.13). As before, discussions were recorded using audio-tapes and mini-discs which were transcribed at the market research company and by the researcher at UWIC.

7.4.6.3 Analysis of the evaluative focus group.

As described in section 7.4.4.4, a detailed content analysis of the transcription from the evaluative focus group was undertaken by the researcher at UWIC to categorise common food safety issues discussed in the focus group.

7.4.7 Final intervention development and evaluation.

Amendments to the 'initial interventions' designed from preliminary focus group findings were made according to responses from the evaluative focus group in terms of format, content and appearance.

7.4.7.1 Intervention 'evaluation pack'.

To ensure that the final interventions designed and developed by the researcher at UWIC were appropriate and 'liked' by members of the target audience, a questionnaire was sent to participants from the target audience who had participated in the focus groups (n=24). Participants were sent a letter (see Appendix

7.15), stamped addressed envelope (SAE), questionnaire to complete (Appendix 7.16) and 'Evaluation pack' (Appendix 7.17). The 'Evaluation pack' contained copies of all of the printed final interventions. Participants were asked to complete the questionnaire and return it to UWIC in the SAE. A £5 supermarket voucher was offered as an incentive for the return of completed evaluation questionnaires.

7.4.8 Strategy development.

A strategy was developed using all formative research findings from the target audience. The strategy included a realistic plan with a specific measurable behavioural objective and a clear statement of overall goals, description of target audience, and approaches used to influence behaviour. Strategy development was largely centred around formation of the Marketing Mix, including product, price, promotion and placement strategies.

7.5 RESULTS.

7.5.1 Initial planning of the social marketing approach.

Initial planning of the social marketing initiative included identification of a target audience (for test and control communities), determination of a means for segmentation of the selected target audience, and determination of a behavioural objective and behavioural determinants.

7.5.1.1 Determination of target audience.

The target audience was identified as older females (aged 60-75 years old) from SEGs C2, D, E.

Rationale for selection of older consumers (aged 60-75 years):

- Older adults are reported as being more vulnerable and susceptible to foodborne disease than younger adults (Smith, 1998).
- Findings from a previous consumer food safety observation study (Redmond *et al.* 2001) indicated that older participants (aged 60-75 years) implemented more food-handling malpractices than other targeted audiences under investigation (young mothers and single young males). In addition, the largest proportion (60%) of positive isolations of *Campylobacter* from end products, on kitchen surfaces / cloths occurred after food preparation sessions undertaken by older participants (aged 60-75 years).
- Many older consumers (aged 60-75 years) believed that they implement all food safety measures during domestic food preparation effectively, however, when observed this has not been found to be the case (Griffith *et al.* 1999a).
- Results from Chapter 3.0 suggest that significantly more older consumers (opposed to younger consumers) have expressed positive attitudes for a number of food safety issues relating to actions associated with cross contamination, cooling and storage of foods. However, observational results have shown that corresponding food safety behaviours were inadequate (Griffith *et al.* 1999a).

Rationale for selection of female consumers, and participants from lower social classes:

- A larger proportion of females prepare meals on a daily basis (80% of females prepare meal on daily basis and 20% of males) (Nicholaas, 1995).
- Eighty five percent of females aged 65-74yrs old prepare every meal in a household, opposed to 34% of men (Nicholaas, 1995).
- A previous consumer food safety observation study has indicated that females (aged 60-75 years) attained a higher average risk score (6,830) than males of the same age (4,778) and thus frequently implement food safety malpractices and consequently increase the risk of food poisoning. In addition,

Campylobacter was isolated more frequently from the kitchen environment / end products after food preparations were carried out by females (Redmond *et al.* 2001).

- Older participants (aged 60-75 years) from lower SEGs were observed to have higher average risk scores than participants from higher SEGs (Redmond *et al.* 2001).
- Assessment of individual food safety behaviours from previous research, (Griffith *et al.* 1999a; Redmond *et al.* 2001) and from data collected in Chapter 5.0 has indicated that older female consumers from lower SEGs failed to implement control for many specific food safety actions, such as hand-washing and failure to wash or use separate chopping boards or knives between raw and RTE foods.

Receptivity of older females (aged 60-75 years old) from lower SEGs to food safety education.

- Overall, targeted consumers were found to have a positive attitude towards receiving information about safe food preparation practices and are also receptive to food safety education information.
- All consumers from the selected target audience indicated that they would be prepared to listen or read food safety advice.
- The majority of consumers (86%) were confident that their current food safety behaviours do not give rise to the risk of food poisoning and 71% indicated that they always carry out all of the necessary food safety precautions that are known during food preparation.

Consumers from the selected target audience (older females aged 60-75years from SEGs C2, D, E) constituted the representative source of consumers from test and control communities for developmental and evaluative formative research in this chapter and for food preparation sessions in Chapter 8.0.

7.5.1.2 Audience segmentation.

The Health Action Process Approach (HAPA) (Schwarzer, 2000) was used as a structure for segmentation of the target audience (see Appendix 7.18). The HAPA combines many of the processes / elements used in previous social cognition models and places them in the context of a stage theory as in the TTM.

Participants for focus groups in this chapter and observed food preparation sessions in Chapter 8.0 were recruited according to the motivational stage of HAPA. This stage consists of the following components: self-efficacy, outcome expectations and threat appraisal (accounting for attitudes towards severity of illness and perceptions of personal vulnerability). The recruitment questionnaire included three questions related to risk perceptions, outcome expectancies and perceived self-efficacy (Appendix 7.2). Ideally, a recruitment questionnaire with more questions based on the HAPA for segmentation of the target audience would have been preferred to ensure that recruited participants fitted the same motivational stage of the HAPA. However, the market researchers were unable to conduct a longer recruitment questionnaire due to time constraints and practicalities of recruiting participant quotas in the given time. As a consequence, qualitative data relating to cognitive perceptions of the HAPA was obtained from preliminary focus groups.

7.5.1.3 Determination of test and control communities in Cardiff.

The areas of Cardiff where the highest proportions of older adults aged 60-75 years in SEG C2, D/E were determined as Llanrumney and then Fairwater. It was decided that Llanrumney would be the test community and Fairwater the control community (see Appendix 7.19). Both communities were located a significant distance apart, which was an additional consideration, so that members of the control community would be unlikely come into contact directly with any intervention material placed in the test community.

7.5.1.4 Determination of the behavioural objective and behavioural determinants.

A review of previous observational data detailing consumers' food-handling behaviour highlighted that control measures to prevent specific cross contamination actions are not correctly implemented by many consumers from the target audience. Data from Chapters 5.0 and 6.0 as well as other observational studies (Jay *et al.* 1999a; Griffith *et al.* 1999a; Redmond *et al.* 2001; Worsfold, 1994) showed that participants very rarely washed and dried their hands adequately or immediately after handling raw poultry and / or used clean or separate equipment / utensils for preparation of raw poultry and RTE foods. In addition to this, recent research and epidemiological data indicated that cross contamination is frequently associated substantial microbiological risks and incidence of foodborne disease in the UK (see Chapter 2.0).

Behavioural objective:

➔ Improvement of food safety behaviours including implementation and maintenance of control measures to prevent cross contamination of pathogenic micro-organisms from raw chicken to food preparation surfaces and RTE foods.

Behavioural determinants:

➔ Effective♦ and immediate hand-washing and hand drying after touching raw chicken.

➔ Use of separate or adequately washed♦♦ and dried utensils between preparation of raw chicken and salad vegetables / cooked ham, or preparation of salad vegetables and cooked ham before handling raw chicken.

➔ Prevention of contamination of the preparation environment from RCP.

♦ Effective hand washing / drying includes use of hot water, soap or detergent followed by rinsing and use of an uncontaminated hand towel or disposable paper towel (Griffith *et al.* 1999a).

♦♦ Adequate washing / drying of utensils includes scrubbing with hot water, detergent and an uncontaminated cloth, followed by rinsing and drying using an uncontaminated 'T'-towel or paper towel (Griffith *et al.* 1999a).

7.5.2 Formative research: quantitative findings from Chapter 3.0 and Chapter 4.0.

7.5.2.1 Quantitative findings: attitudes and perceptions towards food safety in the domestic kitchen.

To increase our understanding of consumers from the target audience, correlations between attitudes and perceptions towards food safety behaviours in the home have been identified from responses to the questionnaire entitled 'Attitudes and perceptions towards food preparation practices' (Chapter 3.0). The sample consisted of 100 consumers that represented a cross section of the population of Cardiff. Findings are as follows:

- Positive attitudes towards the use of clean utensils for food preparation, cooling and storage were significantly correlated with older respondents and negative attitudes towards the same food safety issues were correlated with younger respondents.
- Where significant differences between male and female responses to attitude statements were made, results showed that female respondents had expressed more positive attitudes towards food safety issues than males.
- No strong, significant correlations were identified between SEG and attitudes towards food safety behaviours in the home.
- No correlations were determined between SEG and variables associated with risk, control and responsibility for food safety.
- A significant negative correlation was determined between age of respondent and perception of risk of illness. Older respondents were associated with the perception of a lower personal risk of illness from food poisoning after their own food preparation than younger respondents.
- A significant positive correlation was determined between personal responsibility for food safety and age. As age of respondent increased, so did perception of personal responsibility for food safety.
- Older respondents considered there to be less chance of getting food poisoning from hospitals and old peoples homes than younger respondents.

The following findings have been taken from the above mentioned questionnaire from Chapter 3.0 and are based on responses from consumers aged 55-65+ years and SEGs C2, D and E, (similar to the target audience) who accounted for 9% of the original sample (n=9). Findings are as follows:

- Overall, consumers aged 55-65+ from lower SEGs expressed largely positive attitudes towards actions related to the behavioural objective and behavioural determinants.
- All consumers from this target group agreed that the use of clean utensils / equipment is essential when handling cooked foods.
- The majority of consumers agreed that it is better to use different chopping boards for the preparation of raw and cooked meats.

- The majority of consumers expressed an attitude denoting that paper towels are more useful in the kitchen than J-cloths.
- A comparison of perceptions of risk, control and responsibility between the target group of consumers and a cross section of the population of Cardiff indicated the target group perceive themselves to have a lot, but not total responsibility for food safety, have a very low risk of illness after their own food preparation and have full control over food safety during their own food preparation.
- As for consumers from a cross section of Cardiff, consumers aged 55-65+ years, SEGs C2, D, E ranked their 'own home' as the least likely location to acquire food poisoning.

*7.5.2.2 **Quantitative findings: attitudes and perceptions of aspects of food safety education.***

To increase our understanding of consumers from the target audience correlations between attitudes and perceptions towards food safety education have been identified using responses to the questionnaire entitled 'Attitudes and perceptions towards food preparation practices' (Chapter 4.0). The sample consisted of 61 consumers in Cardiff of all ages and SEGs. Findings are as follows:

- Overall, positive attitudes were expressed towards aspects of food safety education. No attitudes towards this subject were correlated with age of respondent.
- A significant negative correlation was identified between SEG and attitude towards hearing symptoms and medical details about food poisoning illnesses, thus, respondents from lower SEGs were associated with not liking to hear such details*.
- Respondents from lower SEGs were significantly correlated with indicating that information regarding risks of inadequate food safety practices *would not* have any effect upon current food preparation practices, such consumers were also correlated with not acting on any food safety information in the past*.
- Consumers who were more likely to pick up leaflets (e.g. from the supermarket) were aged 45-64 years old and from SEGs AB or DE. Older respondents were more likely to acquire food safety leaflets from magazines / newspapers, the dentist and doctors.
- Older respondents were significantly more likely to pick a leaflet up from the library than younger respondents.
- No SEG / age group was significantly correlated with watching TV documentaries about food safety or TV cookery programmes. Overall, more than half of the respondents indicated they are likely / extremely likely to watch a TV documentary about food safety.
- Respondents from older age groups were significantly correlated with not considering the radio, fridge magnets and t-towels to be preferable sources of food safety information*.
- A negative correlation was determined between SEG and commercial advisory councils in terms of credibility of information provided.
- Respondents from a lower SEG were significantly correlated with being unlikely to believe food safety information delivered by a scientist.

*Such issues were investigated further in focus group discussions.

The following findings have been taken from the above mentioned questionnaire from Chapter 4.0 and are based on responses from consumers aged 55-65+ years and SEGs C2, D and E, (similar to the target audience) who accounted for 11% of the original sample (*n*=7). Findings are as follows:

- The majority of consumers similar to those from the target audience indicated that they are more likely to take notice of specific food safety messages than generalised messages.
- Although 50% of the sample expressed an indifferent attitude, no older consumers from lower SEGs indicated that stories about cases of food poisoning would not lead to improvements in their food safety behaviours. Furthermore, a minority of respondents indicated they did not like to hear about the symptoms and medical details about food poisoning.
- The majority of consumers from this target group thought that personal experience of food poisoning had a greater chance of improving food safety behaviours than education.
- Eighty six percent of consumers from the target group suggested that information about the risks of inadequate food safety practices *may* change their current food preparation practices, no respondents indicated the contrary.
- The supermarket and the library were ranked as the most likely locations where food safety leaflets would be picked up.
- A newsreader was the spokesperson who was most likely to be believed for delivery of food safety information, followed by EHOs, medical doctors and health educators. Politicians and TV personalities were spokespersons least likely to be believed.
- Most preferred sources of food safety information included food packaging, advice from the doctor / health visitor, recipes, leaflets, TV cookery programmes and posters.
- Most trusted / credible organisations to provide food safety information were determined as being the Health Education Authority (HEA), supermarkets, Food and Drink Federation (FDF) and Health Promotion units.

7.5.3 Formative research: preliminary focus group findings.

Preliminary focus group (*n*=3) findings suggested that the majority of participants prepared raw chicken on a frequent basis. Types of chicken based meals prepared included roast dinners, casseroles and curries. When prompted, preparation of meat based salads appeared to be a popular meal amongst participants. Chicken was perceived to be a relatively safe meat '*as long as you're careful with it*'.

Tables 7.1, 7.2 and 7.3 detail summarised focus group findings denoting perceptions of general food safety issues, specific behavioural determinants, cognitive influences related to HAPA and perceptions of food safety education.

Table 7.1 Main findings from preliminary focus groups: general food safety issues, specific behavioural determinants, cognitive perceptions related to HAPA.

Influencing factors.	Reported data.	Participant quotes from all preliminary focus group discussions.
Food poisoning risk severity / consequences and threat to health.	Responses detailing the severity and consequences of food poisoning illnesses were mixed. Some participants acknowledged that food poisoning can be a serious illness with long term repercussions, others thought it was a minor illness lasting a short period of time. The majority of participants could recall an experience of food poisoning and short term and long term consequences were discussed. Perception that there is a greater risk from getting a cold than food poisoning.	*'I realise some cases are extremely severe'* *'Well anything can happen' 'Dire'* *'You get a tummy bug that's it'* *'Its an awful thing to go through'* *'But you know you're going to get over Salmonella'* *'Not that many people die from Salmonella'*
Knowledge about food poisoning.	Some participants indicated inaccurate knowledge about the incubation period of time from food consumption to possible onset of food poisoning illness.	*'If you've taken a food and there's food poisoning it will react on you within the four hours of taking it'*
Individuals at risk from getting food poisoning.	It was thought that individuals most at risk from food poisoning were the elderly –people older than themselves. These people were thought to be more vulnerable because of weaker immune systems and therefore they are less able to fight illnesses such as food poisoning.	*'When we say the elderly we mean people older than us, because their immune system is .. less'* *'By the time you're 78 you haven't got it in you to fight something like that (Salmonella), have you?'*
Perception of the home as a location for getting food poisoning.	Most participants felt that their own food preparation practices in the home were safe. A higher risk of getting food poisoning was associated with food prepared and consumed outside of the home. Food poisoning was attributed to faults where the food has been bought rather than preparation faults in the home.	*'I think in establishments, not necessarily in our own homes' 'I think its eating out'* *'You'd like to thin you wouldn't get it in your own home'* *'I bought a cod in the market and that gave me food poisoning'*
Outcome expectancies.	Participants expected the implementation of certain food preparation practices to result in food safe for consumption.	*'I think all meat is safe if its cooked properly'* *'It's got to be clean'*
Volitional thought processes before and during food preparation.	Participants from all three groups indicated that they had high levels of food safety consciousness. Participants considered themselves used to thinking and maintaining levels of food safety and hygiene in their home kitchens all of the time. Some participants said that they didn't actually think about food safety all of the time because it was second nature / common sense to them. Few participants associated thoughts about food preparation with bacterial contamination and pathogens.	*'I think you're always aware of it if you're in the kitchen'* *'Its just something that you just do, and you're not even thinking about it'* *'It really doesn't pass through your thoughts too much in your own home'* *'I think its just habit' 'I think its just routine'* re: washing raw chicken *'...because i'm thinking of the bacteria....I wash the inside of the body'*
Self-efficacy.	Self-efficacy was high amongst participants from all groups. Experience, age and common sense were all given as reasons for their capability and knowledge re: safe food preparation. The old fashioned way of doing things perceived to be the best way.	*'Anyone our age.. I would think they know what they are doing'* *'We've grown up to it...but youngsters, they just open the wrap, put it in the oven, oh dear'* *'It's the old way of doing it'... 'You go back to the olden days'* *'It's different generations when it boils down to it'* *'I think it's just natural to us' 'Its virtually all common sense isn't it'* *'It's experience through the years isn't it'*
Knowledge of pathogens.	Participants appeared to be familiar with the fact that bacteria or 'germs' do exist, yet confusion re: where they exist. Hazards associated with meat / food preparations were most frequently referred to as 'germs'. *Salmonella, Listeria* and *E.coli* were associated with food poisoning illnesses, but not specifically with hazards of meat / food preparation.	*'It's exposed to the air isn't it, this is where the germs are, in the air'* Re: germs: *'they go flying around don't they, in the fridge'* *'I always cook it* (meat), *overcook it, to get rid of the thingies'*

Table 7.1 *continued.*

Influencing factors.	Reported data.	Participant quotes from all preliminary focus group discussions.
Cross contamination.	Knowledge of 'cross contamination' was varied. Some participants were familiar with the term, and talked about e.g. of cross contamination in the kitchen, whereas others had never heard of the term, however appeared to understand the concept.	*'Using the same knife, the same board, that's a cross contamination'* *'I've never heard of it'* *'I think if you're spreading germs if I touch the tap with a dirty chicken finger'*
Perceptions of / understanding of behavioural determinants: Hand-washing and hand drying.	A widespread unprompted understanding of the concept of the need for hand-washing / hand drying during food preparation for 'hygiene reasons' was determined. When the actual process of hand-washing / hand drying was discussed inadequate practices were thought to be appropriate by participants. Many participants avoided using soap for hand-washing. Paper towels were frequently used for hand drying purposes.	*'Make sure you wash hands, frequently.. as much as you can, its doesn't matter how many times'* *'I normally put mine under the cold tap, leave it running and .... splash about'* *'I put washing-up liquid, Fairy, I give it a good old scrub and then run the tap'* *'I don't need to use soap'* *'I don't use soap, I just use hot water'*
Perceptions of behavioural determinants: Use of separate / adequately cleaned utensils between raw chicken (RC) and RTE foods.	A widespread unprompted understanding of the need for use of separate / adequately cleaned utensils between raw chicken and RTE foods was determined. Participants were familiar with the use of, and term 'bleach', and unfamiliar with 'sanitiser'. Many participants considered rinsing chopping boards / knives between RC and RTE foods to be acceptable for food safety.	*'Never have them together, raw and cooked foods, because you're transferring raw meat onto a cooked meat'* *'I normally wipe mine down with vinegar and water'* *'what I do is put a bit of beach in a bottle and a bit of water in and spray it'* *'I don't use soap, just under hot water'*
Other cross contamination actions.	The majority of participants reported washing RC under running water before preparation. This was considered to be good practice among the majority of participants.	*I always washes my chicken.. always washes it and dries it before I cook it'*
Barriers.	Barriers to undertaking hygienic food practices were thought to be time, lack of thought and lack of routine. A barrier for the failure to use soap for hand-washing during food preparation / washing –up was skin irritation. To prevent this from happening participants would only rinse hands and utensils as a means for washing. A lack of understanding / knowledge was observed regarding the need for soap for adequate washing.	*'You don't need to use soap'* Re: hand-washing *'Some people are just plain lazy and they wouldn't think of it anyway....they just wouldn't think of washing their hands'* *'For a start its time consuming really isn't it?'* *'I get rough hands, really sore hands....its because they are in the water all of the time'* *'I don't think the everyday woman would have time to remember to fill a bowl'*
Benefits.	Safe food preparation for family, the prevention of the feeling of overwhelming guilt for making another family member ill from unsafe food preparation. Benefits of implementation of behavioural determinants included avoidance of financial and impracticalities of being ill.	*'You have to cook safe for your family'* *'I can't afford to be ill'*
Responsibility.	The most popular initial response as to who is responsible for food safety was the 'individual'. When prompted, outside sources such as supermarkets, farmers, inspectors and the Government were thought to also have a level of responsibility too. The Government was associated with the banning of food products rather than provision of food safety information.	*'Yourself really.. it's down to yourself'* *'We do rely on the manufacturer putting the good foods on the shelf for us to buy it in all good faith that we're buying good food isn't it'* *'the governments to blame'*
Risk.	Risks were considered to be a part of everyday life, and were discussed in the context of consumption of food from sources outside the home– it was 'chance' whether safe or unsafe food was purchased for consumption.	*'there's always a risk isn't there, there's a risk in everything'* *'You're taking a chance aren't you?'*
Control.	Responses from different groups were mixed as to the amount of control an individual has for food safety. Some participants were pessimistic and thought that a great deal of risk was associated to the amount of control an individual has. Those participants that felt that they had full control were able to list how they had such control during food preparation.	*'If there's germs still there that's beyond your control isn't it'* *'I've got control over mine'* (re: food safety) *'We haven't got control at all'* *'As hard as you try to be clean and whatever, you've got no control'*

Table 7.2 Information obtained from preliminary focus groups to aid choice of intervention materials.

Intervention type.	Reported data.	Participant quotes from all preliminary focus group discussions.
Perception of leaflets (see Appendix 7.6).	Preference for simple leaflets, such as Leaflets D, E and G. All groups favoured the format and content of Leaflet A. Preferred leaflets directly related to them i.e. directed for 'the consumer' and 'the kitchen'. Leaflets B and C were considered suitable for school children. Leaflets F and H were particularly disliked.	*'You seldom pick up a leaflet .... about hygiene'* *'Its nice for us to.. educate ourselves'* *'Its all right for us as people, we have time on our hands to read, but younger people wouldn't sit down and read all that'* *'They are pretty good really'*
Perception of posters.	The poster was thought of as an effective source and channel of communication because it was eye catching and attractive.	*'I'd hang it* (a poster) *in my kitchen'* *'I like the information on the big one'* (the poster)
Reminder aids.	The majority of participants liked the idea of food safety information on a kitchen magnet as a reminder to implement appropriate practices. Stickers were not thought suitable for the target audience, and were thought more appropriate for school children. Many participants liked the idea of having the magnet stuck on their fridge at home.	Re: do you need reminding about food safety: '*definitely*', '*yes*', '*always*' '*all the time*' Re: stickers: *'I wouldn't go with that, it's too gimmicky'* Re: magnets: *'Oh they're excellent' 'You could keep it out as a little reminder'* *'I think that would be nice in the home, just stuck on the front of your fridge, just to keep you on your toes really'* *'it's convenient to have on your fridge'*
Television documentaries.	Participants indicated that they liked watching TV documentaries. Information provided from television documentaries was considered to be credible.	*'I watch documentaries they... .make you aware, alert'* *'Yes, I enjoy a good documentary'*
Television cooking programmes.	The majority of participants recalled watching TV cooking programmes for entertainment value and general interest. TV chefs were mentioned (unprompted) for their lack of good hygiene behaviour. It was felt that such programmes were making bad food practices seem acceptable and they were perceived as being and unhelpful, yet potential source of food safety information.	*'They should lead by proper example when they're cooking to show'* *'Well I've never seen him wash his hands, he'd cut up the meat and he'd never wash his hands'* *'They use that towel hanging on the side'* *'There's cooking on TV, it's very good, but it's all of a rush, there's not enough time'* *'I sit and watch it and criticise it'* *'when they cook on the TV, its all pink inside'*
Food safety information incorporated into recipes (Appendix 7.9).	Participants in the groups stated that they did use recipes and rarely found food safety information incorporated in the methods. It was felt that the recipe example provided to the group was too long, detailed and would be time-consuming.	*'I don't think they say much about hygiene in recipes'* *'I think they should'* (put hygiene in recipes) *'I think anybody, a lot of people would be turned off before they even start'* *'It's too much and very plain and very bland'*
Newspaper.	Participants indicated that previous reports regarding food safety had been read in local and national newspapers.	*'I read it in the Daily Mail one day. I thought* (re: food safety) *I'll read this through'* Re: reading things: '*it pricks your memory all the time, it makes you aware if you eat something'* *'I've seen it in the paper as well'*

Table 7.3 Information obtained from preliminary focus groups to aid design of intervention materials.

Influential factor.	Reported data.	Participant quotes from all preliminary focus group discussions.
Intervention design.	Many participants liked visual instruction e.g. the layout of the fridge on Leaflet A (Appendix 7.6). All participants thought that large text, legible without reading glasses was important. A definite preference for photographs and colour was found. Use of red for text ('danger') was suggested. Most participants from all groups preferred Leaflet A (Appendix 7.6) in terms of paper size and layout. Leaflet D was also popular for similar reasons (Appendix 7.6).	*'Pictures yes, you could pick up a leaflet and not have your glasses'* *'A lot of people won't go for it if it's got small print because they're going to have trouble reading it'* *'You tend to walk past a dull leaflet, anything that looks bright and colourful... you pick it up'* *'Big writing... so you can read it' 'Make it colourful' 'definitely pictures I think'* *'I wouldn't read that one ...because its all the same colour... it doesn't have any photographs on it'* *'this is a good one....because the pictures are showing you... and the chopping board it tells you everything'* *'I'd stick that on the door of my fridge'* (re A4 inside spread)
Message format.	Many participants stated they liked the ten tips found in Leaflet A (Appendix 7.6). Bulleted instructions were considered to be preferable rather than paragraphs of small text, like in Leaflet N.	*'It's simple steps and that in itself is sufficient'* *'I like it because in a sequence'* *It's good this one isn't it...it's emphasised up to 10 simple steps'* *'I think food safety tips in the kitchen is good'*
Message content.	Use of familiar, understandable terminology was considered to be a prerequisite for message content. Some participants thought shock tactics were required as part of the message content to increase awareness and realise importance.	*'Simple and to the point' 'easy to follow'* *'So you can understand it'* *'It says 'food safety and the consumer 'you can see what they're trying to tell you' 'you're the consumer aren't you'* *'There's got to be something on there to frighten people to be honest, they've got to be frightened into it otherwise they're not going to do it'*
Shock tactics*.	The article read to participants was received by mixed feelings. Some respondents felt anger and disbelief that such a tragedy could happen. Some participants felt that it would make people think of the relevance of food safety to them. Some participants had read similar stories before and were unsure about the impact of such a story.	*'That could occur to any of us, so we'd want to know what to do in an instance like that'* *'Its making you really aware that hygiene is very important'* *'I think its good, regarding hygiene, hygiene is essential and relate the story, or vice versa'* *'You just think, oh another one of those stories'*
Perceptions of images of bacteria (Appendix 7.7).	Images of bacteria shown to the groups received a mixed response. Many participants thought that inclusion of black and white versions of the images may help people understand that the bacteria exist on foods. Colour versions of the bacterial images were not recognised. Participants thought that they looked more like coral, attractive food to eat or types of crisps!	Re: what pictures would be useful for intervention material: *'The germs in it' 'Transferring, you know...cross contamination'* Re: colour pictures: *'You tend to say those pretty coloured germs instead of errrgh! You want something more horrifying'* *'If it was in black and white, maybe'* *If I hadn't seen 'bacteria' I wouldn't know that was bacteria to be honest, I wouldn't have known, I would have thought it was Spaghetti'* *'Looks like cheesy wotsits gone pink'* Re: black / white pictures: *'That would put people off'* *'It shows us the dangers and things you know'*

* An extract from an article was read in each focus group describing the unpleasant symptoms of an older woman who died as a results of a food poisoning illness (see Appendix 7.10)

7.5.4 'Initial intervention' development.

Preliminary focus group data was analysed and interventions developed were based on information obtained from the target audience. *Message content* and *terminology* were based on findings denoting target audience perceptions of the behavioural objective and determinants, as well as perceived barriers, benefits and risks of implementing the desired behaviours (see Table 7.1). The choice of *type* of intervention materials were based on focus group findings presented in Table 7.2, and *design* and *format* of interventions was based on focus group findings denoted in Table 7.3.

Photographs of appropriate domestic kitchen actions of the behavioural determinants were taken by the UWIC researcher and scanned into the computer. Leaflets, posters, magnets and a newspaper article were specifically designed for the target audience using the scanned photographic images and brief descriptions of the food preparation processes. 'Initial interventions' can be found in Appendix 7.12 and 7.13.

7.5.4.1 Additional desirable interventions which were not used.

Attempts were made to arrange a talk at the local community centre for local consumers (including consumers from the target audience), however it was found that only 4% (1/24) of the test sample who attended meal preparation sessions (see Chapter 8.0) attended the community centre OAP groups ('Women's Guild', 'Monday afternoon group', and 'Pensioners Club'). In addition to this, there was no interest in attending an independently arranged talk.

A discussion group, similar to the focus groups, would have been another beneficial method that had been suggested for 'intervention' by consumers from the target audience. The aim would have been to discuss the behavioural objective and determinants of the initiative. However, to get all of the participants who had undertaken the food preparation sessions in a discussion group would create a sample where individuals were not independent from one another. Thus, intervention discussion groups were not included as part of the social marketing promotional strategy.

Inclusion of interventions involving TV chefs promoting food safety advice related to the behavioural objective may have been beneficial to the social marketing initiative. However, it was not possible to recruit such chefs due to financial and time limitations. Furthermore, placement of interventions on buses may have been appropriate as many of the participants indicated that they frequently used public transport within Cardiff. Consumers from the target audience also suggested they may read information if it was '*in front of them*' when travelling on the bus. However, financial limitations limited such a placement strategy.

7.5.5 Formative research: evaluative focus group findings.

7.5.5.1 Shape of the leaflet.

A variety of shapes of leaflets were shown to participants in the evaluative focus group. A unanimous unprompted preference was obtained for leaflet A (an A4 sheet of paper folded into three panels) (see Appendix 7.14). Responses obtained for each leaflet shape can be seen in Table 7.4.

Table 7.4 Summarised consumer responses to a variety of leaflet shapes.

Letter reference.	Shape of leaflet.	Response.
A.	A4 sheet of paper folded into 3 panels.	'*would pick up*', '*ideal*', '*nice size,*' (in big print), '*don't want to have to go into bag and get glasses out*'
B.	A5 with 8 pages (2 sheets of A4 folded once).	'*too large*', '*would have to fold it up to fit into bag*', '*book size*'. '*Depends what's on it*'
C.	A5 with 4 pages (1 sheet of A4 folded once).	'*easy to look at*', '*would pick up a simple fold*', '*yes, prefer without the opening pages as in* (B)'
D.	Unfolded A5 sheet of paper.	'*not A5 on its own*' .. '*too flimsy*', '*just a piece of paper*' , '*would have to cram information on*'
E.	Unfolded sheet of A4 paper.	'*definitely not*'

Leaflet shapes A and C were the most preferable leaflets formats. Generally participants thought that there were too many pages in leaflet type B with potentially too much information. The least preferable formats for leaflets were the A5 and A4 sheets of paper.

7.5.5.2 Word size and content.

Participants repeatedly indicated that they needed the text to be bold and large so that it could be read without reading glasses. The most appropriate size of writing was identified for text on leaflets. Information detailing the same food safety message regarding effective hand-washing techniques using different levels of terminology was evaluated. The majority of participants preferred the most simple terminology, for example, the word '*germ*' was preferred instead of '*bacteria*', '*micro-organism*' or '*Salmonella*'. The more complicated descriptions of the hand-washing process were considered to be '*long winded*'. Other participant comments were as follows '*you'd need to get the dictionary out*', '*bit too complicated*' and '*you'd need a scientist with you*'. Thus, simple descriptions were used in intervention materials.

7.5.5.3 Responses to a variety of pictorial images.

A selection of pictorial images suitable for a leaflet were shown to the group for discussion. A comment regarding such images included '*raw chicken with knife on the* (chopping) *board, that's what we are talking about, it says it all there*'. Consumers indicated information about preparation of raw chicken and vegetables should be described and illustrated using bright distinctive colours. Large images of raw chicken with bacteria were not particularly liked, especially for the front cover '*You don't want to see germs, I wouldn't* *pick up leaflet with this picture on'*. Other participants agreed that the pictures of bacteria were not '*nice'*, however, the majority thought such images would catch attention of people and therefore increase awareness. Indeed, one participant said '*yes, they are not a very nice sight, so I think ... it would make people more aware*'.

7.5.5.4 Cover / title for leaflet.

Participants made a variety of suggestions about suitable text and pictorial images for the front cover of a food safety leaflet relevant for people like themselves. It was considered that pictures were '*far better than words'* and that photographic / pictorial images associating '*germs'* with cleanliness would be of benefit. Non-prompted examples for titles of food safety interventions included '*Hidden germs!'*, '*Germs spread disease'* and '*Think before you handle'* and '*Bacteria is there!*'. See section 7.5.5.6 for perceptions of the title / cover of the 'initial interventions'.

7.5.5.5 Pictorial images V worded descriptions for intervention materials.

A series of photographs taken in a domestic kitchen showing the correct process of adequate hand-washing and hand drying were shown to focus group participants, followed by a written detailed description of methods shown in the photographs. On the whole, consumers from the target audience preferred the photographic images which were thought to be '*very effective'*, '*they're telling you to have the bowl ready, else you transfer germs to the tap'*. The pictures were also considered to be preferable because '*you've got the water ready, it's more eye catching, it's right, it shows stages, from soapy hand-washing after the chicken and then drying'*. One participant thought that a written description was required in addition to the images because '*it would make it sink in more*'.

A series of photographs showing separate preparation of raw chicken and salad vegetables, and appropriate cleaning procedures for chopping boards and knives following preparation of raw chicken and before preparation of salad vegetables were shown to participants in the discussion. Such images were shown alongside detailed worded descriptions of the photographic images. Consumer perceptions were obtained, and as for hand-washing and hand drying, the '*pictures were* (considered to be) *more effective'*.

7.5.5.6 Evaluation of 'initial interventions'.

All focus group participants approved of the chosen title for the initially developed leaflets ('Consumer advice for the over 60's: safe preparation of raw chicken'). Responses from participants in the group included, '*it makes you firstly aware of what its about*' '*it tells you straight away*', and '*for over 60's, that's who it's for'*. Alternative titles were discussed, and participants thought that the term 'elderly' was considered to apply to others older than themselves, and the phrase 'for over 60's' was '*not insulting*' and applied to people like themselves. The term 'seniors' was considered to be an American term, infrequently used in the UK.

The images of faded raw chicken pieces used for the front cover of the initial leaflets (Appendix 7.12) developed were extremely disliked. Responses to these images included '*I didn't like the chicken as it was difficult to see*', '*looks like blobs of cotton wool, or fish*', '*not at all distinctive*'. Overall, participants did not like the faded raw chicken images on the front of the leaflet, so such images were removed from all interventions.

Respondents preferred the smaller, three-fold leaflets (Appendices 7.12 a,b) opposed to the A5, 8-page leaflet (Appendix 7.12c). Word size, descriptions and images were all considered to be appropriate and summarised bullet points were particularly approved of. All focus group participants adamantly disagreed that the information instructing 'not to wash raw chicken before preparation' was wrong because they '*believe in washing raw chicken*'.

Fridge magnets (see Appendix 7.13) designed and created by the researcher (from information obtained in preliminary groups) were evaluated. Positive responses were given about all of the magnets and preferences and suggestions were made. As for information in one of the leaflets developed, the magnet reminding consumers not to wash raw chicken before preparation was not liked because the information was thought to be incorrect therefore the magnet was removed from the promotional strategy. Evaluation of poster material was obtained regarding size of text and content. Participants were satisfied that they could read the size of the writing without having to put their glasses on.

7.5.6 Resultant social marketing interventions.

Appropriate changes were made to previously developed intervention materials in accordance with the evaluative focus group responses detailed in section 7.5.5. A review of the initial leaflets by the researcher also resulted in amendments to the text and content. Main changes included design of front cover, size and shape of some of the leaflets and removal and addition of some information. The background images of raw chicken on the leaflets were replaced with photographic images of hand-washing actions and chopping raw chicken actions denoting '*what the leaflets were about*'. The shape of A5 (8-page) leaflet was considered to be far too long, and there was a unanimous preference for the A4 (3-fold) leaflet. This resulted in the A5 leaflet being withdrawn from the promotional strategy. Information detailing washing of raw chicken was also removed from all of the intervention materials. Given the strong opinions expressed in particularly the evaluative focus group regarding the need for this practice it was considered that inclusion of information indicating such a practice was hazardous and not necessary may undermine and affect the credibility of the rest of the information. Examples of resultant interventions can be found in Appendix 7.20.

Given the positive references in the focus groups about television as a useful source of food safety information, a video documentary detailing consumer food safety in the home was included as part of the social marketing promotion strategy. The video was based upon safe food preparation in the domestic kitchen and upon on the consequences of cross contamination of micro-organisms from raw chicken and included a segment of an older female (like a consumer from the target audience) coping with a food poisoning illness. Furthermore, the lead presenter of the documentary was a familiar newsreader. An evaluation of the video documentary had previously been determined and received extremely positive responses from consumers (Griffith *et al.* 1999a).

7.5.6.1 Quantitative evaluation of resultant interventions.

Fully completed evaluation questionnaires were returned by 63% (15/24) of focus group participants. Overall, 72% (194/270) of responses to the content of both A4 (three-fold) leaflets were positive and no participants thought descriptions given were too complicated, in fact 90% of participants thought descriptions were suitable and relevant for people like themselves. Between 87-100% of participants thought the front cover to the leaflets gave a clear indication of the content, 93% of participants considered information in the leaflets was relevant to themselves and 97% thought the text size was appropriate. More than three quarters of participants rated the leaflets to be 'extremely useful' or 'useful', and marginally more participants thought the chopping board leaflet was a more useful source of food safety information than the hand-washing and hand drying leaflet. As for response to the leaflets, 75% (323/432) of responses to the content of all three posters were positive. The content of the poster denoting facts and risks of raw chicken was considered to be less clear than the other two posters. Similarly, more participants (67%) considered the posters denoting hand-washing and hand drying actions and use of chopping boards and knives to be more useful and noticeable than the poster denoting facts and risks of raw chicken.

The newspaper advert was considered to be the most useful source of food safety information provided in the 'Evaluation pack'. Self-reported findings showed that 63% of participants read the South Wales Echo on a daily basis, and a further 19% do so at least once a week, thus indicating that placement of information in this source is appropriate to reach large proportions of the target audience.

Half of the participants thought that fridge magnets were an extremely useful source of food safety information, and 66% indicated they would use the magnets in their own kitchen. Preferred magnets included 'Remember! Wash hands with soap immediately after handling raw chicken.' and 'Think before you handle'.

7.5.7 Placement of intervention material.

Quantitative data detailing life-point-paths can be found in Table 7.5 and qualitative findings to inform the placement strategy can be found in Table 7.6. It can be seen that most frequently visited locations included the Post Office, Co-op, Butchers, other food shops and newsagents. As expected, life-point-paths were largely determined by which part of the test community participants lived. The majority of participants lived near Countisbury Avenue and a few lived near Burnham Avenue and Llanrumney Avenue, thus, there was a need to place interventions in all locations. Additional factors that influenced where interventions were placed included accessibility. Some establishments were unwilling to place posters or leaflets in their amenity e.g. Boots the Chemist due to 'Company policy'.

Table 7.5 A selection of quantitative life-point-paths of target consumers (n=33)

Location.	Frequency of visiting locations (% of the total). More than once a week.	At least once a month.	Less than once a month.	Never.
CA Post Office.	67%	15%	6%	12%
CA Co-op.	64%	12%	9%	15%
CA Danish Bacon shop (Butchers).	49%	18%	15%	18%
CA Fruit shop.	49%	9%	9%	30%
CA Newsagents (1).	42%	15%	0	42%
CA Newsagents (2).	33%	0	15%	51%
CA Boots.	30%	36%	18%	15%
LA Newsagents.	30%	3%	9%	57%
LA Butchers.	21%	3%	15%	60%
Community centre.	18%	0	6%	76%
CA Doctors.	6%	24%	15%	54%

CA= Countisbury Avenue, LA= Llanrumney Avenue.

Table 7.6 Information from preliminary focus groups to inform channel analysis / placement strategy.

Influential factor.	Reported data.	Participant quotes from all preliminary focus group discussions.
Placement.	Participants suggested a wide variety of locations for food safety information to be placed in the community. Best venues for placement were considered to be the doctors surgery and community centres. Participants indicated that they also visited the post office on a weekly basis and often purchased their meat from local butchers. Pharmacies and the local leisure centre were also frequently visited and some participants thought that provision of such information in the local library would also be beneficial. Posters should be placed where participants would have time to notice, register and read such information. It was thought that leaflets should be posted thought their doors rather than in locations to be picked up.	Re: leaflets *'if that went through you're letterbox you would read it'* *'You see posters in the butchers, but not on hygiene' - 'Danish bacon the butchers'* *'I think you're a bit too harassed in a supermarket, you're getting your shopping and might put it in a bag and not bother to read it'* *'We'd go to the community centre more often than we go to the doctor'* *'in the Post Office' 'In the chemist, that's another place you're always in and out of'* *'In a bingo hall!' 'I'd put it in the library'* *'While you're waiting to see the doctor you're looking for something to do, you read everything on the wall'* *'Anywhere you might possibly wait'* *'I don't think it would be amiss to put it (*a poster*) on a bus because quite often you're just looking over the road, but in fairly clear so you don't have to put your glasses on'* *'they should have them in health centres as well'* *'..and the doctors, they should have it'* *'If you had that, (*the poster*) and then the leaflets underneath.. it would catch your eye'.*

7.5.8 Strategy development.

GOAL OF SOCIAL MARKETING, FOOD SAFETY EDUCATION INITIATIVE.

To improve food safety behaviours during food preparation by increasing implementation of food safety control measures (Figure 7.1 a,b,c) to prevent cross contamination of pathogenic micro-organisms from raw chicken to food preparation surfaces and RTE foods.

TARGET AUDIENCE.

- Older females aged 60-75 years, from SEGs C2, D, E who live in Llanrumney, Cardiff.
- Target audience segmentation was according to the motivation stage of the Health Action Process Approach. Targeted consumers included those who had some prior knowledge of food safety practices when preparing food at home, and also reported to understand that food poisoning can be a severe or moderate illness. In addition, segmented, targeted consumers also thought that there are actions that they can implement to reduce the risk of getting food poisoning at home.

APPROACHES USED TO INFLUENCE BEHAVIOURS.

- Use of interventions suggested by consumers from the segmented, target audience and development of interventions was based on information obtained from consumers from the segmented target audience.
- Repeated evaluations (qualitative and quantitative) of developed intervention materials.
- Intervention messages targeted specifically for consumers who are 'over 60', using preferred formats.
- Use of familiar terminology for messages attempted to visualise risks of the presence of harmful micro-organisms present on raw chicken. In addition, intervention materials presented quantified risks of the transfer of such organisms from raw chicken to hands and RTE foods.
- The target audience was informed (using quotes from focus groups) about experiences (and therefore potential consequences) of food poisoning experienced by local consumers of a similar age.
- Message content forming the basis of exchange theory included promotion of the benefits (peace of mind of safe food preparation and the prevention of illness to yourself and your family) of implementation of the behavioural determinants in exchange for a small amount of time and effort. In addition, targeted consumers indicated that preparation of safe food was a personal responsibility, and health of their families was considered to be important to them.
- Qualitative and quantitative channel analysis findings provided information to aid effectual placement of intervention materials.

Figure 7.1 The Marketing Mix.

Product.

Food safety behaviours

Implementation of control measures:

a. Adequate hand-washing and hand drying immediately after touching raw chicken.
b. Use of separate or adequately washed and dried chopping boards and knives between preparation of raw chicken and salad vegetables / cooked ham, or preparation of salad vegetables and cooked ham before handling raw chicken.
c. Prevention of contamination of preparation environment with raw chicken packaging.

Price.

Barriers to implementation of appropriate food safety practices were reported to be time, lack of thought and lack of routine. Benefits of carrying out appropriate food hygiene behaviours included peace of mind and the responsibility for providing safe food for the family. Participants also commented that they couldn't afford to be ill in terms of time or money.

In terms of exchange theory, promotional material offered advice suggesting a small amount of time and thought to exchanged for '*getting things right*', prevention of illness for themselves and their family and providing a good example for people younger than themselves.

Promotion.

Tailored intervention materials used included specifically designed leaflets and posters, fridge magnets, a relevant television documentary and newspaper article about the desired behavioural determinants.

Spokespersons for the television documentary included a relaxed and respected newsreader and family members who had experienced food poisoning. Non-technical or microbiological terms were used and the documentary was based in a domestic kitchen. Attention was paid to the specific cross contamination actions, highlighting how easy bacteria can be spread from a raw chicken around the kitchen due to inadequate washing and drying of hands and equipment. The magnets were designed to constantly remind the target audience to implement the desired behaviours. Message design for the interventions used quotes from focus groups and terminology used by the target audience. Photographs of desired practices and bright colours were used as a basis for all promotional materials. The content of the leaflet, poster and reminder signs included 'simple tips' of the specific cross contamination behaviours. Visual and worded explanations were provided to illustrate the risk of harmful bacteria present of raw chicken. Participant quotes regarding unpleasant experiences of and perceptions of food poisoning were included in promotion materials.

- Hand-washing (3 folded) leaflet (see Appendix 7.20a).
- Chopping boards (3 folded) leaflet (see Appendix 7.20b).
- Five different magnets (see Appendix 7.20c).
- Three A3 posters (all laminated) (see Appendices 7.20d,e,f).
- A quarter page newspaper advertorial on Food Safety Advice for over 60's in South Wales Echo (see Appendix 20g).
- One 30 minute TV documentary illustrating the severity of food poisoning illness and the luminous glow of cross contamination around a domestic kitchen during preparation of raw chicken (see Redmond *et al.* 2001 for transcription).

Figure 7.1 The Marketing mix (*continued*).

Placement / distribution of intervention materials to test community.

⇒ *Delivery of leaflets / magnets.*

A coloured copy of each leaflet was hand delivered (anonymously) to each test participant home, though the post-box, before 7am in the morning by the researcher. In addition to the leaflets, an envelope with a typed label 'to the occupier' was hand posted to each participant house with five different magnets.

Additional leaflets (black and white d/s photocopies) were also delivered to houses either side of each participant house and opposite each participant house where possible at the same time of delivery of test sample leaflets. At the same time, envelopes with typed labels 'to the occupier' was also hand posted to each house with two different magnets. In total, 200 food safety leaflets and 378 magnets were hand-delivered to residents' homes in Llanrumney.

Colour printed leaflets were also distributed within the community in the Post Office, Doctors Surgery and local Library.

⇒ *Distribution of videos.*

A total of 25 videos were posted (anonymously) to participant houses with a covering letter and form asking for their opinion of the food safety documentary and questions were included to confirm that the participant had actually watched the video. Supermarket voucher incentives were offered for the return of the survey and a SAE to 'Video survey' was enclosed (posted to a home address in Cardiff). A problem that occurred with this method is that there was no information available to determine whether individual test participants owned a video machine / television prior to distributing the video.

⇒ *Newspaper advertorial.*

To ensure that each participant had the opportunity to come into contact with the advertorial placed in the South Wales Echo, a newspaper was hand-delivered to each test participant house during the evening that the newspaper was in press.

⇒ *Placement of posters.*

In total, 28 A3 sized colour posters were placed in Llanrumney community. The majority of posters were placed in the following locations for a period of one month: The Post Office, two local newsagents, Co-op, Spar, Danish Bacon Shop, Library and Doctors Surgery on Countisbury Avenue. In addition to this posters were placed in a third newsagents, 'A1' foodstore and Lloyds Pharmacy on Burnham Avenue and Health care shop and fourth newsagents on Newport Road. Furthermore posters were placed in the 'Eastern Leisure centre and local foodstore on Llanrumney Avenue. The researcher requested that several other shops and amenities would display the posters, however many other places declined the offer for a variety of reasons, one being company policy.

7.6 DISCUSSION.

7.6.1 Introduction.

Use of the structured framework and concepts provided by the social marketing approach facilitated development of a consumer orientated, targeted food safety educational strategy designed to encourage consumers to implement voluntary behavioural change. The following discussion outlines the social marketing developmental process encompassing initial planning, formative research, process evaluation and intervention and message design. For the implementation and evaluation of the effectiveness of the initiative see Chapter 8.0.

7.6.2 Initial planning of the social marketing process.

The initial planning phase of the social marketing initiative provided a foundation for the development and implementation of food safety interventions. Key features of the initial planning process were determination and segmentation of target audience and identification of a behavioural objective and behavioural determinants.

7.6.2.1 Identification of target audience.

A review of previous observation data (Anderson *et al.* 2000; Griffith *et al.* 1999a; Redmond *et al.* 2001; Worsfold and Griffith, 1997b; Worsfold, 1994) facilitated the identification of a relatively analogous group of consumers that implemented unsafe food-handling practices. This, plus a review of the risk status of individuals using epidemiological data provided a clear rationale for the determination of a target audience.

The target audience was identified as older females, aged 60-75 years, from social groups C2, D and E. It is widely reported that older consumers, namely the 'elderly' have a higher risk of contracting foodborne illnesses (Buzby, 1995; Gerba *et al.* 1996; Ralston, 1995; Smith and Fratamico, 2000), indeed such illnesses can be life threatening (Djuretic *et al.* 1996) due to age associated immune deficiency (Smith, 1998). In the UK, the population of older adults is increasing (BBC, 2002) and findings from the United States have reported that not only are 'elderly' consumers the fastest growing segment of the population, but also the majority (78%) of diarrhoeal deaths that occur are to those aged >55years (Gerba *et al.* 1996). As a consequence of such factors, targeted food safety education is required to improve food safety behaviours of this group of consumers (Gettings and Kiernan, 2001; Hudson and Hartwell, 2002).

It has been reported that a fundamental component of older consumers' (aged >60 years) independence is their ability to prepare foods (Gettings and Kiernan, 2001). However, previous research has indicated that food safety behaviours of older consumers (aged 60-75years) were worse than other targeted audiences such as mothers with young children and single young males (Redmond *et al.* 2001). Furthermore, from the same study, *Campylobacter* was isolated from the end products, kitchen surfaces and / or cloths of after more than half (60%) of food preparations undertaken by older participants (Redmond *et al.* 2001). Such findings are concerning, especially given that *Campylobacter* was the most common pathogen detected from food poisoning cases associated with consumers aged >65 years (Djuretic *et al.* 1996).

A consumer food safety observation study has determined that females aged 60-75 years implemented a larger number of food safety malpractices during meal preparation than males of the same age (Redmond *et al.* 2001). When considering that 85% of females aged 65-74 years prepare every meal in the household, as opposed to 34% of males (Nicholaas, 1995), the opportunities for contamination of the kitchen may occur on a more frequent basis by females than males, simply due to the increased frequency of food preparation.

Target audiences chosen for social marketing initiatives are not usually based on the 'most in need' (Andreason, 1995; Bryant, 1999a). Thus, although observational findings have shown that older females, aged 60-75 years from SEGs C2,D,E frequently implement unsafe food safety practices, findings have also shown that consumers from the selected target audience also implement some appropriate food safety control measures during food preparation (Griffith *et al.* 1999a; Redmond *et al.* 2001; Worsfold, 1994). Findings have indicated that consumers aged >65 years use both appropriate and inappropriate food safety practices, were reiterated in self-reported data reported by Gettings and Kiernan (2001). Furthermore, analysis of quantitative data from Chapter 3.0 of this thesis suggested that consumers from the target audience have an awareness of food safety issues, indeed in some cases significantly more so than younger consumers. In addition, consumers from the target audience assume a greater responsibility for food safety than younger consumers, yet also perceive themselves to have a lower risk of food poisoning than younger consumers. Given the risk status of the target audience, such a perception is of concern. Furthermore a perception of optimistic bias may impede upon educational efforts (Weinstein, 1989). Analysis of quantitative data from Chapter 4.0 indicated that consumers from the target audience have a positive attitude towards receiving information regarding safe food preparation. Furthermore, such consumers are also receptive to food safety education.

Llanrumney and Fairwater were considered to be suitable geographical communities in Cardiff to focus upon for this food safety education initiative. Both communities consisted of the largest proportions of targeted consumers in Cardiff. Llanrumney was chosen to the test community (where the largest proportion of the target audience lived) and Fairwater (where slightly fewer targeted consumers lived) was selected as the control community.

7.6.2.2 Segmentation of target audience.

The purpose of segmentation is to define an analogous subgroup of the target audience that have common 'needs', values and perceptions. Identification of such factors, as well as distribution and communication channels common to the segmented target audience increase the potential reach, and potential effectiveness of the message (Lefebvre and Flora, 1988; McCormack-Brown, 1998d). As previously mentioned (section 7.2) Prochaska's TTM has commonly been used for segmentation of the target audience in social marketing campaigns (McCormack-Brown, 1998e). However, use of this model has been found to be inappropriate for food safety (Redmond *et al.* 2000). The food safety based social marketing study targeted consumers into the 'preparation stage of change' and using tailored interventions, the initiative aimed to 'move' the target audience into the 'action stage of change' (Redmond *et al.* 2000). However, unlike other health-related behaviours, such as smoking cessation, implementation of food safety behaviours is not associated with a linear decision making process. Indeed, implementation of food safety behaviours involves a multiplicity of decisions for a variety of complex processes. In addition, food safety practices may occur irregularly, so a straightforward 'move' from thinking about implementing food safety behaviours to actually doing so is far from straightforward.

In this study, the motivational phases of the HAPA (Schwarzer and Fuchs, 1999) was used to segment the target audience. The HAPA retains components of TTM in terms of 'stage theory', however, is separated into two phases – a motivational phase and a volitional phase. The motivational phase consists of cognitive influences upon behaviours, which influence intention, and the volitional phase is based upon thought processes prior to action, action and maintenance of action (Bennett and Murphy, 1999). Segmentation using the motivational phase enabled the target audience in this study to be grouped according to cognitive processes associated with risk, outcome expectancies, and self-efficacy. It is believed that in the motivation phase of the HAPA the individual forms an intention to adopt a precaution measure to change risk behaviours in favour of other behaviours (Schwarzer, 2000). Furthermore, it is reported that the motivational phase of this model is triggered by the perception of a threat to health, and Schwarzer, (2000) has stated that only a minimum level of threat is required to initiate consideration of change. If consumers have knowledge and believe that they can take action to improve a health-related behaviour they may feel more inclined to do so (Schwarzer and Fuchs, 1999). Outcome expectancies refer to the perception of the possible consequences of actions, such as risk perceptions of food poisoning illness, and risk associated with food safety malpractices and personal vulnerability. Targeted consumers were considered to have similar behavioural intentions towards food safety practices. The target audience was segmented according to possession of some, not all, knowledge about food safety practices when preparing food at home, recognition that the risk of food poisoning illness could be moderate / severe (risk perception and threat appraisal), and capability of implementing food safety actions (self-efficacy) to reduce the risk food poisoning.

The volitional phase of the HAPA follows the motivational phase and is made up of cognitive situational and behavioural factors. Such factors were explored in addition to external barriers and resources during focus group discussions and will be discussed in 7.6.3.

7.6.2.3 Determination of the social marketing behavioural objective and behavioural determinants.

A core element to the marketing mix, as part of social marketing is the 'product'. As previously described, the concept of products can include ideas, social causes and behavioural change (Lefebvre and Flora, 1988). In the instance of this food safety education initiative, the product refers to behaviours, for example, the implementation of specific safe food-handling actions.

The products for this social marketing initiative were behaviours related to cross contamination of raw chicken to RTE foods during food preparation. Observational findings from previous research and Chapters 5.0 and 6.0 have shown that cross contamination occurs frequently during preparation of raw chicken and RTE foods in the domestic kitchen. For example, data from Chapter 5.0 showed that 100% participants failed to wash and dry their hands adequately at all times when necessary during food preparation, 77% of participants implemented inadequate food safety behaviours during preparation of raw chicken and RTE foods and 60% of participants contaminated the preparation environment with RCP. In addition to this, cross contamination has been implicated as a contributory factor in 39% of general outbreaks of foodborne disease in England and Wales (Evans *et al.* 1998). Additionally, research has indicated that cross contamination is substantially under-reported as a contributory factor for foodborne disease (See Chapter 2.0). Furthermore, such actions are associated with substantial microbiological risks (Redmond *et al.* 2001; Slader *et al.* 2001; Worsfold and Griffith, 1996a). This data cumulatively provided a substantial base for establishing the behavioural objective and determinants. Thus the *behavioural objective* was defined as 'improvement of food safety behaviours including implementation and maintenance of control measures to prevent cross contamination of pathogenic micro-organisms from raw chicken to food preparation surfaces and RTE foods'. Principle *behavioural determinants* of this objective included: adequate hand-washing and hand drying immediately after touching raw chicken, use of separate or adequately washed and dried chopping boards and knives between preparation of raw chicken and salad vegetables / cooked ham, or preparation of salad vegetables and cooked ham before handling raw chicken and prevention of contamination of preparation environment with raw chicken packaging.

7.6.3 Preliminary focus group findings.

A central feature of social marketing is consumer orientation (Andreason, 1995). This requires that consumers' needs and perceptions should drive health-related initiatives, as opposed to traditional expert driven and top down approaches that have little consumer input (Lefebvre and Rochlin, 1997; Redmond *et al.* 1999). Use of focus groups have been frequently employed during development of social marketing initiatives (Quinn, 1998) and such discussion groups are known to be particularly effective for providing information about *why* people think or feel the way they do (Kruegar, 1994). Hence, it is considered that the use of focus groups can help make risk communication more effective (Desvousges and Smith, 1988).

7.6.3.1 Self-efficacy, control and responsibility.

Perceived self-efficacy is considered to be crucial at all stages of the HAPA (Schwarzer, 2000), and indeed findings from this study indicated that self-efficacy was high amongst participants from all focus groups. Findings showed that consumers believed that their own personal experiences, age and common sense enabled them to have the skills and capability to implement the desired food safety behaviours of this initiative. However, concurring with findings from Gettings and Kiernan (2001), this group of consumers rely on knowledge from the distant past as a basis for their food-handling practices. For example, consumers in this study indicated storage of all foods in 'larder' opposed to a refrigerator and use of vinegar to 'clean' chopping boards after use were acceptable practices. Knowledge of cross contamination and specific actions necessary for adequate implementation of behavioural determinants was varied. Corresponding with previous research (Redmond and Griffith, 2003a) this study ascertained a widespread understanding of the *need* for adequate hand-washing during food preparation and the *need* to use separate or cleaned utensils between preparation of raw chicken and RTE foods. However, the majority of participants in all preliminary focus groups in this study perceived inadequate practices that may result in indirect cross contamination of pathogenic bacteria from raw chicken to RTE foods to be adequate and safe. Such findings concur with previous focus group research that indicated that mothers of young children also perceived inadequate practices to be safe and adequate (Griffith *et al.* 1999a; Redmond *et al.* 2000). Findings from this study suggested that consumers from this target audience did need to be provided with information detailing correct, adequate hand-washing and hand drying practices and safe use of chopping boards / knives during preparation of raw chicken and RTE foods. Thus, such information was provided in the developed intervention materials.

Perceptions of the amount of control consumers have over their own food safety were varied. Focus group findings corresponded to quantitative survey results, both of which indicated that the majority of target consumers were confident and believed that they had full control over their own food safety during food preparation at home. Most of these participants were able to state how they had such control, by reporting safe food-handling actions that they reported themselves to implement. As discussed in Chapter 3.0, such an 'illusion of control' can be an obstacle for health education when communicating information about food safety hazards and risks to consumers (Hoorens, 1994; Weinstein and Klein, 1995). A minority of consumers thought that if bacteria or '*germs*' were present in food that was bought into the domestic kitchen, it was '*beyond your control to prepare food safely*'. Thus, inclusion of information to overcome this and empower the consumers to have control over their own food safety was considered to be important in developed interventions. In an attempt to overcome notion of the 'illusion of control', realistic, quantified risks of pathogenic bacterial contamination resulting from improper food-handling actions were included in intervention materials.

Quantitative survey data denoting older female attitude responses towards responsibility for food safety differed to qualitative findings from focus groups of consumers from the target audience. Seventy-eight percent of older female consumers considered that manufacturers are ultimately responsible for the safety of their foods, however, focus group participants thought that it was up to the *'individual'* to be responsible for food safety. Nevertheless, in focus groups, when prompted, the majority of participants thought that outside sources such as supermarkets, farmers, inspectors and the Government also had a responsibility for safe food production / regulation. Such findings reiterate the need for a shared responsibility for food safety between industry and consumers (Griffith, 2000a), yet more emphasis needs to be given to personal responsibility of consumers for their own food safety (Unklesbury *et al.* 1998). Such issues have been discussed in more detail in Chapter 3.0. In terms of development of social marketing interventions for this educational initiative the focus of responsibility has been centred upon the consumer. For example, advice provided in interventions 'for the consumer' was highlighted on the front pages of leaflets and posters, and phrases such as 'Its down to YOU!' were included in interventions to raise awareness of personal responsibility.

7.6.3.2 Risk perceptions.

The target audience perceived 'risk' to be part of everyday life and risks associated with food safety were discussed in the context of consumption of food away from the home opposed to within the home. It was generally felt that it was '*chance*' whether safe or unsafe food was purchased for consumption. Concurring with data representing a cross section of the population of Cardiff (see Chapter 3.0), and other research (CFIA, 1998; MAFF, 1988; Mathias, 1999; Williamson *et al.* 1992; Woodburn and Raab, 1997) the majority of consumers thought that their own food preparation practices in the home were safe and that there is a higher risk of getting food poisoning from food away from the home. This illustrated the need to emphasise information in tailored interventions regarding the risks of food poisoning associated with the home.

Focus group findings from this study indicated that some of the targeted consumers' perceptions of food poisoning illnesses were inaccurate. In addition to this, perceived severity and consequences of food poisoning illness were varied. Some participants acknowledged that food poisoning could be a serious illness with long-term repercussions and this perception was usually supported with personal experience of food poisoning. Other participants thought that food poisoning was a minor illness lasting for a short period of time. Such findings concur with other reports denoting consumer perceptions of illnesses resulting from food poisoning. For example, Endres *et al.* (2001) found that many American adults underestimate the potential for foodborne illnesses and Leman (2001) reported that many UK consumers fail to recognise key clinical features of foodborne illnesses.

Individuals most at risk from food poisoning were thought to be 'elderly' due to increased vulnerability and weakened immune systems, yet the participants in the focus groups considered elderly people to be '*older than themselves*', suggesting that consumers from the target audience fail to recognise themselves as being more susceptible to food poisoning than younger adults. Thus consumers from the target audience may unknowingly put themselves more at risk from poisoning.

7.6.3.3 Outcome expectancies.

Focus group participants indicated that they expected the implementation of certain food preparation practices to result in food that is safe for consumption. It appeared to be understood that failure to separate raw chicken and RTE foods could result in the transfer of micro-organisms from (e.g.) *'raw meat onto cooked meat'*. Furthermore, it was recognised by some consumers from the target audience that consumption of contaminated food could result in food poisoning.

7.6.3.4 Perceptions of behavioural determinants.

Perceptions of a variety of written descriptions (see Appendix 7.8) of adequate and inadequate actions relating to behavioural determinants were obtained from focus group participants. For hand-washing practices, the description 'after touching raw chicken, rinse hands under running water' was considered to be a realistic description of how the majority of participants reported to wash their hands after handling raw chicken. A lack of understanding and knowledge was also observed regarding the need for use of soap for adequate hand-washing amongst targeted consumers. It was also considered that the description describing acceptable hand-washing practices was too time-consuming. Such focus group findings are inconsistent with previous survey data that has indicated that the majority of consumers report to wash their hands properly after handling raw meat / poultry (Jay *et al.* 1999b; Nunnery, 1997). Thus, it can be suggested that discrepancies occur between self-reports of hand-washing and hand drying collected using qualitative focus groups and quantitative survey research methods. In addition, qualitative data from focus groups may represent a more accurate description of self-reported food safety behaviours than quantitative surveys. This may be because focus group discussions offer a more relaxed and open means of data collection. Focus group discussions also found that participants frequently reported using paper towels for drying of hands, however, such self-reported behaviours do not correspond with observational findings from Chapter 5.0 and Redmond *et al.* (2001) and Griffith *et al.* (1999a).

Focus group findings indicated that consumers from the target audience had misconceptions about the safe use of chopping boards and knives after preparation of raw chicken and before preparation of RTE foods and consequently reported unsafe practices. Although the majority of participants recognised the description on Showcard 3, 'after cutting raw chicken on a chopping board.... wash with hot water and washing up liquid, scrub with scourer, brush or unused cloth, rinse and spray with sanitiser and then rinse for a second time' as being the most appropriate and safe method to use, many participants reported implementing the inadequate 'cleaning' procedure stated in Showcard 1, 'after cutting raw chicken on a chopping board ..... rinse under running water and wipe with a cloth'. The word sanitiser was not understood by many participants, yet several participants commented that they use bleach when cleaning their chopping board after preparation of raw meat. A substantial amount of previous survey based consumer food safety research has investigated consumer usage of utensils for preparation of raw meat / poultry and RTE foods. However, no survey data detailing specific self-reported methods of decontamination of utensils between preparation of raw meat / poultry and RTE foods has been identified and so direct comparisons between survey data and focus group findings from this study cannot be made. Further research is required to ascertain specific decontamination methods employed to clean utensils after domestic preparation of raw meat / poultry and before preparation of RTE foods.

7.6.3.5 Barriers, benefits and exchange theory.

In social marketing, the product (in this case, specific food safety behaviours) must be promoted as the solution to what target audience perceives to be important and / or truly beneficial to life (Andreason, 1995). In addition, the benefits of implementing the product must be more highly valued than the benefits provided by the barriers, known as the 'competition' (Bryant, 2002). Consumers in this study indicated the main barriers to undertaking food safety behaviours required to fulfil the social marketing behavioural objective were time, lack of thought and lack of routine. Furthermore, as mentioned earlier, many consumers from the target audience do not believe that they personally are at risk from illness resulting from food poisoning. This barrier was also identified in the 'Thermy' social marketing based food safety education initiative in USA (FSES, FSIS, USDA, 2001). A practical barrier for the failure to use soap for hand-washing during food preparation and washing up was skin irritation and as mentioned earlier, a lack of understanding and knowledge was observed regarding the need for soap for adequate hand-washing. Benefits of safe food preparation included the satisfaction of provision of safe food for the family, '*getting it right*' and the avoidance of overwhelming guilt for making another family member or individual ill. Thus, phrases such as 'A little more time..... for peace of mind' and 'How to control the harmful germs and protect yourself and your family against food poisoning illness' were included to represent the notion of exchange theory. Thus, overcoming a major barrier, belittled to a 'little more time' spent implementing food safety behaviours, can provide the benefit of something that is of great importance to members of the target audience – peace of mind and protection of themselves and their families from illness.

7.6.3.6 Perceptions of intervention materials.

A selection of food safety education interventions used in previous health education initiatives were evaluated in the preliminary focus groups to obtain unprompted feedback from the target audience denoting preferable formats, content and overall perceptions of different intervention materials. The intervention that was unanimously preferred by all focus groups was produced by the Meat and Livestock Commission entitled 'Food Safety and the Consumer'. Other leaflets of a similar format (A4, 3-fold) were also favoured. Information presented as bulleted tips was preferred to paragraphs of text. All participants thought that large text that was legible without reading glasses was important. Text found in leaflets provided by MAFF and the Food Safety Advisory Centre (in the 1990's) in the UK was considered to be too small to read with ease. Thus it can be suggested that interventions provided from such major institutions may have been ineffective for educating older consumers, such as those in this target audience, about safe food preparation behaviours and the risks of food poisoning. In terms of appearance, most participants from the focus groups preferred the use of colour photographs and a short description denoting the food safety message written using familiar terminology. However, some participants indicated they would find written food safety information more interesting and informative. Leaflets with cartoon images were considered to be suitable for school children and inappropriate for people like themselves. Phrases such as 'the consumer' and 'the kitchen' included in the title leaflets designed by the Meat and Livestock Commission and Milton appeared to attract the target audiences' attention, because it was clear *who* the leaflets were intended for and *what* the content was about.

Survey responses from target consumers indicated that they were more likely to take notice of food safety education based upon specific issues opposed to generalised messages. However, generalised messages have formed the basis of the majority of traditional food safety education initiatives in the UK. A preference for information to be presented upon specific issues favours the social marketing approach whereby messages are targeted towards the specific behavioural determinants.

A variety of photographic images were shown to focus group participants and images of bacteria shown to the groups received a mixed response. Colour images of the bacteria were not recognised – participants thought they looked like '*coral*' and '*attractive food to eat*' rather than pathogenic bacteria. Black and white versions of the same images received a more serious response and it was thought that inclusion of similar images into intervention materials may help other consumers understand the direct association between bacteria or '*germs*' and food.

An article was read to consumers to obtain perceptions of fear appeals (Appendix 7.10) which could be included as part of a food safety message for this social marketing strategy. Fear appeals (or shock tactics) are considered to be persuasive messages that emphasise the harmful or physical or sometimes social consequences of failing to comply with the message recommendations (Hale and Dillard, 1995). The article described the unpleasant symptoms of food poisoning that a female from the same age group as the target audience had experienced. Responses to the article were mixed. Some participants felt anger and disbelief that such a tragedy could happen. Others thought that it would make people think of the relevance of food safety to them. Other participants thought that they had read similar stories before in womens' magazines and were unsure about the impact of such a story. Health campaign professionals are split in their opinions on the usefulness of fear appeals (Hale and Dillard, 1995). It is reported that behavioural change resulting from shock tactics can be short-lived (Bennett and Murphy, 1999) and thus such messages may have limited effectiveness (Austin, 1995). Nevertheless, the use of such information in health education is widespread and three quantitative reviews have shown that inclusion of fear appeals in health education messages have had a positive, persuasive impact influencing behavioural change (Hale and Dillard, 1995). Therefore, in response to the feedback to the shock tactics article from the focus groups and potential for promoting better health, inclusion of experiences of food poisoning illnesses (in the words of consumers from the target audience), illustrating the consequences of food poisoning, were included into intervention messages.

Qualitative and quantitative perceptions of intervention types provided information to drive decisions regarding the choice of format to promote food safety information to the target audience. Advantages and disadvantages of different intervention formats have been discussed in Chapter 2.0. Quantitative data indicated that consumers from the target audience thought that food packaging, advice from doctors and recipes were the most preferable sources of food safety information, followed by leaflets, television and posters. Although the concept of provision of food safety information in recipes was considered to be a missed health education opportunity (Griffith *et al.* 1994), perceptions of food safety information within recipes examined in focus groups were largely negative due to there being '*too much information*' to follow. Thus, inclusion of recipes as a source for food safety information was not included in this social marketing initiative. In addition, as for food packaging, the provision of food safety information in recipes, for this study may bias findings detailing the effectiveness of interventions in Chapter 8.0 by creating a direct link between interventions in Llanrumney community and UWIC food preparation research.

Findings from this study indicated that older consumers were more likely to acquire food safety leaflets than younger consumers, and that leaflets were a preferable source of food safety information. The majority of the focus group participants had not previously seen any of the food safety leaflets evaluated in the preliminary focus groups. Indeed, one participant said *'you seldom pick up a leaflet... about hygiene'*. Participants considered that provision of information in leaflet form was more appropriate for people like themselves, because they have time to read the leaflets, unlike younger consumers. In addition, many participants liked the idea of being provided with leaflets as it enabled them to *'educate themselves'* which was considered to be *'nice'*. Findings from an American qualitative study denoting perceptions of written food safety educational materials (pamphlets) found that consumers liked the concept of pamphlets because they could keep them with recipes, cookbooks and in their pocket (Gettings and Kieran, 2001). Findings from this study indicated that placement and method of acquiring leaflets may influence potential reach and consequent effectiveness (see section 7.6.6).

Qualitative and quantitative findings showed that other sources of food safety information that were considered to be preferable by the target audience included posters and the media of television. Perception of posters was largely dependent upon size of text and legibility and placement (see section 7.6.6). The majority of participants from the target audience reported watching television cookery programmes and many recalled having seen documentaries about food safety. Food safety behaviours demonstrated by TV chefs were considered to be inadequate in focus group discussions, and improvement of such behaviours was considered to be a good source of food safety education, however due to constraints of the study and practicalities of such as intervention, such a source was not developed. However, the quantitative findings from Chapter 4.0 indicated that consumers who watch TV cookery programmes are significantly likely to watch TV documentaries about food safety. In addition, positive responses were made during group discussions regarding TV documentaries about food safety. Therefore, thus bearing the requirements of the behavioural objective, the needs, perceptions and educational level of understanding of the target audience in mind, an appropriate video documentary was selected for intervention. Quantitative data from consumers similar to the target audience who answered the food safety education questionnaire indicated that the most likely spokesperson that they would believe to convey food safety information was a newsreader. The spokesperson for the chosen documentary was Michael Burke, an older, familiar and well respected ex-BBC newsreader. The documentary was also set in a domestic kitchen and had a very non-scientific, relaxed style that would be familiar to the target audience. Subjects addressed within the documentary included concepts of cross contamination, illustrated by the spread of illuminous gel representing bacteria on a raw chicken during domestic food preparation. In addition an older female, similar to the consumers from target audience described the consequences of food poisoning.

Findings denoting reminder aids such as magnets for promotion of food safety education information from focus groups and the survey (Chapter 4.0) did not correspond. Quantitative survey results indicated that magnets were not considered to be preferable sources of information, especially from older consumers. However, when shown examples of such magnets in focus groups, participants thought they may help to remind them of food safety in their home kitchens and thus might help improve food safety practices. Focus group discussions indicated that the use of magnets and small A4 sized posters for the kitchen were particularly novel and useful as constant reminders '*you could keep it out as a little reminder*'. Incidentally the nation-wide food safety education campaign in the United States has included magnets as an important source of information for consumers (Partnership for Food Safety Education, 2002). Therefore in response to the positive qualitative formative research, design and creation of magnets promoting food safety information occurred for this social marketing initiative.

As described in Chapter 4.0 the credibility of the health education information may influence the effectiveness of the intervention(s). Older females from the target audience ranked the HEA, supermarkets, FDF and Health Educators as most credible and trusted providers of food safety information. Thus, at the bottom of all leaflets and posters, it was noted that the information was provided by 'Health Educators'.

7.6.4 Development of social marketing intervention materials.

7.6.4.1 Initial development of social marketing interventions.

Interventions developed after analysis of preliminary focus groups included three leaflets and a selection of reminder aids (see Appendices 7.12 and 7.13). Design, content and terminology used were based on responses from consumers from the target audience. Photographic images were used, with bulleted 'tips' for instruction. Red text was used to denote 'danger' and larger text was use for ease of sight. Design of leaflets included information presented on the centre pages of a three-fold-A4 piece of paper. In response to focus group respondents suggestions, the centre pages were suitable for sticking up in a domestic kitchen as small posters. Use of familiar terminology was used, appropriate for the understanding of the target audience.

7.6.4.2 Evaluation of initial intervention materials.

Evaluation and consumer orientation are key factors addressed during to social marketing initiative development (Bryant, 1999b). It is considered that focus groups drawn from the target audience are an appropriate method used for pre-testing intervention material (Downie *et al.* 1998). Evaluation at this stage of development of the social marketing initiative is known as 'process evaluation'. Pre-testing aids determination of material suitability and ensures design is 'on the right track' before the final interventions are completed (Salazar, 1998).

Results from the evaluative focus group indicated that respondents from the target audience did not like the larger, eight page A5 leaflet (seen in Appendix 7.12a) due to it being too '*book like*' and '*too large*'. However, participants unanimously preferred the A4, 3-fold leaflets (Appendix 7.12b,c). The main criticism of the initial intervention materials developed, was the use of images of pieces of raw chicken for the background design of all of the leaflets. Respondents from the target audience did not like such images, which were considered to be '*unrecognisable*', '*indistinctive*' and '*have a similar appearance to cotton wool*' rather than raw chicken. Appropriate word size and terminology was evaluated to ensure that final intervention materials were designed as ideally as possible for legibility for older females aged 60-75 years. As expected, simple, uncomplicated descriptions of food-handling processes and actions were preferred to more scientific instructions. Overall, the evaluation of the content of the leaflets was positive.

Positive responses were obtained from consumers regarding food safety magnets. A common feeling amongst participants regarding information instructing not to wash raw chicken was considered to be incorrect and so was removed from most of the designed intervention material. It was thought that inclusion of information perceived to be inaccurate may undermine the credibility of the remaining information so was removed from most intervention materials. Continuing the application of 'process evaluation' of the social marketing initiative development, initial intervention materials were changed to account for responses from the evaluative focus group.

7.6.5 Evaluation of final interventions.

Final interventions (see Appendix 7.20) were quantitatively evaluated by consumers from the target audience. Overall, responses to interventions were positive, thus justifying the acceptability of materials for promotion of the specific food safety issues for the target audience.

7.6.6 Placement of interventions.

Implementation of a channel analysis provided data to ensure that promotion of social marketing interventions could be placed in life-point-paths of the target audience. Indeed, it is reported that careful placement of health communication messages can facilitate an effective, cost-effective campaign (Weiner and Brookes, 1998). Qualitative data obtained from the focus groups about placement of intervention material did not correspond with quantitative data. In focus group discussions participants were asked where they think the best places to put leaflets, posters and other information about food safety. Participants from focus groups suggested that the best venues in Llanrumney were community areas such as the doctor's surgery '*I think you're more inclined to read it if you're sat in the doctors because you always wait ages don't you*' or Community Centres '*I think it's a wonderful idea in the community centre*'. It was thought that posters should be put up where consumers would have time to notice, register and read them. Supermarkets were also mentioned as being appropriate places for obtaining information about food safety. However, when life-point-paths were identified using a quantitative channel analysis to determine how frequently various local amenities in the test community were visited, it was apparent that the target audience did not visit venues perceived to be best for placement of interventions on a frequent basis. Findings indicated that 90% of the target audience most frequently visited the Post Office in Llanrumney at least once a week or more. Other locations in test community that persons from the target audience visited frequently included the 'Co-op', 'Danish Bacon Shop', 'Fruit shop', 'Pharmacy' 'Greggs the Bakers' and 'Boots the Chemist'. The majority of locations visited by the target audience were along the main row of shops in Llanrumney on 'Countisbury Avenue'. It was found that Doctors Surgeries were attended to by most of the sample, however, on a less frequent basis. Thus, main locations for placement of large posters in the community were the Post Office, local supermarkets and food stores listed above as well as other locations around the community that were visited by the target audience.

Focus group participants indicated that leaflets posted through the letterbox with the post would receive more attention than leaflets left in locations to be picked up. Therefore, leaflets and magnets were anonymously posted through all of the participants' doors to ensure they were received.

Participants commented about a variety of incidents regarding food safety and food poisoning that they had read in the local paper (South Wales Echo). Furthermore, many focus group participants indicated they read such a newspaper on at regular basis. Therefore, such a location was considered to be a suitable life-point-path to place additional tailored information for the target audience.

7.7 CONCLUSIONS.

Use of a social marketing approach has facilitated the development of a consumer orientated, highly-focussed food safety education strategy with tailored intervention materials. The structured framework provided by social marketing supported the developmental process which included initial planning, formative research, channel analysis, exchange theory, process evaluation and strategy formation. The resultant food safety education strategy was based upon the concepts of the marketing mix (product, price, promotion, placement).

During the initial planning the target audience was determined to be older females aged 60-75 years from SEGs C2, D and E. Geographical test and control communities in Cardiff were determined as Llanrumney and Fairwater respectively. The target audience was segmented according to the motivational phase of the Health Action Process Approach. Targeted consumers were segmented according to those who had some knowledge of food safety in the home, recognised food poisoning could be a moderate or severe illness, and possession of a degree of self-efficacy for reducing the risk of food poisoning.

A review of observational data from previous research and Chapters 5.0 and 6.0 indicated that actions associated with cross contamination of pathogens from raw chicken to RTE foods required improvement to prevent microbiological contamination of the domestic kitchen and reduce the risk of food poisoning. Thus, the *products* of this social marketing initiative were food safety behaviours including immediate and adequate hand-washing and hand drying after handling raw chicken, use of separate / inadequately washed chopping boards for preparation of raw chicken and RTE foods or preparation of RTE foods before handling raw chicken. An additional behavioural determinant of the initiative included prevention of contamination of the preparation environment with RCP.

In accordance with social marketing principles, quantitative and qualitative formative research findings were central to the development of interventions, food safety messages and strategy formation. Overall it was determined that attitudes of consumers from the target audience towards the behavioural determinants were largely positive, however, perceived 'correct' behaviours were inadequate to control pathogenic contamination in the domestic kitchen. The home was seen as an unlikely location for acquiring food poisoning and consumers from the target audience were found to have a low perceived risk of illness and people older than themselves were considered to be more susceptible to food poisoning illnesses. The target audiences' perceptions of food poisoning illnesses were found to be inaccurate and underestimated and although the majority indicated they were responsible for food safety at home, some felt that they had no control over preparation of safe food.

Identification of barriers and benefits to implementation of behavioural determinants occurred in focus group discussions, and thus informed the concept of exchange theory. Therefore, the *price* to be paid for implementing the desired behavioural determinants was 'a little more time', in exchange for peace of mind, empowerment and personal control to protect their own health and the health of their families.

Findings from preliminary focus group discussions were used to inform the *promotional* component of the social marketing strategy, including material type, format, design, content and message. Pre-testing of initial interventions enabled further improvement and tailoring of intervention designs based on target audience perceptions and comments. Final intervention types devised included two A4, 3-fold food safety leaflets, five magnets, three posters, a newspaper advertorial and a food safety video documentary. A quantitative evaluation of final interventions received a positive response from consumers from the target audience.

Content of interventions was based upon the provision of images and simple descriptions illustrating the processes required for adequate implementation of behavioural determinants. Design of the interventions ensured that it was clear whom interventions were intended for and what information was about. Messages were based upon the notion of exchange theory, empowerment, consequences of not implementing behavioural determinants and raising awareness of the presence of 'harmful bacteria' on raw chicken using visualisations. Terminology used in all interventions was based upon that used, and familiar to the target audience, and information was presented at a suitable level of understanding.

The *placement* strategy was determined from formative research findings and a quantitative channel analysis. Consumers indicated they were more likely to respond to leaflets that were posted through the letterbox with their post than if placed in a community area, thus developed leaflets were disseminated to test consumers (see Chapter 8.0) in this manner. Life-point-paths were largely determined as locations for placement of intervention materials. For example, findings showed that the majority of consumers from the target audience visited the Post Office at least on a weekly basis and thus placement of interventions in such a location will increase potential reach and consequent effectiveness of the food safety education strategy.

CHAPTER 8.0

EVALUATION OF THE EFFECTIVENESS OF A SOCIAL MARKETING FOOD SAFETY EDUCATION INITIATIVE USING THE OBSERVATION TECHNIQUE.

8.1 INTRODUCTION.

A summative evaluation of intervention effectiveness is considered to be an important component of any health education initiative (see Chapter 2.0). This chapter utilises risk based observation (developed in Chapter 5.0 and 6.0) to assess targeted consumers' food safety behaviours before and after implementation of a social marketing based food safety education initiative (developed in Chapter 7.0)

8.2 REVIEW OF LITERATURE.

Evaluation of health promotion initiatives is required to attribute value to interventions (Ovretveit, 1998) and a well-planned evaluation with easily measured outcome criteria is considered to be an integral part of any intervention (HEA, 1996). Issues related to the evaluation of intervention effectiveness for changing health-related knowledge, attitudes and behaviour have been addressed by several workers (Eiser and Eiser, 1996; Ehiri and Morris, 1996; Loevinshn, 1990; Paul and Redman, 1997).

Data representing intervention effectiveness is known as an 'outcome measurement'. Such information can be determined by implementation of a variety of evaluation process designs, including a descriptive design, audit design, before-after design, comparative-experimentalist design and randomised-controlled experimental design. Such approaches have been described by Overtveit (1998). An outcome evaluation using one of the listed designs is considered to be part of the summative evaluation (Overtveit, 1998).

In the past, methods utilised to measure intervention effectiveness of health-related behaviours have largely included use of surveys, direct and indirect observation studies and assessment of recorded vaccinations and screening and attendance rates. In addition, some studies have assessed the recall of interventions and determination of intervention 'reach' to gauge potential intervention impact (Cole and Holand, 1986; Montazeri and McEwen, 1998; O'Loughlin *et al.* 1997). The most informative method of evaluation used for determining intervention effect should be directly related to aims of the health education initiative. Thus, the use of surveys undertaken before and after intervention for evaluation of initiatives, that have aimed to improve knowledge and / or attitudes of a health-related subject, can be considered to be appropriate for the evaluation of such intervention effect. For example, Nichols *et al.* (1998) used a postal survey to evaluate the effectiveness of a leaflet designed to change knowledge and attitudes about eating and health, and Stenberg-Nichols and Schmidt, (1995) used a telephone survey to evaluate impact of the use of videotapes played in grocery stores to increase awareness of issues related to fat and cholesterol. However, given the discrepancies between cognitive antecedents and actual behaviour discussed in Chapter 2.0 and Chapter 5.0, the use of surveys is not always an effective means of evaluation of intervention effect, especially if the aim of the intervention is to change behaviour.

The ultimate goal for social marketing initiatives is behavioural change (Andreason, 1995; Lefebvre, 1995) and sustained behavioural change (McCormack Brown, 1998b). Thus, when determining the effectiveness of community based social marketing interventions, direct measurement of behavioural change is advocated as opposed to indirect measures such as self-reported practices or an increase of awareness, both of which have been described as unreliable indicators of behaviour (Griffith *et al.* 1995; McKenzie-Mohr and Smith, 1999). Indeed, social marketers are not satisfied if, for example, people know more about healthy behaviours unless they also practice them (Bryant and Salazar, 1998). In addition, a social marketing initiative is not considered to be a success if, after intervention, the target audience only has a more positive attitude towards (e.g.) a public health programme unless they actually attend the service advocated (Bryant, 1999a). Social marketing initiatives that have aimed to change specific health-related behaviours have evaluated the effectiveness of programmes by monitoring the frequency that (e.g.) telephone calls are made to a free phone number, which may be the 'call to action', or (e.g.) monitored the frequency of attendance to a cancer screening clinic (Forthover, 1998).

Observation studies detailing specific behaviours provide valuable information detailing what people do, skill deficits and behavioural sequences (McKenzie-Mohr, 1999). The observation technique is also useful for evaluating behavioural compliance, particularly for behaviours where people are being asked to learn and maintain new skills (Mckenzie-Mohr and Smith, 1999) as may be the case for food safety. Observation is not commonly employed to assess intervention effectiveness or impact for practical and financial reasons, however, a few studies have used observation to evaluate the effectiveness of interventions that have intended to improve adequate hand-washing behaviours in hospitals (Naikoba and Haywood, 2001) and in schools (Early *et al.* 1998).

Although the provision of food safety education as a means for improving food-handling has been widely recognised (Rennie, 1995b), during the past 10-20 years, consumer food safety education in the UK has received relatively little attention. A reason for this may be the lack of suitable means for assessing intervention effectiveness (Griffith *et al.* 1995). Indeed, it is considered that unless educational strategies are perceived be cost effective, '*no serious effort will be made to implement them*' (Todd, 1989c).

Evaluation of the effectiveness of food safety training has often been measured by determination of self-reported practices and knowledge, which are not usually reflected in behavioural change (Ehiri and Morris, 1996; Mederios *et al.* 2001b). Indeed, an evaluation of a national domestic food safety campaign implemented in New Zealand in 1999 was based upon a self-administered questionnaire relating to recall of campaign messages and resultant 'behavioural changes' (Simmons *et al.* 2001) which were self-reported. Although inherent biases in the evaluation method were recognised, and a high proportion of respondents already reported desirable food safety practices, the campaign was considered to be effective (Simmons *et al.* 2001). In the US, evaluation techniques employed to evaluate the nationwide 'Thermy' consumer food safety education campaign have included epidemiological data, consumer food safety surveys, industry data (regarding thermometer sales) and specific market surveys (Conely, 2002). In the UK, the evaluation of consumer food safety education has largely been disregarded or based on survey responses. Indeed, the impact of the first phase of the FSA Food Hygiene campaign that was launched in 2001 has recently been determined using an assessment of recalled interventions and reported knowledge (FSA, 2002c). Although such responses may provide an indication of the reach and understanding of interventions, they do not provide a measure of behavioural change, which the FSA are attempting to achieve. It is considered that measurement instruments for the evaluation of food safety education are required (Mederios *et al.* 2001b).

8.3 AIMS AND OBJECTIVES.

8.3.1 Aim.

- Evaluate the effectiveness of a food safety education initiative using observation and risk based scoring.

8.3.2 Objectives.

- Select a suitable meal for preparation by consumers in the model domestic kitchen.
- Devise an observational checklist and corresponding scoresheet for recording observed food-handling behaviours.
- Observe meal preparations of targeted consumers from a test community in the model domestic kitchen before, immediately after, and 4-6 weeks after intervention.
- Observe meal preparations of a matched sample of consumers (from a control community) in the model domestic kitchen during three repeated meal preparations, (at the same intervals as targeted consumers from the test sample).
- Using risk based scoring, quantitatively assess observed food safety behaviours implemented by the test and control samples during meal preparations.
- Compare food safety behaviours of the test sample with the control sample observed during first, second and third meal preparations.
- Evaluate the impact of interventions upon the test sample using food safety risk scores.
- Investigate the relationship between the recall of interventions and change in food safety behaviours.

8.4 METHODS.

8.4.1 Design of the intervention study.

A classic intervention design is to create two groups, an experimental group (who receive intervention) and a matched control group (who receive no intervention) (Ovretveit, 1998). For this study (as described in section 7.5.1.3) an experimental or 'test' group of targeted consumers were recruited from Llanrumney (in Cardiff), and a 'control' group of targeted consumers were selected from Fairwater (in Cardiff). The intervention study followed the design of a 'before-after' approach, and 'comparative-experimentalist' approach where by the comparison of food safety risk scores (representing food safety behaviours) were compared between the two groups of consumers (Ovretveit, 1998).

8.4.2 Observation of test and control participant food preparation sessions.

8.4.2.1 Participant recruitment for food preparation sessions.

Consumers from the target audience (see section 7.5.1.1) were recruited using a local Market Research Agency (Beaufort Research Ltd., Cardiff) to participate in three meal preparation sessions. As for focus group recruitment described in section 7.4.4.1, face-to-face recruitment interviews were conducted by field researchers using a specified recruitment questionnaire (see Appendix 7.2) in test and control communities and all recruits were given an invitation to confirm recruitment (see Appendix 8.1). To avoid contamination bias, no more than one person was recruited from each household or social gathering.

Target recruitment quotas given to the Market Research Agency to fulfill were based upon the over-recruitment requirements (30% more than the target quota) to achieve repeated observations of 30 participants from the test community and 15 participants from the control community. Thus, 40 potential participants were recruited from the test community and 20 were recruited from the control community.

As described in Chapter 5.0, once recruited, participant recruitment details were forwarded from the Market Research Agency to the researcher at UWIC. As in Chapter 5.0, each of the recruits was telephoned and given a detailed explanation of what was required during the three meal preparation sessions (for a similar telephone protocol see Appendix 5.13). Each participant was subsequently sent an information pack with letter confirming date / time arrangements prior to attending the first meal preparation session (see Appendix 8.2). Participants were also telephoned 24 hours before the cooking session to confirm arrangements. Arrangements for second and third meal preparation sessions were made at the end of the first and second sessions respectively and all participants were sent letters to confirm such arrangements (see Appendix 8.3). Free transport was provided for all participants attending meal preparation sessions. As in Chapter 5.0, participants were offered supermarket incentives for participation in all three meal preparation sessions, amounting to £50. Ten pounds was offered after the 1st and 2nd meal preparation sessions and £30 was offered after preparation of the final (3rd) meal preparation session.

8.4.3 Observations of food preparations in the model domestic kitchen.

For this part of the study, participants were required to prepare a chicken salad (see Appendix 8.4) from raw foods in the model domestic kitchen. As described in Chapter 5.0, food safety practices were observed using CCTV (see section 5.4.6.3) and recorded using detailed observational checklists (see section 5.4.4 and Appendix 5.4). The risk based scoring system developed in Chapter 5.0 (section 5.4.5) was used to quantitatively assess food safety behaviours (see Appendix 5.8 and 5.9 for examples of descriptions of awardable demerit scores and an example of a scoresheet used to record demerit scores).

Observed meal preparations for this study occurred on three separate occasions over a period of three months. All participants from both test and control communities attended the second food preparation session within 3 weeks of the first session, and all participants attended the third food preparation session between 4 and 6 weeks after the second food preparation session. Figure 8.1 illustrates the order of meal preparations for both test and control community and time of placement of intervention materials in the test community.

Figure 8.1 Plan of observed meal preparations for participants from the test and control communities.

TEST PARTICIPANTS (*n*=24)

First meal preparation of chicken salad
(food safety behaviours observed and scored).

↓ < 3 weeks

Interventions distributed in the test community and
delivered to test participants.

↓ 2-4 weeks

Second meal preparation of chicken salad
(food safety behaviours observed and scored).

↓ 4-6 weeks

Third meal preparation of chicken salad
(food safety behaviours observed and scored).

CONTROL PARTICIPANTS (*n*=14)

First meal preparation of chicken salad
(food safety behaviours observed and scored).

↓ 3-4 weeks

Second meal preparation of chicken salad
(food safety behaviours observed and scored).

↓ 4-6 weeks

Third meal preparation of chicken salad
(food safety behaviours observed and scored).

8.4.4 Recall of interventions.

At the end of the final meal preparation session all participants from the test community were asked a series of questions concerning their recollection of seeing any food safety based and nutritional based leaflets, posters, videos, magnets or information in the local newspaper during the past 2-3 months (see Appendix 8.5). If participants recalled such information, they were then asked to describe what they had seen, thus ensuring recalled information had been part of the social marketing initiative.

8.4.5 Analysis of data.

All observational data and risk scores obtained (see section 8.4.3) were entered into the Consumer Food Safety Microsoft Access '97 database (see section 5.4.8.1). All further descriptive and statistical analyses were carried out using SPSS version 9.0 for Windows and Microsoft Excel '97.

8.4.5.1 Evaluation of food safety risk scores between test and control samples: descriptive analysis.

An initial comparison between food safety risk scores obtained from meal preparations conducted by test and control sample participants was made by calculating mean risk scores for first, second and third meal preparations from the test and control sample. A bar chart was plotted and visual evaluation made.

8.4.5.2 Evaluation of food safety risk scores between test and control samples: statistical analysis.

A statistical analysis commonly employed for the evaluation of the effectiveness of interventions between test and control samples is an Analysis of Variance (ANOVA). Thus, (as with other similarly designed outcome evaluations) (Ovretveit, 1998) it was hypothesised that the subjects undergoing intervention will differ from the controls on a measured characteristic (observed food safety behaviours). For this study, use of an Univariate ANOVA allowed identification of statistically significant differences between test and control samples based on a comparison of risk scores obtained between first and second meal preparations for both samples. It was considered that the interventions would have the biggest impact upon food safety behaviours immediately after intervention, and thus the ANOVA was conducted on data collected before and immediately after intervention.

When conducting the ANOVA, the variable including risk scores from time one (before intervention) was determined as the covariate, risk scores from time two (immediately after intervention) was determined as the dependent variable, and the fixed factors were the test and control sample variables. Definition of the covariate as risk scores obtained before intervention enabled the baseline difference in risk scores to be controlled.

8.4.5.3 Effectiveness of interventions (test sample): effect size analysis.

The effect size measure is an index of how important or powerful the relationship between the variables is (Wood, 1995). Thus, calculation of an 'effect size' enables quantification of the effectiveness of a particular intervention (Coe, 2000) and thus it has been frequently used in meta-analyses (Aron and Aron, 1997; Wood, 1995) and as a measure of effectiveness for educational interventions (Conn *et al.* 2002). Effect size is not related to statistical significance, yet is an important measure in small intervention studies (such as this one) whereby an intervention effect determined on a small sample also denotes an expected effect upon a larger sample size.

Effect size is a standardised mean difference between two groups and is calculated by dividing the mean difference of the two groups (e.g. before and immediately after intervention) by the standard deviation of the mean difference (Aron and Aron, 1997). Interpretation of effect size findings has been standardised by Cohen (1988) who specified three conventions based upon the effects observed in many actual studies. Such conventions include small effect (0.2), medium/moderate effect (0.5) and large effect (0.8) (Aron and Aron, 1997; Cohen, 1988).

8.4.5.4 Effectiveness of interventions (test sample): descriptive analysis.

A descriptive analysis of food safety malpractices implemented by test participants was undertaken for all food safety malpractices, overall targeted social marketing malpractices and individual targeted malpractices such as hand-washing and hand drying, use of knives and chopping boards for preparation of raw chicken and RTE foods and potential contamination of the preparation environment from raw chicken packaging (RCP). Such analyses included quantification of the proportion of the sample whose food safety behaviours improved or worsened between first, second and third meal preparations, for all behaviours and targeted behaviours. In addition specific counts of component actions were analysed in terms of frequency of implementation.

8.4.5.5 Effectiveness of interventions related to recall (test sample).

Descriptive statistics were used to describe the number of participants who recalled seeing between 1 and 2 interventions and 3, 4 and 5 interventions. In a similar manner to the statistical analysis in section 8.4.5.2, a Univariate One Way ANOVA was used to determine the difference between risk scores obtained from the two samples (those who recalled 1-2 and 3-5 interventions) over time (before intervention to immediately after intervention). Such an analysis was carried out using risk scores representing all food safety malpractices and malpractices associated with the social marketing objective. It was hypothesised that food safety risk scores (and thus, food safety behaviours) associated with subjects who recalled 3-5 interventions will differ from subjects who recalled 1-2 interventions.

8.5 RESULTS.

8.5.1 Introduction.

Observed food safety malpractices implemented by all test and control participants in the model domestic kitchen were allocated food safety risk scores (as described in Chapter 5.0). In this section, the effectiveness of social marketing interventions have been measured and evaluated using observations of food safety behaviours and corresponding food safety risk scores before, immediately after, and 4-6 weeks after intervention.

A standard approach has been taken to analyse this intervention study. However, due to the sample size an effect size approach has also been undertaken, with less emphasis on statistical significance. Descriptive and statistical analyses have been undertaken over time, and between test and control samples denoting total food safety risk scores (representing all observed food safety behaviours) and social marketing risk scores (representing food safety behaviours related to the social marketing objective). In addition, the impact of recall of interventions upon observed food safety behaviours has been evaluated.

8.5.2 Participant sample.

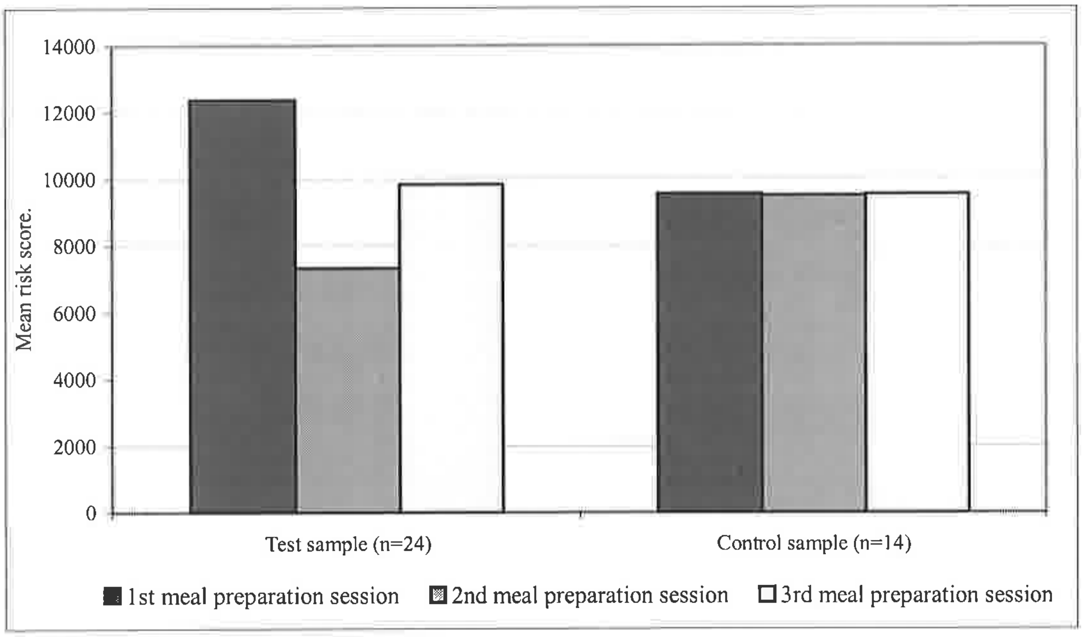
Recruitment, time constraints and consumer commitment limited recruitment and participation of consumers in this study. Overall, 65% (39/60) of the recruited participants participated in the study. Those who withdrew their interest in the study (35% of recruited participants) did so either between the recruitment stage of the study and arrangement of the initial meal preparation in UWIC or before the initial meal preparation session. Thus, 83% (25/30) of the targeted number of consumers from the test community and 93% (14/15) of the targeted number of consumers from the control community attended in the three meal preparation sessions required for the study (117 meal observations). The data from observed meal preparations was analysed for only 24 test sample participants. Rejection of one set of data (from participant number '45') was due to the additional guidance required and given to the participant who was unable to prepare the chicken salad without intervention from the researcher. In addition, during conversations with the participant it was apparent that, unlike all of the other participants, she no longer prepared food or cooked for herself. All data collected from the control sample was used in the following analysis.

8.5.3 Comparative measurement of food safety malpractices implemented during repeated meal preparations by participants from the test and control communities.

8.5.3.1 Comparison of mean risk scores for repeated meal preparations by the test and control sample.

An initial evaluation of the difference of food safety malpractices (represented by mean risk scores) between test and control samples first, second and third meal preparations (see Figure 8.2) was carried out. Visually, results suggested that observed food safety malpractices implemented by the control sample (who received no food safety intervention from UWIC) appeared to be consistent between repeated meal preparations, with mean risk scores ranging between 9,501 to 9,845. Observed food safety malpractices implemented by the test sample (who were subject social marketing food safety interventions) appear to have improved immediately after intervention as the mean risk score decreased from 12,373 (before intervention) to 7,322 immediately after intervention. However, after a period of 4-6 weeks the mean risk score increased to 9,835, thus, the initial improvement was not maintained. Nevertheless, overall findings suggest that food safety behaviours of the test sample may have been subject to an intervention effect.

Figure 8.2 Comparison of mean risk scores representing all observed food safety malpractices from repeated meal preparations for the test and control samples.



8.5.3.2 Statistical analysis of the difference of food safety malpractices implemented during repeated meal preparations between the test and control sample.

Implementation of a One Way ANOVA was used to determine the statistical effectiveness of intervention, the results of which can be found in Table 8.1. Overall, no significant difference (p>0.05) was identified between risk scores representing all food safety behaviours, all behaviours related to the social marketing objective or individual social marketing determinants between the first and second meal preparations undertaken by the test and control samples. Thus, the hypothesis purporting a difference between food safety behaviours implemented between test and control participants was rejected. Such findings were not altogether unexpected given the small size of the test and control samples, as well as potential external influences as described later in the discussion (section 8.6). As a result of such statistical findings and considerations, data analysis in this chapter has largely been based upon an evaluation of food safety behaviours implemented by all of the test sample before intervention, immediately after and 4-6 weeks after intervention using an analysis of effect size and descriptive statistics.

Table 8.1 ANOVA results indicating levels of significance between failure to implement food safety behaviours by the test (*n*=24) and control (*n*=14) sample between first and second meal preparations.

Food safety behaviours	F value	*p* value
All observed food safety behaviours.	3.27	0.08
All targeted food safety behaviours related to the social marketing objective.	0.55	0.46
Hand-washing and hand drying practices after handling raw chicken.	0.19	0.67
Use of chopping board for preparation of raw chicken and RTE foods.	0.65	0.42
Use of knife for preparation of raw chicken and RTE foods.	0.02	0.90
Potential contamination of food preparation environment with RCP.	0.33	0.57

Key: RTE= ready-to-eat foods (including lettuce, cooked ham, tomato, spring onion); RCP=raw chicken packaging.

8.5.4 Effect size analysis of intervention effectiveness on food safety malpractices implemented during repeated meal preparations of the test sample.

Using food safety risk scores, findings from the effect size analysis provided data to determine comparable effectiveness of interventions between overall food safety practices, and targeted practices relevant to the social marketing initiative. Results (see Table 8.2) show that, as expected, the maximum effectiveness of the food safety education interventions occurred immediately after intervention, as opposed to 4-6 weeks after intervention. The biggest impact that interventions appeared to have had was regarding all food safety behaviours immediately after intervention (effect size = 0.65). Immediate intervention effect upon 'all targeted behaviours', hand-washing and hand drying and use of chopping board for preparation of raw chicken and RTE foods was 'moderate' (effect sizes ranging from 0.40-0.47). For the remaining practices, potential contamination of the preparation environment with RCP and use of knives for preparation of raw chicken and RTE foods, immediate intervention effect was considered to be 'low' (effect sizes ranging from (0.18-0.23).

Table 8.2 Potential effectiveness of interventions: effect size analysis (test sample n=24).

Food safety behaviours.	Intervention effectiveness: between before and immediately after intervention⊗.	Intervention effectiveness: between before and 4-6 weeks after intervention⊗.
All observed food safety behaviours.	0.65	0.32
Use of chopping board for preparation of raw chicken and ready-to-eat foods.	0.47	0.39
All targeted food safety behaviours related to the social marketing objective.	0.42	0.28
Hand-washing and hand drying practices after handling raw chicken.	0.40	0.34
Potential contamination of food preparation environment with raw chicken packaging.	0.23	0.23
Use of knife for preparation of raw chicken and ready-to-eat foods.	0.18	0

⊗Interpretation of effect size: small effect =0.2, moderate effect =0.5, and large effect =0.8 (Aron and Aron, 1997; Cohen, 1988).

8.5.5 Descriptive evaluation of intervention effectiveness: all observed food safety malpractices (test sample n=24).

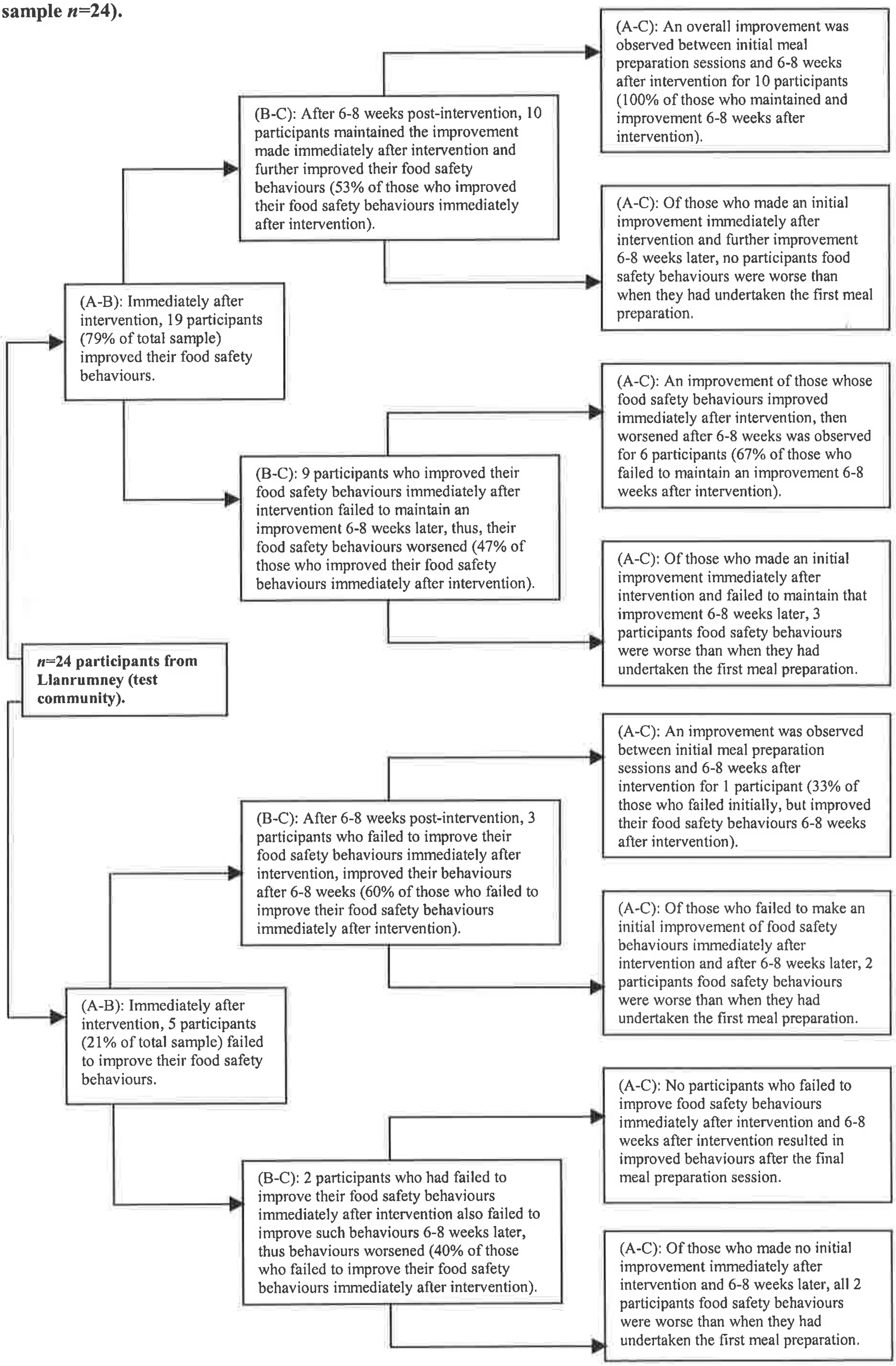
Assessment of observed meal preparations showed that 79% (19/24) of test sample participants' food safety risk scores decreased after immediate exposure to intervention materials, thus indicating improvement of food safety behaviours (see Table 8.3). Overall, 71% (17/24) of participants' risk scores decreased (food safety behaviours improved) from initial meal preparation session to 4-6 weeks after intervention.

Mean risk scores determined from meal preparations of the test sample before, immediately after and 4-6 weeks after intervention are presented in Figure 8.2 and reported in section 8.5.3.1.

Table 8.3 Proportions of the test sample whose overall food safety behaviours improved and worsened between meal preparations (n=24).

Direction of risk score.	Change in risk score from before intervention to immediately after intervention n (%).	Change in risk score immediately after intervention to 4-6 weeks after intervention n (%).	Change in risk score from before intervention to 4-6 weeks after intervention n (%).
Risk score decreased (food safety behaviours improved).	19 (79)	13 (54)	17 (71)
Risk score increased (food safety behaviours worsened).	5 (21)	11 (46)	7 (29)

Figure 8.3 A breakdown of the number of participants who implemented food safety malpractices before, immediately after and 4-6 weeks after intervention: all observed food safety malpractices (test sample n=24).



A= Before intervention (1st meal preparation session).
B= Immediately after intervention (2nd meal preparation session).
C= 6-8 weeks after intervention (3rd meal preparation session)

Improvement and deterioration of participants' food safety behaviours before, immediately after and 4-6 weeks after intervention can be seen in Figure 8.3. Of the 79% (19/24) participants whose food safety behaviours improved (risk scores decreased) immediately after intervention, 53% (10/19) participants maintained and improved their behaviours further (risk scores decreased further) 4-6 weeks after intervention. However, 47% (9/19) of participants failed to maintain the initial improvement and consequently food safety behaviours worsened (risk scores decreased). Nevertheless, risk scores for 67% (6/9) of these participants were lower than the risk scores obtained before intervention, indicating that food safety behaviours were better than before intervention. Thus, of the 79% (19/24) participants whose food safety behaviours improved immediately after intervention, 84% (16/19) implemented better food safety behaviours than before intervention. Of the 21% (5/24) of participants who failed to improve their food safety behaviours (risk scores increased) immediately after intervention, only 60% (3/5) of participants improved their food safety behaviours (risk scores decreased) 4-6 weeks after intervention. However, only 33% (1/3) of these participants' food safety behaviours were better (risk scores lower) than before intervention.

8.5.6 Descriptive evaluation of intervention effectiveness: targeted behaviours (test sample *n*=24).

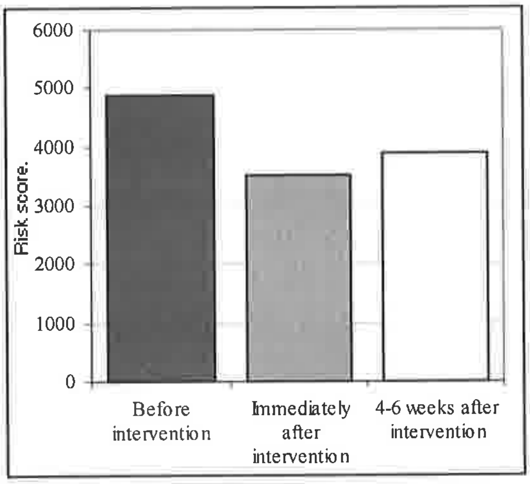
Targeted behaviours of the social marketing initiative included adequate hand-washing and hand drying after handling raw chicken, use of separate / adequately washed chopping boards and knives for preparation of raw chicken and RTE foods, and prevention of indirect contamination from RCP to the preparation environment. A comparison of risk scores representing these behaviours between meal preparations (see Table 8.4) has shown that immediately after intervention, 75% (18/24) of participants improved the targeted behaviours. Overall, 67% (16/24) of participant risk scores representing targeted behaviours decreased (food safety behaviours improved) from the initial meal preparation session to 4-6 weeks after intervention.

Table 8.4 Proportions of the test sample whose targeted behaviours improved, worsened and remained unchanged between meal preparations (test sample *n*=24).

Risk score direction.	Change in risk score from before intervention to immediately after intervention *n* (%).	Change in risk score immediately after intervention to 4-6 weeks after intervention *n* (%).	Change in risk score from before intervention to 4-6 weeks after intervention *n* (%).
Risk score decreased (food safety behaviours improved).	18 (75)	10 (42)	16 (67)
Risk score increased (food safety behaviours worsened).	6 (25)	11 (46)	8 (33)
Risk score stabilised (food safety behaviours did not improve or worsen).	0	3 (13)	0

Data presented in Figure 8.4 shows mean risk scores representing all of the targeted behaviours in the social marketing initiative. Mean risk scores for the test sample show a similar pattern to data presented in Figure 8.2 for all food safety behaviours, where scores decrease immediately after intervention. However, after 4-6 weeks, although retaining an overall improvement not all improved behaviours are maintained.

Figure 8.4 Mean risk scores representing targeted behaviours (test sample *n*=24).



Mean risk scores for individual targeted behaviours are presented in Figure 8.5 and Figure 8.6. Reflecting the overall findings presented in Figure 8.2 an initial, (albeit small) improvement of mean risk scores can be observed immediately after intervention for each of the targeted behaviours. Results suggest that improved use of chopping boards for preparation of raw chicken and then RTE foods and implementation of adequate hand-washing and hand drying practices was maintained 4-6 weeks later.

Figure 8.5 Bar chart showing mean risk scores for targeted behaviours: use of chopping boards and knives for preparation of raw chicken and then ready-to-eat (RTE) foods (test sample *n*=24).

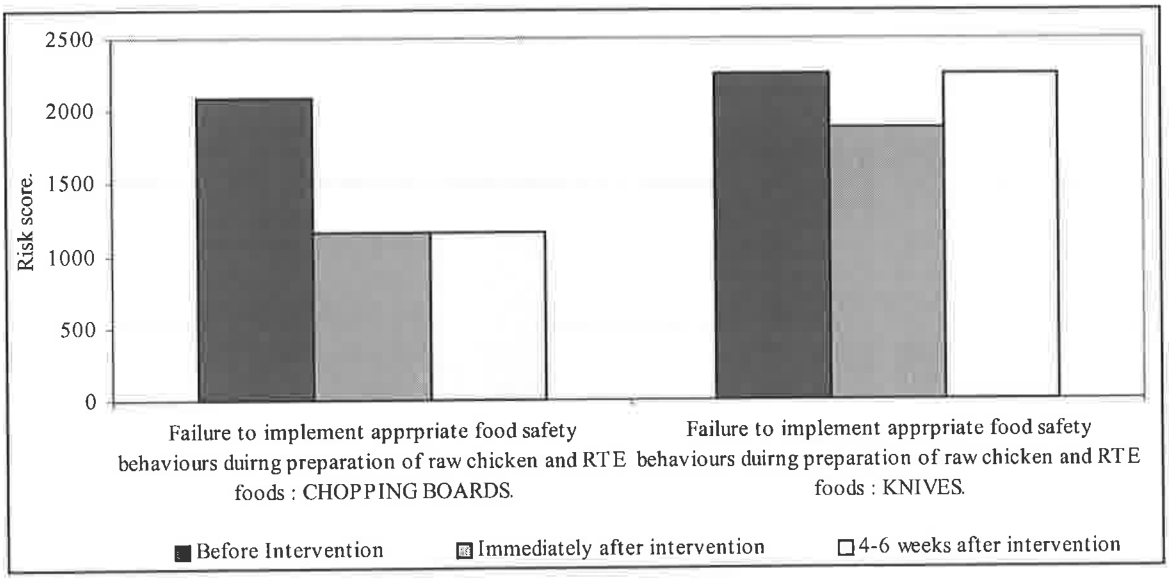
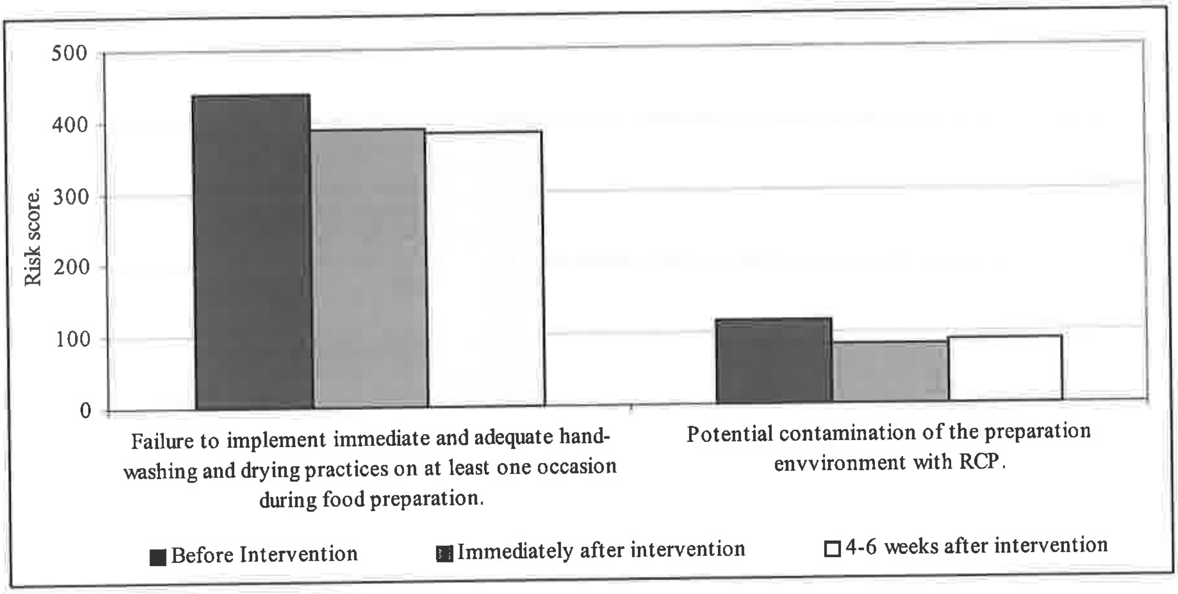
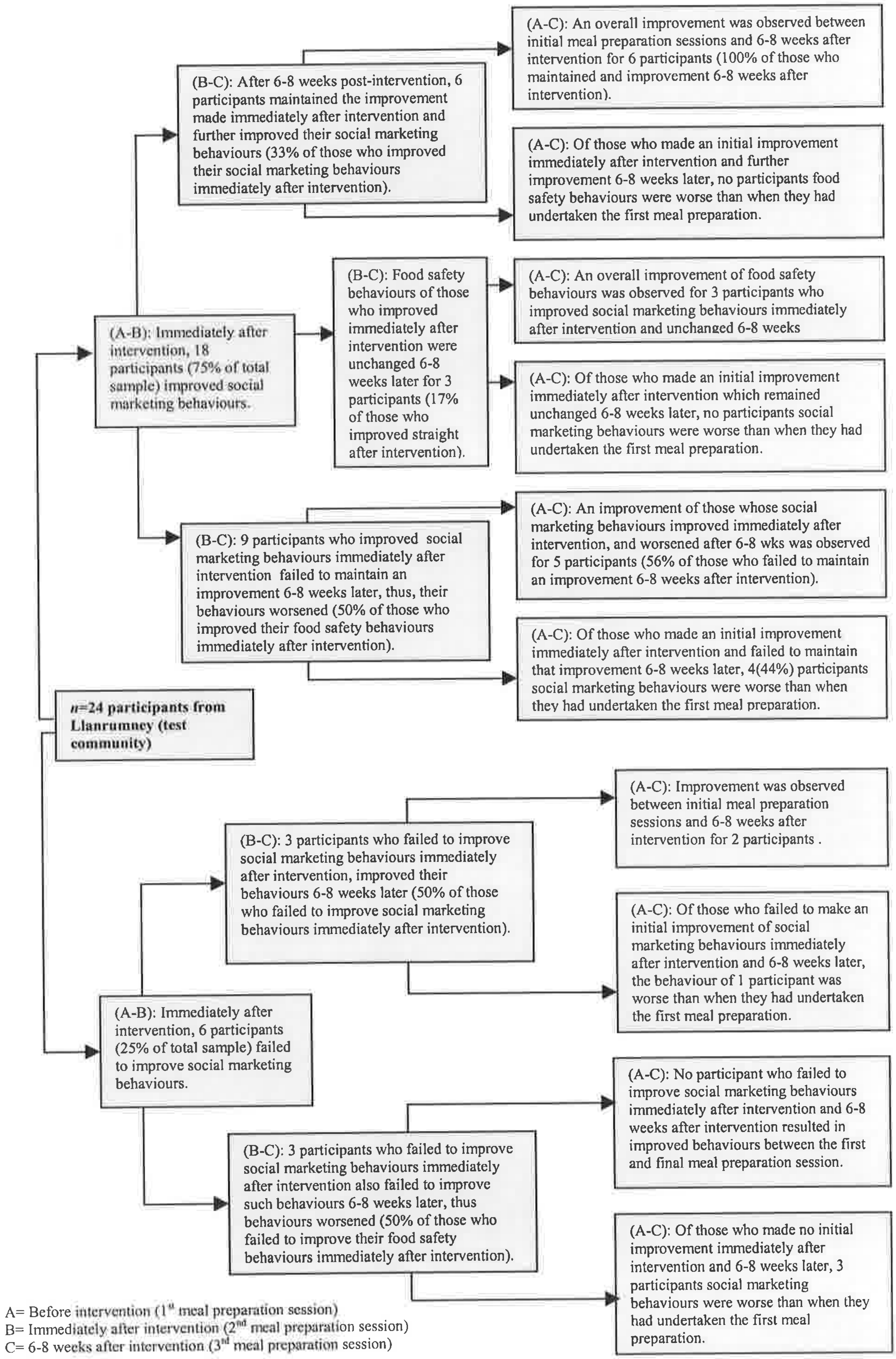


Figure 8.6 Bar chart showing mean risk scores for targeted behaviours: hand-washing and hand drying and contamination of preparation environment with raw chicken packaging (RCP) (test sample *n*=24).



Data presented in Figure 8.7 shows the proportions of test participants whose targeted food safety behaviours changed from before, to immediately after, and 4-6 weeks after intervention. Of the 75% (18/24) of participants whose targeted behaviours improved (risk score decreased) immediately after intervention, 50% (9/18) maintained that improvement after 4-6 weeks post intervention. Of these participants, 67% (6/9) improved their behaviours further (risk scores decreased), and the remaining 34% (3/9) participants' behaviours remained unchanged (risk scores stayed the same). All of the participants who maintained their initial improvement of targeted behaviours after intervention, and 4-6 weeks later demonstrated better targeted food-handling behaviours in the final meal preparation session than in the first session, thus, risk scores had shown an overall decrease. Of the 50% (9/18) of participants who failed to maintain the improvement of targeted behaviours immediately after intervention, 56% (5/9) demonstrated better targeted food-handling practices in the final preparation session than in the first session. Furthermore, 44% (4/9) participants' targeted food safety behaviours were worse than before intervention. Of the 25% (6/24) participants who failed to improve targeted food safety behaviours (represented by an increase of risk score) immediately after intervention, 50% (3/6) participants' targeted behaviours improved and 50% (3/6) participants' targeted behaviours deteriorated between second and third meal preparations. Results showed that 33% (2/6) participants' targeted behaviours did not improve immediately after intervention, but did improve 4-6 weeks later, to a standard that was better than before intervention. However the majority (67%) of the participants who failed to improve targeted behaviours immediately after intervention resulted with worse behaviours than observed prior to intervention.

Figure 8.7 A breakdown of the number of participants who implemented food safety malpractices before, immediately after and 4-6 weeks after intervention: targeted food safety malpractices (test sample *n*=24).



8.5.7 Descriptive evaluation of intervention effectiveness: hand-washing and hand drying behaviours (test sample *n*=24).

Overall, implementation of hand-washing and hand drying actions after handling raw chicken was poor. Before intervention, no participants washed and dried their hands immediately and adequately at any time during meal preparations. However, immediately after intervention 21% (5/24) of participants implemented adequate hand-washing and hand drying practices for between 33-60% of times necessary after handling raw chicken. Subsequently, 4-6 weeks after intervention, only 13% (3/24) of participants each implemented a single immediate and adequate hand-washing and hand drying action after handling raw chicken.

Analysis of hand-washing and hand drying behaviours showed that although few participants implemented adequate hand-washing and hand drying practices after handling raw chicken, 14/24 (58%) participants risk scores (representing hand-washing and hand drying actions) decreased immediately after intervention (see Table 8.5). In addition, hand-washing and hand drying risk scores of half of the sample were less than prior to intervention, suggesting that an improvement had occurred. This improvement may have been due to increased implementation of adequate practices by a small number of participants, as well as the reduced frequency of times when raw chicken was handled and consequent number of times when hand-washing and hand drying was required.

Table 8.5 Proportions of participants whose observed hand-washing and hand drying behaviours improved, worsened and remained unchanged between meal preparations (test sample *n*=24).

Risk score direction.	Change in risk score from before intervention to immediately after intervention *n* (%).	Change in risk score immediately after intervention to 4-6 weeks after intervention *n* (%).	Change in risk score from before intervention to 4-6 weeks after intervention *n* (%).
Risk score decreased (hand-washing and hand drying behaviours improved).	14 (58)	8 (33)	12 (50)
Risk score increased (hand-washing and hand drying behaviours worsened).	4 (17)	8 (33)	8 (33)
Risk score stabilised (hand-washing and hand drying behaviours did not improve or worsen).	6 (25)	8 (33)	4 (17)

Frequency of inadequate hand-washing and hand drying actions during meal preparations can be seen in Table 8.6. Findings indicate that some participants failed to wash and dry hands immediately and adequately on more than 11 occasions per meal preparation and the majority failed to implement appropriate actions on 3 to 6 occasions. Results also illustrate the reduction in the number of times that failure to implement hand-washing and hand drying occurred after intervention. Only 16% of the sample failed to wash and dry hands on 1 to 2 occasions during meal preparations before intervention, however this increased to 38% after intervention. Despite this, 13-16% of the sample still implemented inadequate hand-washing and hand drying behaviours on seven or more occasions immediately after intervention and 4-6 weeks later.

Table 8.6 Frequency of hand-washing and hand drying failure after handling raw chicken in meal preparations before, immediately after and 4-6 weeks after intervention (test sample *n*=24).

Number of occasions where failure to implement immediate and adequate hand-washing and hand drying practices occurred.		Before intervention *n* (% of total sample).	Immediately after intervention *n* (% of total sample).	4-6 weeks after intervention *n* (% of total sample).
No. of participants that failed to implement adequate hand washing and drying practices immediately after handling raw chicken....	.....on 0 occasions	0	0	0
	.....on 1-2 occasions	4 (16)	9 (38)	9 (38)
	.....on 3-4 occasions	9 (38)	7 (29)	7 (29)
	.....on 5-6 occasions	9 (38)	5 (21)	4 (16)
	.....on 7-8 occasions	1 (4)	1 (4)	3 (13)
	.....on 9-10 occasions	0	2 (8)	0
	.....on 11 occasions or more	1 (4)	0	1 (4)

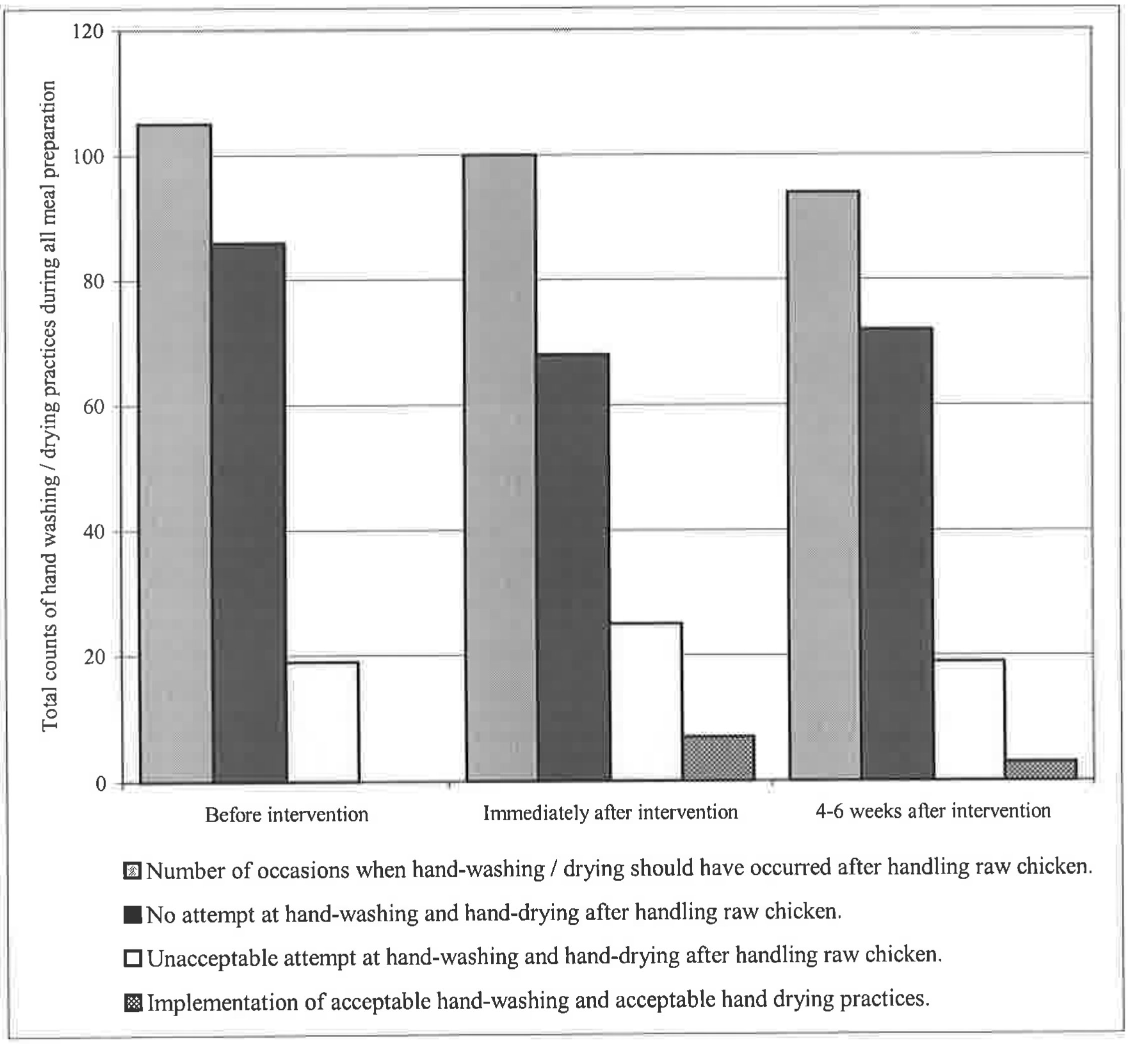
Data presented in Table 8.7 and Figure 8.8 illustrate the total number of times that raw chicken was handled and the consequent number of times when immediate and adequate hand-washing and hand drying was required during all meal preparations before, immediately after and 4-6 weeks after intervention. Counts of malpractices obtained from baseline meal preparation sessions (before intervention) showed that adequate hand-washing and hand drying was required on 102 occasions after handling raw chicken (an average of 4.4 occasions per meal preparation). Frequency of handling raw chicken decreased after intervention and 4-6 weeks later. Results showed a small improvement of hand-washing and hand drying practices immediately after intervention, however, this small improvement was not maintained 4-6 weeks later. Nevertheless, it is noted that a reduction in 'no attempts' at hand-washing and hand drying of 14% occurred at the same time as unacceptable attempts increased by 7%. However, such an improvement was not maintained, although the proportion of hand-washing and hand drying attempts had increased from meal preparations prior to intervention.

Table 8.7 Frequency of acceptable, unacceptable and no attempts at hand-washing and hand drying (composite actions) immediately after handling raw chicken (test sample n=24).

Hand-washing and hand drying actions.	No. of occasions that participants failed to wash and dry hands immediately and adequately after handling raw chicken n (%*).		
	Before intervention.	Immediately after intervention.	4-6 weeks after intervention.
Number of occasions when hand-washing / drying should have occurred after handling raw chicken.	105 (100)	100 (100)	94 (100)
No attempt at hand-washing and hand-drying after handling raw chicken.	86 (82)	68 (68)	72 (77)
Unacceptable attempts at hand-washing and hand-drying after handling raw chicken.	19 (18)	25 (25)	19 (20)
Implementation of acceptable hand-washing and acceptable hand drying practices.	0	7 (7)	3 (3)

* expressed as the number 'attempts' / number of occasions when actions should have occurred after handling raw chicken.

Figure 8.8 Frequency counts of acceptable, unacceptable and no attempts at hand-washing and hand - drying immediately after handling raw chicken (test sample n=24).



Further analysis of hand-washing and hand drying behaviours indicated that hand drying practices were performed better than hand-washing practices (see Table 8.8). Results also showed that immediately after intervention the numbers of times when 'no attempts' for hand-washing occurred was consistent for hand drying. However, acceptable hand drying practices (22%) were implemented on more occasions than adequate hand-washing practices (9%). Frequency of implementation of adequate food safety behaviours decreased by ~50%, 4-6 weeks later.

Table 8.8 Frequency of acceptable, unacceptable and no attempts at hand-washing and hand drying (as separate actions) immediately after handling raw chicken (test sample *n*=24).

Food safety behaviours.	No. of occasions that participants failed to wash or dry hands immediately and adequately after handling raw chicken *n* (%*).		
	Before intervention	Immediately after intervention	4-6 weeks after intervention
Number of occasions when hand-washing / drying should have occurred after handling raw chicken.	105 (100)	100 (100)	94 (100)
No attempt at **hand-washing** after handling raw chicken.	90 (86)	68 (68)	73 (78)
Unacceptable attempt at hand-washing after handling raw chicken.	14 (13)	23 (23)	17 (18)
Implementation of adequate hand-washing practice.	1 (1)	9 (9)	4 (4)
No attempt at **hand-drying** after handling raw chicken.	87 (83)	68 (68)	69 (73)
Unacceptable attempt at hand-drying after handling raw chicken.	8 (8)	10 (10)	13 (14)
Implementation of acceptable hand-drying practices.	10 (9)	22 (22)	12 (13)

* expressed as the number 'attempts' / number of occasions when actions should have occurred after handling raw chicken.

8.5.8 Descriptive evaluation of intervention effectiveness: use of chopping boards and knives (test sample *n*=24).

A descriptive comparison of risk scores from meal preparations before, immediately after and 4-6 weeks after intervention can be seen Table 8.9. Results showed that the proportion of participants who improved their use of chopping board and knives after preparation of raw chicken and before RTE foods in terms of food safety immediately after intervention was limited. Only half of the sample improved their behaviours (decrease of risk score) immediately after intervention and at the same time nearly a fifth of the samples behaviours in question deteriorated (risk score increased). After a period of 4-6 weeks, the same proportion of participants had improved their behaviours (risk score decreased), however, a further 12% of participants' behaviour had worsened (risk score decreased).

Table 8.9 Proportions of participants whose chopping board / knife usage improved, worsened and remained unchanged between meal preparations (test sample *n*=24).

Direction of risk score.	Change in risk score from before intervention to immediately after intervention *n* (%).	Change in risk score immediately after intervention to 4-6 weeks after intervention *n* (%).	Change in risk score from before intervention to 4-6 weeks after intervention *n* (%).
Risk score decreased (safe use of chopping board and knife improved).	12 (50)	9 (38)	12 (50)
Risk score increased (safe use of chopping board and knife worsened).	5 (21)	9 (38)	8 (33)
Risk score unchanged (safe use of chopping board and knife did not improve or worsen).	7 (29)	6 (26)	4 (17)

Results showed that more participants failed to use separate / adequately washed and dried knives than chopping boards when preparing raw chicken and RTE foods (see Table 8.10). Overall, before intervention 67% and 75% of participants failed to prepare RTE foods using an adequately washed and dried or separate chopping board and knife respectively, and immediately after intervention both proportions reduced by 25%. Additionally, immediately after intervention a further 8% of the sample prepared all RTE foods before raw chicken. Four to six weeks later, overall use of chopping boards, whilst preparing raw chicken and RTE foods, improved further. At the same time, 63% of the sample (13% more than the meal preparations immediately after intervention) failed to use of knives for preparation of raw chicken and RTE foods and only one participant prepared the RTE foods before raw chicken.

Table 8.10 Unsafe use of chopping boards and knives whilst preparing raw chicken and ready-to-eat foods (test sample *n*=24).

Food safety behaviour.	Before intervention *n* (%).	Immediately after intervention *n* (%).	4-6 weeks after intervention *n* (%).
Failure to use separate / adequately washed and dried chopping boards after preparation of raw chicken and before ready-to-eat foods.	16 (67)	10 (42)	9 (38)
Failure to use separate / adequately washed and dried knives after preparation of raw chicken and before ready-to-eat foods.	18 (75)	12 (50)	15 (63)
Preparation of ready-to-eat foods before raw chicken.	0	2 (8)	1 (4)

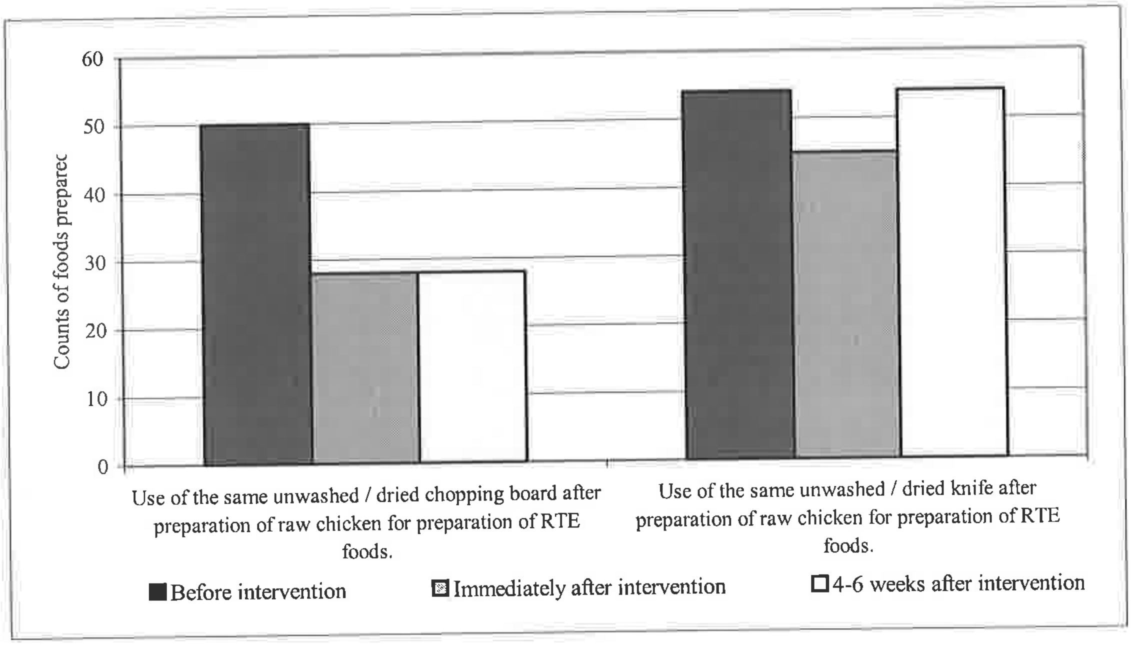
Observational findings indicated a variety of combinations of food safety behaviours regarding the use of chopping boards and knives implemented for preparation of raw chicken and RTE foods. Such combinations included use of *separate* chopping boards and knives for all raw chicken and RTE foods, use of the *same* chopping boards and knives for preparation of all foods, preparation of RTE foods *before* raw chicken and the use of *separate* and the *same* chopping boards and knives for raw chicken and RTE foods for different foods within the same meal preparation session. A summary of the proportions of consumers who implemented such behaviours can be seen in Table 8.11.

Table 8.11 Proportions of participants who used the same / separate chopping boards / knives during meal preparations before, immediately after and 4-6 weeks after intervention (test sample *n*=24).

Food safety behaviour.	Before intervention *n* (%).	Immediately after intervention *n* (%).	4-6 weeks after intervention *n* (%).
Use of separate **chopping boards** for raw chicken and all ready-to-eat foods.	7 (29)	6 (25)	9 (38)
Use of *separate* chopping boards for raw chicken and ready-to-eat foods for some foods and use of the *same* chopping board for some foods.	6 (25)	9 (38)	8 (33)
Use of the same chopping board for all foods.	11 (46)	7 (29)	6 (25)
Ready-to-eat foods prepared before raw chicken (chopping board).	0	2 (8)	1 (4)
Use of separate **knives** for raw chicken and all ready-to-eat foods.	5 (21)	6 (25)	5 (21)
Use of *separate* knives for raw chicken and ready-to-eat foods for some foods and use of the *same* knife for some foods.	9 (38)	5 (21)	4 (17)
Use of the same knife for all foods.	10 (41)	11 (46)	14 (58)
Ready-to-eat foods prepared before raw chicken (knife).	0	2 (8)	1 (4)

The total number of foods prepared using inadequately washed and dried chopping boards and knives are presented in Figure 8.9. It can be seen that in accordance with other findings of this chapter, food safety risks are more prevalent during knife usage than chopping board usage during preparation of raw chicken and RTE foods. It can be seen that during 24 meal preparations before intervention, 50 RTE foods were prepared on unwashed and / or inadequately washed and dried chopping boards after preparation of raw chicken, and 54 RTE foods were prepared using an unwashed and / or inadequately washed knife after preparation of raw chicken. The number of RTE foods prepared on a potentially contaminated chopping board reduced by 44% immediately after intervention, a reduction that was maintained 4-6 weeks later. The number of RTE foods prepared using a potentially contaminated knife reduced by 17% immediately after intervention, however, such a reduction was not maintained 4-6 weeks later when the number of RTE foods prepared using a potentially contaminated knife returned to the original level determined prior to intervention.

Figure 8.9 The total number of foods prepared using the same unwashed chopping board(s) and knife (knives) for preparation of raw chicken and then ready-to-eat (RTE) foods (test sample *n*=24).



8.5.9 Descriptive evaluation of intervention effectiveness: indirect contamination of preparation environment with RCP (test sample *n*=24).

Potential contamination of the preparation environment with RCP was implemented less frequently, yet by similar proportions of participants as for other targeted behaviours. However, as seen in Table 8.12, the majority (87%) of participants did so on at least one occasion prior to intervention, 62% of whom did so only once per meal preparation session. Immediately after intervention, results (see Table 8.12 and 8.13) indicated that 38% of participants either reduced the frequency and / or prevented the potential contamination of the preparation environment with RCP. However, overall, between the first and last meal preparations only 29% participants improved this behaviour, nearly half (46%) participants' behaviour remained unchanged and a quarter of participants' behaviour deteriorated.

Table 8.12 Frequency of contamination of the preparation environment with raw chicken packaging within individual meal preparations (test sample *n*=24).

Food safety behaviour.		Before intervention.	Immediately after intervention.	4-6 weeks after intervention.
Contamination of preparation environment with raw chicken packaging.	0 occasions.	3 (13)	6 (25)	6 (25)
	1 occasion.	15 (62)	16 (67)	15 (62)
	2 occasions.	5 (21)	2 (8)	3 (13)
	3 occasions.	1 (4)	0	0

Table 8.13 Proportions of participants whose contamination of the preparation environment with raw chicken packaging increased, decreased and remained unchanged between meal preparations (test sample *n*=24).

Direction of risk score.	Change in risk score from before intervention to immediately after intervention *n* (%).	Change in risk score immediately after intervention to 4-6 weeks after intervention *n* (%).	Change in risk score from before intervention to 4-6 weeks after intervention *n* (%).
Risk score decreased (safe use of chopping board and knife improved).	9 (38)	2 (8)	7 (29)
Risk score increased (safe use of chopping board and knife worsened).	3 (12)	5 (21)	6 (25)
Risk score unchanged (safe use of chopping board and knife did not improve or worsen).	12 (50)	17 (71)	11 (46)

8.5.10 Implications of recall of interventions upon change of food safety behaviours.

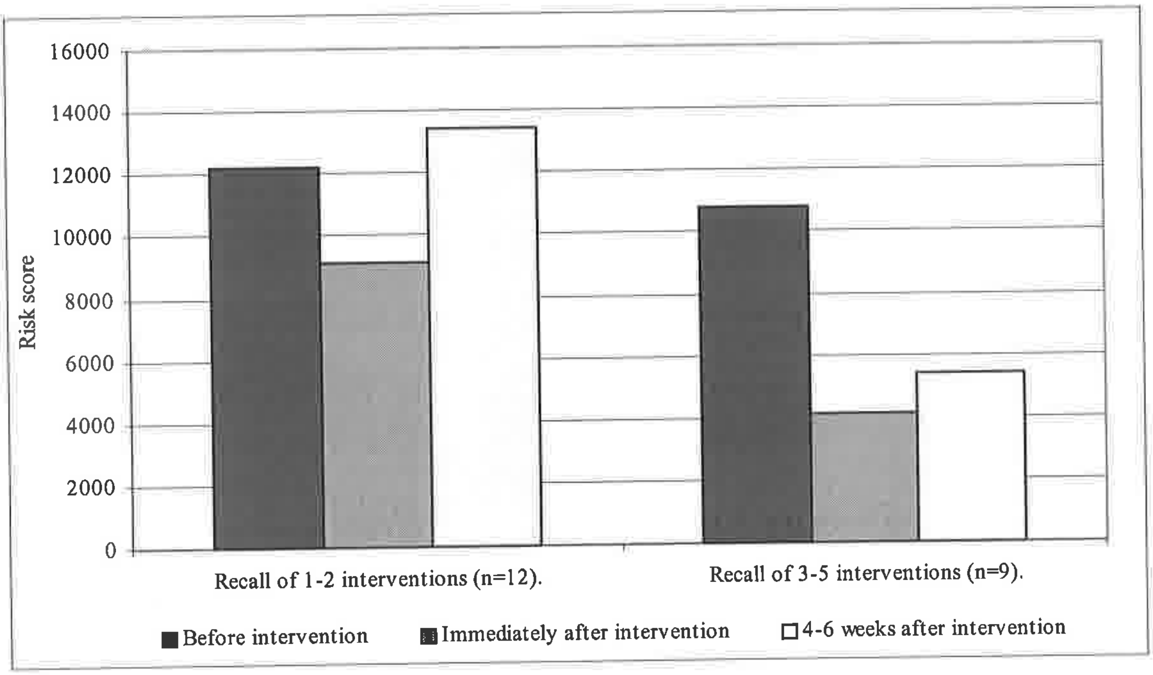
Test sample participants' food safety behaviours were analysed according to recollection of seeing food safety intervention materials in Llanrumney during the course of study. Of the whole test sample, 88% (21/24) participants recalled seeing at least one of the possible five interventions delivered to participant homes and placed in Llanrumney (test community) during the course of study. Of these 21 participants, 57% (12/21) of participants recalled between one and two interventions and 43% (9/21) of participants recalled between three and five interventions.

Table 8.14 Frequency of recall of food safety interventions delivered to participant homes* or placed in Llanrumney◆ community during the period of study (test sample n=24).

	No. of test participants who recalled seeing food safety information (% of total).
Leaflets◆*	11 (46)
Posters◆	4 (17)
Magnets*	10 (42)
Video*	19 (79) , 13 (54) of whom watched the video
Echo Newspaper article*	12 (50)
Other	0

Use of the Univariate One Way ANOVA and food safety risk scores were used to identify any differences in food safety malpractices implemented by those test participants who recalled 1-2 (n=12) interventions and 3-5 (n=9) interventions. The hypothesis denoting food safety risk scores associated with subjects who recalled 3-5 interventions will differ from subjects who recalled 1-2 interventions was accepted for all food safety behaviours and rejected for all targeted behaviours. Results indicated that for all food safety behaviours there was a significant difference (F=4.63, p<0.05) between the food safety malpractices implemented by the two samples before and immediately after intervention. Data presented in Figure 8.10 illustrate such differences. However no significant difference (F=2.53, p>0.05) was identified during the same time, between the two samples for implementation of targeted behaviours related to the social marketing.

Figure 8.10 Mean total risk scores from meal preparations undertaken by those who recalled intervention materials during the initiative duration (test sample n=21).



8.6 DISCUSSION.

8.6.1 Introduction.

Observation of targeted consumer food safety behaviours before, immediately after and 4-6 weeks after intervention enabled an evaluation of the impact social marketing interventions had upon actual food safety behaviours. Given the limited amount of previous research detailing effectiveness of food safety education upon food-handling behaviours the following discussion has largely been based upon results determined in this chapter.

8.6.2 Comparative measurement of food safety behaviours implemented by consumers from the test and control communities.

The success of an educational strategy cannot simply be determined by comparing implementation of desired behaviours from two samples (one sample who has received intervention and another that has received no intervention) (Ovretveit, 1998). To correctly determine the impact of a strategy, there is a need to collect baseline data prior to intervention from both samples (Ovretveit, 1998). Thus, in this study baseline risk scores representing observed food safety malpractices were determined before interventions were placed in the test community as well as after intervention. Similarly, food safety risk scores were determined at the same intervals for a control sample as for the test sample. The design of the evaluation study included components of a 'before and after' design and the 'comparative-experimental' approach.

An initial visual quantitative comparison of mean total risk scores between first, second and third meal preparations of the test and control sample suggested that test sample participants' food safety behaviours may have been subject to a short-lived, positive, intervention effect. Results also indicated that mean total risk scores from repeated meal preparations undertaken by the control sample remained relatively consistent.

The statistical analysis, however, determined no significant differences between first and second meal preparations for overall food safety behaviours, all targeted behaviours, or individual targeted behaviours between the test and control samples. Nevertheless, the difference between test and control samples for all food safety behaviours approaches a significant difference ($F=3.27$, $p=0.08$). This may be particularly relevant given that the sample size of both test and control samples was relatively small. Indeed, a limitation of this study that had implications for the statistical analysis was the small sample sizes from both test and control communities. Therefore, further research is required to assess the effectiveness of interventions using larger numbers of participants. Other than sample size, there are a variety of explanations for the lack of significant difference determined between food safety behaviours implemented by consumers from the test and control sample. Firstly, the community specific nature of this study may have potentially influenced targeted consumers' food safety behaviours. It was observed that overall mean risk scores were lower during the first meal preparation sessions for control participants than for test participants. A reason for this may have been a result of previous, local food safety educational attempts that had may have been implemented in Fairwater and not in Llanrumney. Alternatively, such a finding may have simply been due to random chance of the recruited sample. Indeed, when data is collected from few participants, the effects of random chance can be significant, and as the number of participants increases, then the effects of chance diminish (Anon, 2002b). Thus, further research is required to implement a food safety evaluation study which includes the components of before-after design and the comparative-experimental approach using a larger number of participants. This will be discussed further in Chapter 9.0.

In consideration of the initial statistical findings from this study, and the fact that many social marketing initiatives are evaluated based upon behavioural change of targeted consumers who are subject to tailored interventions (McCormack-Brown, 1998e) and not with a matched control group (Bloom and Novelli, 1981), observational findings from this study have been analysed and will be subsequently discussed in terms of a descriptive and effect size analysis of observed food safety behaviours of the test sample.

8.6.3 Effect size analysis of intervention impact upon test participants.

Given that mean total risk scores of the test sample suggested that social marketing interventions had improved consumer food safety behaviours, an effect size analysis was undertaken to gauge an extent of intervention effectiveness and to compare immediate impact to any maintained impact after a period of 4-6 weeks. As expected, the intervention effect was greater immediately after intervention than 4-6 weeks after intervention. Given that the largest effect size (0.65) determined immediately after intervention was for all observed food safety behaviours it can be assumed that targeted interventions produced a halo effect upon food safety behaviours other than those included in the social marketing interventions. For the targeted food safety behaviours, intervention effect size was largest (0.47) for practices related to the use of chopping boards for preparation of raw chicken and RTE foods. Therefore, it can be expected that use of an educational strategy and interventions developed using a consumer orientated social marketing approach can cause an immediate moderate effect if implemented upon a larger number of consumers. It is of note that intervention effect sizes determined in this study are considerably higher than determined in other studies.

For example, effect sizes of 0.05-0.25 were determined for improvement of physical activity among adults (Conn *et al.* 2002) and effect sizes of 0.1-0.2 were determined in a review of risk communication interventions in health care settings (Edwards *et al.* 2000). Therefore it can be seen that effectiveness of the social marketing interventions developed for this study produced a comparably good effect.

Four to six weeks after intervention, effect sizes for all food safety behaviours and behaviours associated with the social marketing objective changed from between an effect size of 0 to -0.33. The largest reduction of intervention effect (-0.33) was for all observed food safety malpractices and maintained intervention effect was greatest for actions regarding potential contamination of the food preparation environment with RCP. Furthermore, results showed that intervention effect for hand-washing and hand drying behaviours and use of chopping boards for preparation of raw chicken and RTE foods reduced by an effect size of -0.06 to -0.08 4-6 weeks after intervention. Thus, results suggest that a smaller, immediate intervention effect may be maintained more readily than an immediate, moderate intervention effect. Although social marketing interventions may have initially had a halo effect upon food safety behaviours that were not targeted in social marketing interventions, observation results showed that maintenance of overall initial food safety behavioural improvement was not as substantial as for targeted behaviours. This may have been due to the fact that the interventions focussed upon specific targeted behaviours, and message format and content had been developed and pre-tested using the consumer orientated approach. Indeed, other research has suggested that effect sizes tend to be larger when interventions target specific behaviours or activities (Conn *et al.* 2002) and it is well documented that use of a consumer orientated approach for development of an educational strategy increases the potential effectiveness of initiatives.

Overall, targeted food safety interventions from a 'one-off' strategy, developed using the social marketing approach can bring about an immediate and short-term behavioural change of food safety practices. Further research is required to ascertain maintenance of intervention effect and consequent behavioural change intermittently over a longer period of time. Furthermore, an assessment of the effectiveness of a continuous food safety intervention strategy is required.

8.6.4 Descriptive evaluation of all food safety behaviours implemented by the test sample.

Observation results showed that when all food safety behaviours were accounted for, 67% of the test sample improved food safety behaviours immediately after intervention and also maintained such an improvement. So from this point of view the initiative can be viewed as a success. In addition, the results show that participants with similar motivational cognitions responded positively to specifically designed and placed intervention materials using the social marketing approach. Although the improvement of all observed food safety behaviours is important and has implications for the effectiveness of specific interventions, achieving improvement of all food safety behaviours was not a main behavioural objective of the initiative. Nevertheless, it is a positive effect if tailored interventions have had a halo effect upon overall behaviours and so this must not be overlooked.

8.6.5 Descriptive evaluation of targeted social marketing food safety behaviours implemented by the test sample.

8.6.5.1 Descriptive evaluation: all social marketing behaviours.

The product of this social marketing initiative was behavioural change of the specific food safety behaviours outlined in section 7.5.1.4. To obtain an accurate summative evaluation of the effectiveness of the social marketing strategy and food safety education interventions, it was important to assess actual change of the specific behavioural determinants. The impact of interventions upon each of the individual determinants will subsequently be discussed. Marginally fewer (75%) participants' risk scores (representing all targeted behaviours) decreased immediately after intervention than did for scores representing all food safety behaviours (79%). However, as mentioned in 8.6.3, maintenance of intervention effect was greater for targeted behaviours than for overall food safety behaviours.

8.6.5.2 Descriptive evaluation: hand-washing and hand drying behaviours.

Observational results showed that before and after intervention, no participants implemented appropriate hand-washing and hand drying practices at all times during a single meal preparation session. However, a small number of consumers did improve their hand-washing and hand drying behaviour, but not for all occasions required during meal preparations. Such an improvement was not wholly maintained. Results also showed that immediately after intervention, the number of *attempts* at hand-washing and hand drying increased from 18% to 32% of the required occasions when hand-washing was necessary after handling raw chicken. This proportion decreased to 23% after the period of 4-6 weeks, resulting in an overall marginal improvement of hand-washing and hand drying behaviours.

Although hand-washing and hand drying behaviours only marginally improved after this 'one-off' intervention strategy, findings suggest that targeted behaviours (such as hand-washing and hand drying) can be improved and maintained in response to targeted and tailored interventions. Such a finding has implications for future food safety education initiatives whereby provision of strategically targeted continuous interventions may result in small, maintained improvements of food safety behaviours. Given that generalised 'one-off' interventions that have been implemented in the UK (MAFF, 1995) have largely been ineffective, the use of targeted interventions presented in a continuous manner using sources that are credible to the audience may be beneficial. Further research is required to ascertain the potential effectiveness of the continuous provision of social marketing food safety interventions.

The frequent implementation of hand-washing and hand drying malpractices has implications for increasing potential risks for indirect cross contamination of foodborne pathogens in the domestic environment (Pether and Gilbert, 1971) and the consequent risks for causing food poisoning. In this study, nearly half (44%) of participants implemented inadequate hand-washing and hand drying practices on five or more occasions during single meal preparations. Such a proportion decreased to 33% after intervention, indicating that the number of times unacceptable practices had been implemented had reduced. Thus the associated microbial risks of cross contamination in the domestic kitchen were marginally decreased.

Given that results from this study have indicated that implementation of adequate hand drying actions were implemented more frequently than adequate hand-washing actions before, immediately after, and 4-6 weeks after intervention it is suggested that further research is required to find out why this occurs. In addition it is suggested that future interventions addressing the hand-washing and hand drying process focus upon the washing and drying components separately. It is considered that doing so may increase sustained intervention effect. Furthermore, inclusion of demonstrations or provision of interpersonal support (Griffith *et al.* 1994) into the social marketing strategy may increase the overall intervention effect.

8.6.5.3 Descriptive evaluation: use of chopping boards and knives for preparation of raw chicken and RTE foods.

Before intervention, observations of meal preparations showed that large proportions of targeted consumers implemented food safety malpractices when preparing raw chicken followed by RTE foods using inadequately washed and dried chopping boards and knives. Such practices are associated with substantial microbiological risks (Redmond *et al.* 2001) which may increase the risk potential for food poisoning. Interestingly, results indicated that a larger proportion of consumers failed to use a separate / adequately washed and dried knife (75%) for preparation of RTE foods after raw chicken than chopping boards (67%).

Such an overall pattern of utensil usage was apparent before, immediately after and 4-6 weeks after intervention. Although a 25% more consumers implemented correct food safety practices (use of knives and chopping boards) for preparation of raw chicken and RTE foods immediately after intervention than before intervention, the initial improvement for use of knives was not maintained by 12% of the sample 4-6 weeks later. However, during the same period of time, maintenance of implementation of correct food safety practice was observed for the use of chopping boards. Thus, reducing the risk potential for cross contamination of pathogens such as *Campylobacter* and *Salmonella* from raw chicken to RTE foods (Slader *et al.* 2001). Social marketing interventions detailed identical messages for chopping board and knife usage, yet potential intervention effect appears to have an inconsistent sustained impact for both behaviours. Thus, further research is required to determine consumer perceptions of the separate actions, even though the principles behind microbial cross contamination are similar. As a consequence of this, and findings from this study, it is also suggested that future food safety interventions address knife usage and chopping board usage for the same actions (preparation of raw chicken and RTE foods) in a separate manner.

8.6.5.4 Descriptive evaluation: potential contamination of food preparation environment with RCP.

As previously mentioned in this thesis, microbiological risks are associated with indirect contamination from RCP to the food preparation environment. Food safety messages in social marketing interventions were largely based upon the behavioural determinants in sections 8.6.5.2 and 8.6.5.3 and therefore it was not surprising to determine only a small intervention effect upon prevention of potential contamination of the preparation environment with RCP. Results showed no change of effect size between meal preparations observed immediately after intervention and 4-6 weeks later, thus showing that the small initial intervention effect had been maintained. Overall, 12% of the sample who implemented the malpractice in question before intervention refrained from doing so immediately after intervention, and this was maintained 4-6 weeks later. Furthermore, results showed that observed frequency of potential contamination of the preparation environment with RCP decreased after intervention. Therefore, it can be suggested that like other targeted behaviours, the one-off set of social marketing interventions may have been effective in causing a small behavioural improvement. Future food safety education initiatives based upon a consumer orientated, targeted continuous strategy may be more effective for further improvement of food safety behaviours and additional research is required in this area.

8.6.6 Test sample recall of social marketing food safety education interventions.

Quantitative data was collected to evaluate the reach of intervention materials placed in the test community. Despite being hand-delivered through all test participant letterboxes, only 46% recalled having received / or having seen a food safety leaflet and only 42% of participants recalled obtaining social marketing food safety magnets during the course of study. Thus, results indicate that direct provision of intervention materials promoting health-related behaviours does not guarantee 'reach'. Only 17% of participants saw at least one of the posters promoting food safety for the over 60's in Llanrumney, and 12% recalled seeing a newspaper article in the South Wales Echo about food safety for the over 60's. Although 79% of participants recalled receiving a video through the post, 54% reported to having watched the video. Thus, although a detailed qualitative and quantitative channel analysis was undertaken prior to placement of intervention materials only limited numbers of participants encountered, or could recall encountering materials. Nevertheless, 88% of the sample recalled encountering at least one of the interventions and 41% recalled seeing between three and five of the interventions.

Findings from this study indicated that the participants who observed more intervention materials improved their food safety behaviours to a greater extent than those who recalled fewer intervention materials. Given the small sample, identification of a significant difference ($p<0.05$) of risk scores between subjects who recalled seeing 1-2 and 3-5 interventions before and after intervention is of importance. This finding suggests that the effectiveness of a larger number of interventions may be more likely to result in immediate positive behavioural change than fewer interventions. However, it is important to bear in mind that participants only self-reported that they saw interventions, and discrepancies between self-reported behaviours and actual behaviours have previously been discussed (see Chapter 2.0). In addition, it is possible that the participants who changed their behaviour, were more likely to have recalled interventions. Therefore, there may be a need to produce more obvious and memorable interventions in future food safety initiatives as they may be able to change people's behaviour more readily.

It is of interest and relevance to the field of consumer food safety education to determine the effectiveness of the different interventions used in this social marketing initiative according to improvement of food safety behaviours. However, to conduct such an analysis a larger sample size would be required. Findings from such research could aid further development and cost effectiveness of an initiative.

It is recognised that the use of social marketing for the development of a targeted food safety education strategy is more expensive than provision of traditional interventions such as leaflets that have formed the base of many food safety education initiatives in the past (Griffith, 2002). The average cost of a leaflet has been reported to be 20p when produced in large numbers (Harvey *et al.* 2000), whereas in this study, leaflets, posters, videos, magnets and newspaper advertising were all used as part of the food safety education initiative, thus accumulating more expense. Furthermore, use of the consumer orientated social marketing approach for strategy and intervention development is more time consuming than the traditional top-down approach. However, use of the more expensive social marketing approach has proven to bring about behavioural change. Given the substantial costs of foodborne disease (as discussed in Chapter 2.0) it may be more cost effective to utilise a more expensive approach to food safety education that is more likely to result in behavioural improvement than an approach that is more likely to change knowledge or attitudes (Andreason, 1995) opposed to actual behaviour. Furthermore use of observation for evaluation of the effectiveness of interventions has limitations in the sense that it too, is more expensive alternative research methods such as a survey to measure change of (e.g.) knowledge or attitude. Indeed, the cost of observing one participant on three consecutive occasions in this study was ~£65 (excluding cost of the video equipment and model domestic kitchen), the cost of survey administration may be only £1-2 per survey. However, as discussed in Chapter 2.0 and Chapter 5.0, to obtain an accurate measurement of how consumers actually prepare food, there is a need to directly observe what they do. Therefore, the use of observation in the model domestic kitchen can provide an invaluable tool for evaluating the effectiveness of interventions on a small scale prior to launch of a larger scale initiative.

8.7 CONCLUSIONS.

Use of the observation technique and risk based scoring was effective for the quantitative assessment of the effectiveness of food safety education interventions. Behavioural change is considered to be the ultimate goal in social marketing initiatives, and observation of meal preparations in the model domestic kitchen facilitated evaluation of actual behavioural change. It is recommended that use of the observation technique should be employed to gauge the effectiveness of promotional materials as a means of pre-testing in pilot studies, prior to the launch of large-scale food safety education initiatives.

Overall, results from this chapter suggest that 'one-off' social marketing interventions may result in improvement of consumer food safety behaviours. However, an initial improvement of food safety practices was not wholly maintained after a period of 4-6 weeks. Further research is required to determine maintenance of improved food safety behaviours when consumers are continually provided with food safety interventions.

Practical and financial constraints limited the sample size and therefore the ability to detect significance in this study. However, using an effect analysis upon the test sample risk scores obtained before and after intervention, provided quantitative, comparable intervention 'effects' for food safety behaviours immediately and 4-6 weeks after intervention. Results indicate that if the same intervention strategy was implemented upon a larger scale, a 'moderate' effect (as defined by Cohen, 1988) may be expected for immediate and a short term improvement of all food safety behaviours. A 'low-moderate' effect may be expected for immediate and short term improvement of the specific behavioural determinants of the social marketing initiative. Therefore, it is considered that effect findings of this social marketing based food safety initiative are promising. In addition, findings demonstrate potential for the development of effective larger scale social marketing future food safety education strategies and interventions. Further investigations are required to see if intervention effect size is the same for a larger number of consumers than in this study.

A more substantial improvement of overall food safety behaviours was observed in comparison with the food safety behaviours that were targeted in this study. Thus suggesting that interventions targeting specific food safety behaviours may produce a 'halo effect' upon other food safety behaviours that are known, yet not consistently implemented during domestic food preparation. Nevertheless, the one-off set of social marketing interventions resulted in a smaller, yet more maintained improvements of targeted behaviours. Such findings have implications for future food safety education initiatives, whereby setting a behavioural objective denoting *complete* implementation of all targeted food safety behaviours after a 'one-off' initiative may be unrealistic. Results from this study suggest that smaller improvements of targeted food safety behaviours may be maintained more successfully than the larger initial improvements of overall food safety behaviours. Therefore, future food safety education initiatives may benefit from not only using a social marketing approach for strategy and intervention development, but also provide continuous interventions.

Findings from this study indicated that the participants who recalled more intervention materials improved their food safety behaviours to a greater extent than those who recalled fewer intervention materials. Therefore future food safety education initiatives may prove to be more effective if information is provided from more, strategically selected sources. Additional research is required to ascertain the impact of individual intervention sources upon food safety behaviours (see Chapter 9.0).

Each of the targeted behavioural determinants of the social marketing initiative were considered to be suitable given the substantial failure to implement correct practices by the majority of targeted consumers before intervention. Interventions resulted in a marginal improvement of hand-washing and hand drying behaviours after handing raw chicken. Furthermore, the frequency of inadequate hand-washing and hand drying decreased for 10% of the sample during the course of study. It can also be concluded that adequate hand drying actions were implemented more frequently than hand-washing actions, therefore future hand decontamination educational initiatives may be more effective if they focus upon hand-washing and hand drying actions separately. Overall, a larger number of consumers implemented unsafe food-handling behaviours using knives (as opposed to chopping boards) for preparation of raw chicken and RTE foods. A maintained intervention effect was also found to be greater for use of chopping boards. Potential intervention effect upon safe use of knives to prevent cross contamination from raw chicken to RTE foods was short lived. Food preparation behaviours using knives 4-6 weeks after intervention presented the same potential risk of cross contamination as before intervention. Finally, as for hand-washing and hand drying, only a marginal proportion of the test sample prevented the potential contamination of the food preparation environment with RCP after intervention. Such an improvement was largely due to a decrease in the frequency of implementation of such an action, as opposed to complete prevention.

Although the use of the social marketing approach for development of a food safety education strategy and interventions may be more expensive than traditional non-targeted approaches, it can be concluded that use of social marketing interventions resulted in a positive outcome – improvement of food safety behaviours. Therefore, it may be more cost-effective to invest more time and money at the developmental and pre-testing stages of an initiative and to produce a strategy and targeted interventions, and achieve behavioural improvement that can reduce the risk of foodborne disease, than spend less time and money on interventions that may be ineffective.

CHAPTER 9.0

CONCLUSIONS AND RECOMMENDATIONS.

9.1 CONCLUSIONS.

9.1.1 Introduction.

Illness resulting from foodborne disease has become one of the most widespread public health problems in the contemporary world (Kaferstein, 1997). The domestic kitchen, known as *'the final line of defence'*, (Gilbert, 1983) is thought to be a point of origin for a substantial proportion of foodborne disease cases. In England and Wales, (1993-1998) epidemiological data has indicated that between 12-17% of reported, general foodborne disease outbreaks have originated from the home. However, the majority (>95%) of cases are thought to be sporadic (FSA, 2000b) and less likely to be identified by public health authorities (Worsfold and Griffith, 1997a). Therefore the actual proportion of foodborne disease cases that occur in the home is likely to be much larger than initially realised.

Foodborne pathogens associated with a range of raw foods are regularly brought into the domestic kitchen. Unless appropriate food safety control measures are implemented, pathogenic contamination of the environment with consequential foodborne illnesses are seen to be inevitable (Jones, 1998). Thus, there is a need for consumer food safety education to improve food safety behaviours implemented during domestic food preparation. In the UK, the FSA has set itself a target of reducing foodborne disease incidence by 20% by 2006 (FSA, 2001c; Hilton, 2002). It is considered that the most significant reduction of the number of cases of foodborne disease is likely to come from focusing attention on food preparation practices (FSA, 2001a). To achieve the 20% reduction of incidence, the plans of the FSA include raising the standards of food hygiene in the home (FSA, 2000c) through implementation of a national consumer food safety education campaign (FSA, 2002c). This thesis provides important baseline data to inform the development of future food safety education initiatives that intend to raise awareness of food safety issues and bring about behavioural change.

A detailed review of previous consumer food safety studies (Chapter 2.0) has revealed that although there is a wealth of information detailing consumer knowledge of food safety and self-reported practices, limited information is available detailing consumer attitudes towards food safety in the home and towards food safety education. Furthermore, few studies have carried out observations to determine actual consumer food safety behaviours. Therefore, attitudes and perceptions towards food safety in the home and food safety education have been examined in this study. In addition, an observation technique has been developed to facilitate the collection of detailed, objective, quantified data denoting food safety malpractices implemented by consumers. Furthermore, a consumer food safety education strategy based upon a social marketing approach has been developed, implemented and evaluated. This chapter aims to provide a collective overview of the findings of this thesis within the context of the field of consumer food safety education.

9.1.2 Consumer attitudes and perceptions towards food safety in the home.

A key to the design of effective educational initiatives is an understanding of factors that influence an individual's behaviour (Middlestadt *et al.* 1996). Indeed, to raise awareness of food safety issues there is a need to determine baseline attitudes towards food safety behaviours. Furthermore, research has indicated that consumer attitudes towards food safety may be an important influence on performed behaviours (Saba and DiNatale, 1999; Westaway and Viljoen, 2000). Quantitative data from a cross-section of the population of Cardiff (Chapter 3.0) and qualitative findings from a targeted audience (Chapter 7.0) cumulatively suggest that overall, general attitudes towards safe food preparation in the home were positive. However, attitudes towards specific food safety behaviours, particularly cooling actions, were less positive. Attitudinal responses from this study have corresponded with previous quantitative consumer food safety research detailing knowledge and self-reported practices for cross contamination actions and heating, whereas, attitudes towards storage practices have compared with knowledge, but not self-reported practices. Concurring with attitudinal findings from this study, previous research has suggested that consumer knowledge denoting cooling of cooked foods is inadequate, and further research is required to determine knowledge and self-reported practices of specific cooling practices.

In the past decade, food safety education efforts have provided generalised food safety information for the overall population. However, in this thesis older consumers were found to be associated with an expression of positive attitudes towards food safety and younger adults were associated with negative attitudes. This difference of attitudes has been reiterated by a comparison of findings from focus groups composed of older females (aged 60-75 years) undertaken in this thesis (Chapter 7.0), and focus groups composed of young mothers (Redmond *et al.* 2000). Furthermore, significant differences of responses were determined between males and females for several attitude statements. Cumulatively, findings from this thesis illustrate the diversity of attitudes and perceptions that consumers have towards food safety in the home. Thus, targeted food safety education strategies are required for different groups of consumers in the population. For example, it may be necessary to improve attitudes towards specific behaviours for males and / or younger adults before attempting to improve their food safety behaviours. Whereas, females and / or older adults, who may possess a more positive attitude towards a food safety behaviour, may be more receptive towards interventions promoting a corresponding behavioural change. For food safety education to be effective there is a need for consumers to perceive interventions to be personally relevant to elicit a response. Overall, findings from this thesis increase our understanding of attitudes and provide important information to inform future food safety education initiatives.

Data presented in Chapters 3.0 and 7.0 have provided evidence to suggest that consumers possess a variety of attitudes and perceptions related to food safety that may form barriers to intervention effectiveness. Consumer perceptions of risk and control for food safety in the home determined in this thesis concur with previous research (Frewer *et al.* 1995a; Weinstein, 1987) which indicates that consumers have expressed judgements of optimistic bias (Weinstein and Klein, 1996) and the illusion of control (McKenna, 1993). Cumulatively, results suggest that after food preparation at home, consumers perceived their personal risk of acquiring food poisoning to be less than for 'other people'. In addition, consumers perceived themselves to have more control over food safety at home than 'others'. Such judgements are reported to relate to perceived personal invulnerability (Weinstein, 1982) and a consequent reduction of potential intervention effectiveness (Hoorens, 1994). Thus, to increase the potential effectiveness of food safety education strategies and reduce perceived invulnerability, it is important that the aspects of perceived risk and control, highlighted in this thesis, are addressed.

Failure to associate domestic food-handling practices with foodborne illnesses is considered to be a serious impediment to convincing consumers to change inappropriate food-handling behaviours (Fein *et al.* 1995). Quantitative (Chapter 3.0) and qualitative (Chapter 7.0) data from this thesis support internationally published research (CFIA, 1998; Fein *et al.* 1995; MAFF, 1988; Williamson *et al.* 1992) which indicates that the majority of consumers do not perceive 'the home' to be a likely location to acquire food poisoning. Therefore, it is recommended that future food safety education initiatives specifically equate incidence of food poisoning with the need for domestic food safety.

Multiple food safety responsibilities are required by the consumer during domestic food preparation (CDNANZ, 1997). Failure to recognise personal responsibility for food safety may not only impede upon intervention efforts that aim to raise awareness of food safety issues and bring about behavioural change, but also result in a negative assumption that 'others' have ensured complete food safety of their foods. Thus, necessary food safety control measures that are required during domestic food preparation may not be implemented, which subsequently increases the risk of foodborne disease. Data in this thesis has shown that the majority of consumers perceive themselves to be responsible for food safety during their own food preparation, but also perceive manufacturers to have responsibility for the safety of the foods that they produce. Thus, results suggest that consumers may recognise an element of personal responsibility, but still consider external providers of food are also accountable to maintain levels of food safety. Furthermore, expectation of being provided with 'safe food' by food manufacturers or 'other people' may undermine overall positive attitudes towards food safety in the home. Cumulatively, these findings concur with other consumer food safety research (Unklesbury *et al.* 1998), which recommends more emphasis needs to be given to personal responsibility for food safety in future food safety education initiatives.

Additional attitudes towards domestic food safety that may hinder food safety education attempts have been examined in Chapter 4.0. Findings have indicated that the majority of consumers expressed confidence that their current food preparation practices presented no risk of food poisoning, even though many admitted not knowing all of the food safety precautions necessary for safe food preparation or always implementing the food safety behaviours that they do know. Such findings concur with perceptions of food-handlers in research conducted by Griffith *et al.* (2001). Furthermore, in this thesis many consumers did not think that their own current food safety behaviours required improvement. In view of such findings, consumers may think that food safety education is intended for other people rather than themselves. Indeed, quantitative and qualitative data from this thesis concurs with findings from Hoorens (1994) and provides evidence to suggest that consumers' perceived need for food safety education is considered to be greater for 'others' than for themselves.

9.1.3 Attitudes and perceptions towards food safety education.

The development of an effective food safety education strategy is considered to be a complex process due to the need for provision of information for diverse target audiences in many settings. It is considered that better education depends upon a better understanding of the modes and channels of communication that people actually use (Khare, 1988; WHO, 1988). Thus, using a quantitative approach, factors that influence the efficacy of risk communication and consumer perceptions for sources of food safety education have been investigated (Chapter 4.0). Furthermore, as part of the social marketing formative research process for the development of a targeted food safety education strategy, focus group discussions elicited qualitative data to inform the promotion and placement strategy (Chapter 7.0).

In this thesis, receptivity towards food safety education of a cross-section of the population has been determined using a quantitative survey (Chapter 4.0) and receptivity of a targeted group of consumers has been investigated using focus groups (Chapter 7.0). Cumulatively, quantitative data showed that differences in attitude responses indicating receptivity to food safety education were identified according to consumer demographics, thus once again illustrating the need to target food safety education for different groups of persons to maximise potential intervention impact. The majority of consumers who responded to the survey and participated in focus group discussions indicated willingness to read or listen to food safety advice. However, survey responses denoting likelihood of acting upon food safety education were correlated with likelihood of acting upon information in the past. Thus, self-reported receptivity to previous food safety education could be used as a means for segmentation of a target audience in future food safety strategies.

Trust in information about food-related hazards is reported to be an important determinant of public reaction to intervention material (Frewer *et al.* 1995b; Shepherd *et al.* 1996). Furthermore, it is believed that a credible source of information is more likely to influence the public than a source that lacks credibility (FAO/WHO, 1998). Cumulatively, findings from this thesis suggest that EHO's and Environmental Health departments and the FSA are the most believable, trusted and credible providers of food safety advice for the general population. In view of such findings, it is suggested that Environmental Health departments become more accessible to consumers and assume a more proactive role in providing the general population with food safety education regarding domestic food preparation. The positive response obtained determining the FSA as a credible, trustworthy and believable provider of food safety information indicates that the promotion of the FSA over the past two years as an 'independent voice….that protects the interests of consumers' (FSA, 2000d) has been successful. Furthermore, results from this study bode well for the national consumer food safety education initiatives intended for the general population that are being planned by the FSA (FSA, 2002c) to increase food safety awareness, improve food safety behaviours and help achieve a reduction of foodborne disease (FSA, 2000c; FSA, 2002c).

Inconsistencies between quantitative responses denoting trusted and credible organisations as providers of food safety information have been identified between the general population and older females aged 60-75yrs (Chapter 7.0). Older females ranked the HEA and FDF as most credible and trusted providers of food safety information, as opposed to the FSA and Environmental Health Departments as ranked by the general population. Identification of such a difference reiterates the need to conduct an in-depth analysis of target audience(s) to ensure sources of food safety information provided in a food safety education initiatives are appropriate to preferences of the target audience. Furthermore it is recommended that future food safety education initiatives that aim to improve food safety behaviours or raise awareness of food safety issues for older females (aged 60-75yrs) collaborate educational efforts with the HEA or FDF to increase potential credibility of information provided.

Limited consumer research has been carried out to determine preferred sources of food safety information, yet, preference for such sources may influence potential intervention effectiveness. The most preferred information source determined in this study was food packaging. However, previous research has suggested that food safety advice on packaging of raw meat in the USA was not an effective method for improving food safety behaviours in the home (Yang *et al.* 2000). Furthermore, more than a third of raw meat packaging has been found to be contaminated with pathogens (Harrison *et al.* 2001a), therefore, there may be increased risks of cross contamination by handling and reading the instructions, as in many cases such instructions are on the inside of raw meat packaging.

Consumers who responded to the survey in Chapter 4.0 also ranked advice from the doctor or health visitor as a preferable source of food safety information. Given that such persons were also ranked as believable spokespersons, it may be beneficial for such 'sources' to be more proactive regarding the provision of food safety advice to consumers in future food safety education initiatives. Quantitative findings from Chapter 4.0 also showed that leaflets, TV documentaries, TV cookery programmes and recipes were preferable sources of food safety education by the cross-section of the population from Cardiff. Consumers in focus groups (Chapter 7.0) also considered leaflets and TV to be preferable sources of food safety information. However, focus group responses from this study, and previous research (Redmond *et al.* 2000) has indicated that recipes which include food safety instructions in the method were too long, detailed and looked too time consuming to follow. Furthermore, although quantitative data from Chapter 4.0 indicated that leaflets were a preferable source of food safety information, focus group responses (from Chapter 7.0) showed that some leaflets were liked and captured the attention of targeted consumers, whereas others were disliked and would have been ignored. Additional data from the questionnaire indicated that reminder aids such as fridge magnets and t-towels were considered to be least preferable sources, especially by older consumers, like the target audience. However, an evaluation of food safety education materials in focus groups (Chapter 7.0) by a targeted audience (older females) suggested that reminder aids were particularly novel and could be used as a constant reminder to implement safe food preparation behaviours. Indeed, magnets have been included as an intervention in a social marketing based food safety initiative in USA (Partnership for Food Safety Education, 2002) and previous research has shown that use of strategically placed reminders to aid hand-washing compliance in hospitals can help to improve behavioural compliance (Naikoba and Haywood, 2001). Issues relating to the use of recipes, leaflets and reminder aids illustrate that focus groups (including the use of stimulus materials) may provide more valuable information for the development of the promotional component of a food safety education strategy than quantitative survey data. This is largely because focus group discussions provide the opportunity for targeted consumers to indicate not only whether intervention materials are preferable or not, but *why* they are liked or disliked. It is recommended that future food safety education initiatives use focus group discussions to aid the development of consumer food safety education strategies.

The food safety message is considered to be a core component of the communication process (McCormack-Brown, 1998a). It is considered that generalised food safety messages have a role in raising awareness of food safety issues, yet specific messages are required to achieve behavioural change (Griffith, 2002). Consumer responses from the general population (Chapter 4.0) and the target audience (Chapter 7.0) in this study expressed a preference for specific, as opposed to generalised, food safety messages. Such a finding was particularly positive, as the social marketing approach is not only based upon targeting educational attempts at a specific audience, but also targets specific behaviours to achieve behavioural change. In this thesis, quantitative data has shown that approximately 50% of consumers indicated that personal experience of food poisoning may have a greater chance of improving food safety behaviours than education. Thus, as a substitute for personal experience of food poisoning the potential inclusion of 'shock tactics' – namely medical details describing foodborne illnesses – as part of the food safety message to encourage implementation of safe food preparation behaviours has been explored (Chapters 4.0 and 7.0). Collectively, qualitative and quantitative data correspond with previous findings (Redmond *et al.* 2000) that suggests the use of 'shock tactics' may impact some segments of the population and provide potential motivation for behavioural change.

9.1.4 Consumer food safety behaviour.

A reduction of foodborne disease in the general population required to meet FSA targets (Hilton, 2002) depends on positively altering the behaviour of food-handlers (Howes *et al.* 1996). It is reported that food safety education is likely to be most effective when messages are targeted towards changing behaviours most likely to cause foodborne illness (Mederios *et al.* 2001a). Therefore, there is a need to identify the food safety malpractices that are most frequently implemented in domestic food preparation associated with the microbiological risks of foodborne disease. A review of previous consumer food safety research (Chapter 2.0) has indicated that although surveys provide valuable information detailing the cognitive antecedents to food safety behaviours, observation provided a more accurate assessment of what food safety practices are, and are not implemented during domestic food preparation.

A small number of consumer food safety observation studies have been carried out in recent years, and collectively results have shown that many food safety malpractices are implemented during domestic food preparation. However, observational methods used for such studies were subject to a variety of limitations (Chapter 5.0). This thesis is a significant progression from previous consumer food safety observation research (Griffith and Worsfold, 1994b; Worsfold, 1994) and design, development and piloting has resulted in a much more advanced observational method for assessment of consumer food safety behaviours. Such a method is based on use of CCTV to observe food safety behaviours during meal preparations in a model domestic kitchen. Development of detailed observational checklists facilitated recording of the frequency of malpractices, and the risk based scoring system developed enabled observed food safety malpractices to be quantified according to microbiological risks. Application of the risk based scoring system to piloted meal preparations in the model kitchen (see Chapter 5.0) provided evidence to indicate that that risk scores allocated to observed food safety malpractices did reflect the associated risks presented by malpractices implemented during domestic food preparation. Assessment of food safety behaviour in relation to microbiological risks can be used to prioritise food safety education interventions.

As opposed to previous studies, this approach offers the potential to assess consumer food safety behaviours objectively, determine reliability of the research method, and facilitated replication of meal preparations for assessment of reproducibility and consistency of food safety malpractices (Chapter 6.0). Furthermore, the approach facilitated an evaluation of a classic 'before and after' intervention study (Chapter 8.0). To date, there has been no published research that determines the consistency of food safety behaviours implemented during domestic food preparation. In addition, none of the published observational studies (Anderson *et al.* 2000; Jay *et al.* 1999a; Worsfold and Griffith, 1997b) have assessed methods and techniques used for collection of actual consumer food safety behaviours in terms of reliability. However, in this thesis, using risk based scoring, it was determined that overall food safety malpractices under investigation were habitual and reproducible between the different environments – thus validating observations in the model domestic kitchen. Furthermore, an assessment of *intra*-observer reliability showed that measurements of food safety behaviour were recorded during repeated observations of the same meal preparations were reliable and consistent. An assessment of test-retest reliability showed that use of the observational technique and risk based scoring system developed in Chapter 5.0 provided a reliable measurement of food safety behaviours over the period of time necessary to collect observational data for a classic 'before and after' intervention study (Chapter 8.0). Analysis of observations from Chapter 6.0 also determined no familiarity effect upon repeated meal preparations in the model kitchen. Furthermore, key food safety behaviours appeared to be consistent between repeated meal preparations. Thus, it can be assumed that improvement of food safety behaviours in the social marketing intervention study (Chapter 8.0) were a result of intervention effect (see section 9.1.6).

Quantitative total risk scores representing observed food safety malpractices from the pilot study (Chapter 5.0) indicated that all consumers implemented unsafe food preparation behaviours during meal preparations. The variability between different individuals' food safety malpractices during preparation was reflected in the overall risk scores obtained. Thus, data obtained from this thesis corresponds with previous research findings which indicate that some consumers implement a wide range of safe practices, whilst others do not (Anderson *et al.* 2000; Griffith *et al.* 1999a; Jay *et al.* 1999a; Worsfold, 1994). In accordance with previous research findings, observational data from this thesis illustrates the imperative need for improvement of consumer food safety behaviours to reduce the risk of foodborne disease by means of food safety education initiatives designed to achieve behavioural change.

Results presented in Chapter 5.0 showed that the food preparation process required in different meals largely influenced the number of food safety malpractices implemented. For example, increased opportunities for cross contamination in selected recipes resulted in increased malpractices being implemented, and heating efficacy of foods appeared to be influenced by the heating method used. Therefore, it is recommended that future food safety education initiatives that aim to improve consumer behaviour target food safety messages at specific preparation and cooking processes, as opposed to general application of a generic practice such as 'adequate cooking'.

9.1.5 Use of social marketing for development of a food safety education strategy.

Application of a structured social marketing framework and developmental process to food safety education has been limited. Internationally, social marketing food safety initiatives that have been implemented have mainly been based in the USA and developing countries. However, in a recent strategy document, (FSA, 2001a) the FSA expressed an interest to use social marketing in consumer food safety initiatives in the UK.

The more that is known about the factors underlying performance or non performance of a health-related practice, the more successful the design of interventions can be for influencing that practice (Strand, 1999). Social marketing strategies are heavily influenced by what is learned from the targeted consumers (Andreason, 1995) and formative research in the social marketing process facilitates an in-depth analysis, and understanding of consumers' psychological and social factors that influence the desired behavioural objectives (Bryant and Salzar, 1998). Thus, in this thesis, in accordance with social marketing principles, quantitative data (Chapter 3.0 and Chapter 4.0) and qualitative research findings (Chapter 7.0) were central for intervention, message and strategy development. Furthermore, observed food safety malpractices using the observational technique developed and piloted in Chapter 5.0 informed the 'product' strategy of the social marketing initiative.

Overall, Chapter 7.0 has provided evidence to suggest that application of a social marketing approach for initiative, intervention and strategy development can provide highly-focussed and tailored food safety intervention materials for targeted group(s) of consumers. Furthermore, use of concepts provided by a social marketing approach facilitated the formulation of a consumer orientated food safety education strategy. Such a strategy was designed to encourage targeted consumers to voluntarily improve their food safety behaviours. The effectiveness of such an initiative has been determined in Chapter 8.0 (see section 9.1.6).

9.1.6 Evaluation of the effectiveness of the social marketing food safety education initiative using observation.

Behavioural change is considered to be the ultimate goal of social marketing initiatives (Andreason, 1995; Lefebvre, 1995; McCormack Brown, 1998b) and indeed a primary concern when evaluating the effectiveness of such initiative should be to determine change of the actual targeted behaviour using a direct measurement approach (McKenzie-Mohr and Smith, 1999). In this thesis, the observation technique and risk based scoring developed in Chapter 5.0 and validated in Chapter 6.0, provided a method for objective measurement of food safety behaviour before and after implementation of the food safety education initiative.

Data presented in Chapter 8.0 provided evidence to suggest that multiple food safety interventions developed using a consumer orientated, social marketing approach may result in behavioural improvement. It is of note, and of relevance to future food safety education initiatives, that although a 'one-off' intervention resulted in immediate behavioural improvement, such an improvement was not wholly maintained. Therefore, it is suggested that future initiatives provide continuous food safety advice, or advice at staged intervals. Further research is required to determine the effectiveness of continuous and staged interventions using the observation technique developed in this thesis.

Evaluation of the effectiveness of targeted food safety interventions may result in an immediate 'halo effect' upon improvement of other food safety behaviours that are not targeted in interventions. Further research, using observation and risk based scoring, is required to ascertain the extent of such an effect (see section 9.2.2). Results from this study suggest that smaller improvements of the targeted food safety behaviours may be maintained more successfully than the larger initial improvements of overall food safety behaviours. Therefore, as previously suggested, future food safety education initiatives may benefit from not only using the social marketing approach for strategy and intervention development, but also the provision of continuous or staged intervals.

Previous research has suggested that messages from multiple sources should be utilised to convey food safety information to the public (Bruhn and Schultz, 1999) and use of a social marketing approach facilitated the development of multiple sources of food safety information for the educational initiative. An evaluation of food safety behaviours to determine initiative effectiveness found that consumers who recalled a larger number of intervention materials, improved their food safety behaviours to a greater extent than those who recalled fewer intervention materials. Therefore, future food safety education initiatives may prove to be more effective if information is provided from more, strategically selected sources.

Given that the FSA has stated that an improvement in consumer food safety behaviour is likely to reduce the risk and incidence of foodborne disease (FSA, 2001a), findings from this evaluation study are particularly relevant and important to the FSA, health educators and providers of consumer food safety education. Furthermore, application of the social marketing an approach to food safety education may help the FSA to achieve its target for foodborne disease reduction by 20% by 2006 (FSA, 2001c; Hilton, 2002).

Cumulatively, data from this thesis adds to the body of knowledge of consumer food safety, and provides valuable information that can be used for the development of future consumer food safety education initiatives.

9.2 RECOMMENDATIONS.

9.2.1 Recommendations for future food safety education initiatives.

The findings of this thesis suggest that the FSA and other health education / promotion organisations should consider the following for future food safety education initiatives:

- Development and implementation of food safety education initiatives to raise awareness of food safety issues and bring about behavioural change.
- Use of risk based observational data detailing actual food safety behaviours to inform and prioritise food safety education messages.
- Application of a consumer orientated, social marketing approach for the development and implementation of future consumer food safety education initiatives to improve consumer food safety behaviours in domestic food preparation.
- Focussing educational messages upon specific, food safety malpractices that are associated with quantified microbiological risks. Furthermore, realistic behavioural objective(s) need to be set.
- Targeting food safety messages at specific preparation and cooking processes, as opposed to general application of generic practices. For example, information may include the specific requirements for cooking a roast chicken adequately, as opposed to advice denoting 'thorough cooking of all foods'.
- Implementation of formative research methods for development of food safety education strategies to ensure that interventions provided are perceived to be preferable and credible to the intended audience. Development of food safety education initiatives may particularly benefit from the use of focus groups.
- Inclusion of food safety messages in food safety interventions equating the risk of food poisoning from implementation of food safety malpractices during domestic food preparation. More emphasis should be placed upon personal responsibility for food safety during domestic food preparation.
- Promotional material for targeted audiences needs clear design, detailing specifically who the information is intended for, and placement of promotional materials at life-point-paths to potentially maximise intervention effect.
- Evaluate and pre-test the potential effectiveness of food safety interventions prior to the launch of a more widespread food safety educational strategy using observation and formative research.
- Reinforcement of food safety messages to encourage maintained improvement of consumer food safety behaviours.

9.2.2 Recommendations for further research.

As a result of this thesis, the following recommendations for further research are made:

- Determine consumer attitudes towards specific component actions of food safety behaviours to inform development of future food safety initiatives.
- Determine consumer knowledge and self-reported practices of cooling and storage practices in domestic food preparation.
- Compare food safety malpractices observed during meal preparations undertaken in the model kitchen with quantitative data denoting consumer knowledge of food safety behaviours, attitudes towards food safety behaviours, and self-reported practices and incorporate such cognitive antecedents of food safety behaviours with social cognition models.
- Demonstrate the broader application of the observational technique and risk based scoring system developed in this thesis, conduct an *inter*-observer reliability analysis.
- Undertake further development of the risk based scoring system using a quantitative risk assessment approach.
- Evaluate pathogenic contamination of kitchen surfaces and end products after food preparation in the model domestic kitchen and compare with observed food safety malpractices.
- Determine the consistency of generic food safety malpractices implemented during repeated meal preparations of different meals in the model domestic kitchen.
- Determine the reproducibility of generic food safety malpractices between preparations of different meals.
- Assess the effectiveness of a social marketing food safety initiative using the developed observation technique on a larger sample of consumers and on more than one test and control community.
- Social marketing interventions have indicated that food safety behaviours can be improved for a limited time from 'one off' interventions. Information is required to assess effectiveness if intervention strategies were sustained, whereby targeted consumers are provided with continual information.
- Determine maintained effectiveness of social marketing interventions over a longer period of time.
- Evaluation of the effectiveness of interventions on different target audiences and using different behavioural objectives.

- Investigate the use of different methods for segmentation of target audiences, for example, use of other social cognition models, perceptions of risk of illness, risks of outcome expectations.
- Determine the extent of the potential halo effect that targeted social marketing interventions may have on overall food safety behaviours.
- Determine the cost-benefit effectiveness of a food safety social marketing initiative and compare the cost-benefit effectiveness of food safety campaigns developed using social marketing and traditional methods.
- Ascertain the effect size from individual intervention sources (e.g. leaflet, video, poster, magnets, TV documentary, TV cookery programme, interpersonal advice) upon food safety behaviours.
- Evaluate consumer perceptions of shock tactics (detailing medical symptoms etc. upon different target audiences). Furthermore there is a need to determine the potential effectiveness of shock tactics upon immediate behavioural change and maintained behavioural change.

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APPENDICES

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Review

Consumer Food Handling in the Home: A Review of Food Safety Studies

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ABSTRACT

Epidemiological data from Europe, North America, Australia, and New Zealand indicate that a substantial proportion of foodborne disease is attributable to improper food preparation practices in consumers' homes. International concern about consumer food safety has prompted considerable research to evaluate domestic food-handling practices. The majority of consumer food safety studies in the last decade have been conducted in the United Kingdom and Northern Ireland (48%) and in the United States (42%). Surveys (questionnaires and interviews), the most frequent means of data collection, were used in 75% of the reviewed studies. Focus groups and observational studies have also been used. One consumer food safety study examined the relationship between pathogenic microbial contamination from raw chicken and observed food-handling behaviors, and the results of this study indicated extensive *Campylobacter* cross-contamination during food preparation sessions. Limited information about consumers' attitudes and intentions with regard to safe food-handling behaviors has been obtained, although a substantial amount of information about consumer knowledge and self-reported practices is available. Observation studies suggest that substantial numbers of consumers frequently implement unsafe food-handling practices. Knowledge, attitudes, intentions, and self-reported practices did not correspond to observed behaviors, suggesting that observational studies provide a more realistic indication of the food hygiene actions actually used in domestic food preparation. An improvement in consumer food-handling behavior is likely to reduce the risk and incidence of foodborne disease. The need for the development and implementation of food safety education strategies to improve specific food safety behaviors is reviewed in this paper.

Illness resulting from foodborne disease (defined as "a disease of an infectious or toxic nature caused by or thought to be caused by the consumption of food or water" *(156)*) has become one of the most widespread public health problems in the world today *(89, 119)*. Internationally, foodborne diseases associated with microbial pathogens, biotoxins, and chemical contaminants in food present a serious threat to the health of millions of individuals *(173, 174)*.

Extensive surveillance has also been carried out by epidemiologists to estimate the extent of foodborne disease and food related illness in industrialized countries *(50)*. It has been estimated that 130 million Europeans *(172)*, 2.1 million to 3.5 million Great Britons from England and Wales, 76 million Americans *(112)*, and 4.7 million Australians *(18)* are affected by episodes of foodborne disease and food-related illnesses annually. Direct comparisons of incidence data are not possible because of differences in national surveillance systems; however, it has been suggested that Australia, the United Kingdom, and the United States appear to have similar incidences of foodborne disease *(39)*. It has also been suggested that individuals from England, Wales, the United States, and Australia may suffer from foodborne disease at least once every 4 to 5½ years *(131)*.

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The true incidence of foodborne disease is difficult to ascertain because cases of illness are underreported *(103)*. Although foodborne illnesses can be severe and fatal, milder cases are not often detected through routine surveillance *(112)*. The majority (>95%) of cases of foodborne disease are believed to be sporadic *(63, 104)*. These cases, as well as small outbreaks that originate in the home, typically involve individuals or a small number of people and thus are less likely to be identified by public health authorities *(98, 176)*. Therefore, the actual proportion of foodborne outbreaks and individual cases originating in the home is likely to be much larger than it has been reported to be *(179)*.

Restaurants, cafeterias, and bars are the most frequently cited locations where foods implicated in reported foodborne disease outbreaks are consumed. However, it has been reported that illness from foodborne disease arising from foods consumed in private homes is three times more frequent than that arising from foods consumed in cafeterias *(26)*. Over the past decade, up to 87% of reported foodborne disease outbreaks in the United Kingdom, Europe, Australia, New Zealand, the United States, and Canada have been associated with food prepared or consumed in the home (see Table 1 and Fig. 1). Historically, the largest proportions of reported foodborne disease outbreaks associated with private homes have been caused by *Salmonella* *(156)*. Epidemiological studies have indicated that sporadic

TABLE 1. *International and national incidences of foodborne disease originating in consumers' homes*

Country	Year(s) of data collection	Incidence
Australia	1999	20–40% of foodborne illness suggested to arise from private homes *(18)*
Canada	1982	14% of incidents (outbreaks and cases) caused by mishandling of foods in homes *(157)*
England and Wales	1992–1993	17% of general foodborne outbreaks of infectious intestinal disease associated with food prepared in private homes and served elsewhere *(41)*
	1993–1998	12% of general outbreaks of foodborne disease attributed to food consumed in private homes *(156)*
	1970–1979	20% of general and family outbreaks of food poisoning associated with family homes as the place of consumption or origin of food incriminated *(140)*
France	1993–1997	40% of foodborne disease outbreaks (microbiologically confirmed and suspected) associated with private homes (where food was eaten) *(156)*
Germany	1993–1998	36% of foodborne disease outbreaks associated with private homes (where food was eaten) *(156)*
Ireland	1997–1998	10% of foodborne disease outbreaks associated with private homes (where food was eaten) *(156)*
New Zealand	1997	~50% of cases of foodborne illness reported to be caused by poor food-handling techniques in domestic kitchens *(24)*
Scotland	1996–1998	9% of foodborne disease outbreaks occurring in private homes *(156)*
Spain	1993–1998	49% of foodborne disease outbreaks associated with private homes (where food was eaten or acquired) *(156)*
Sweden	1992–1997	19–22% of outbreaks and single cases attributed to food consumed in private homes *(106)*
Switzerland	1993–1998	11% of foodborne disease outbreaks associated with private homes (where food was eaten) *(156)*
United States	1993–1997	20% of reported bacterial foodborne disease outbreaks originating from place where food was eaten *(125)*

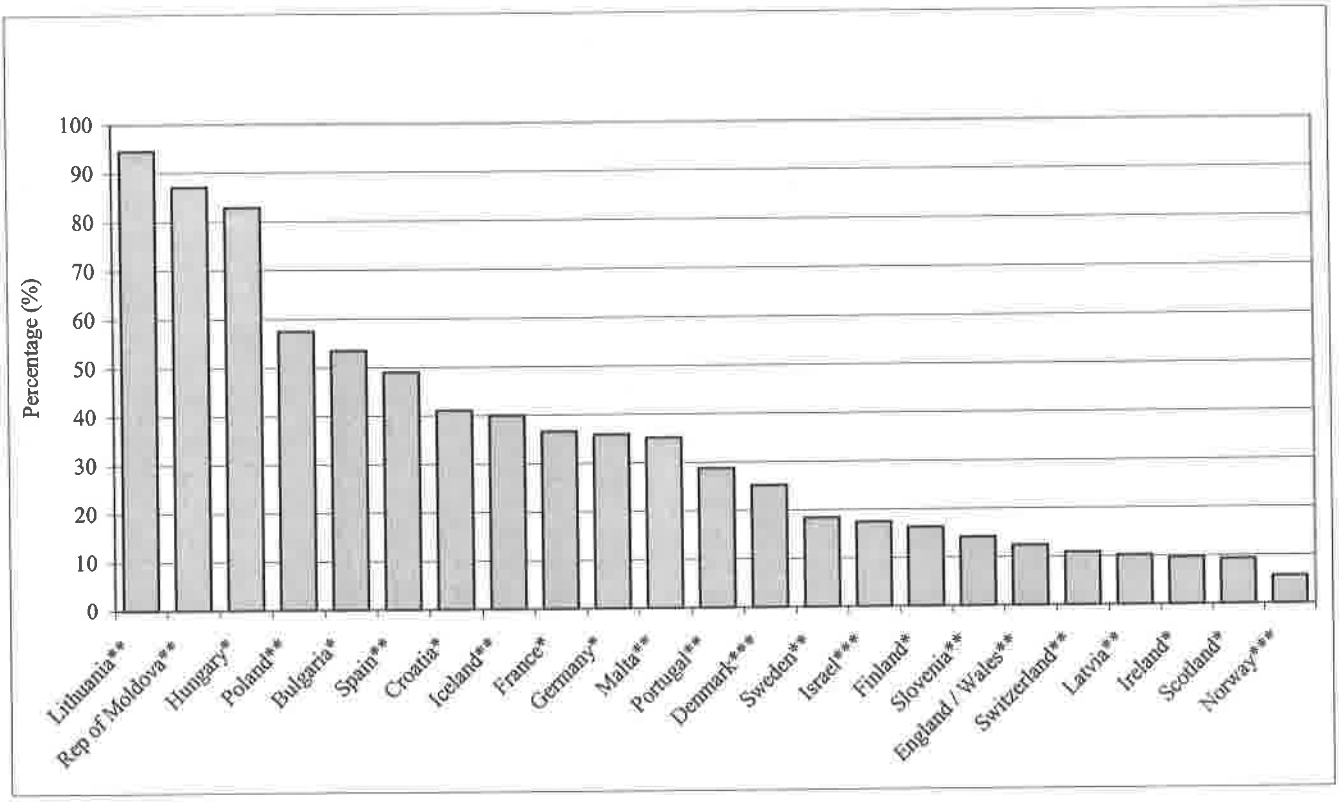

FIGURE 1. *Incidence of reported foodborne disease outbreaks associated with private homes in Europe (156). * Outbreaks of foodborne disease caused by food eaten or contaminated in private homes. ** Outbreaks of foodborne disease for which food was eaten or acquired in private homes. *** Outbreaks of foodborne disease for which food was prepared or contaminated in private homes.*

ganisms to a level that no longer constitutes a threat to health *(85)*.

The importance of adequate consumer food-handling practices is widely acknowledged *(62, 71, 127, 148)*. A great deal of research has been carried out on manufacturing, processing, and distribution processes in the food industry. However, the consumer remains the least studied link in the food chain, and information available about the consumer has been considered to be largely anecdotal *(43)*. A considerable amount of food preparation and handling occurs in the domestic environment, so research and consumer education regarding the risk of unsafe food-handling practices is an essential element of the prevention of foodborne disease *(94)*.

Information about domestic food-handling practices comes from two main sources: analyses of food poisoning outbreaks and consumer-based research studies *(78)*. Internationally, numerous consumer-based research studies have been conducted to evaluate the food safety practices of consumers. Different approaches have been adopted, including questionnaires and interview surveys, focus group discussions, and observational studies. Epidemiological studies provide quantitative data regarding contributory unsafe food-handling practices that have resulted in cases of food poisoning. However, a retrospective analysis of food poisoning provides limited information about consumer food safety behavior. The accuracy and availability of data are limited because it is often difficult for people to recall exact food consumption details and handling practices that may have taken place some time before the illness was reported.

The purpose of consumer food safety studies is to ascertain how consumers handle food in their homes and to determine what consumers know about food safety and why some safe food-handling practices are or are not implemented. General food safety and hygiene knowledge has been determined by several investigators *(113, 151, 153, 159)*, and other workers have sought to obtain an understanding and an awareness of specific food safety issues *(21, 55, 76, 121, 131, 169)*. Many studies have assessed consumers' self-reported practices *(7, 30, 53, 91, 113, 168)*, whereas others have assessed actual food-handling behaviors *(15–17, 74–76, 80, 87, 131, 135, 138, 175, 176)*. Some studies have investigated general attitudes about aspects of food safety *(60, 64, 65, 91, 131)*, and a few investigations have used the constructs of psychological theories to attempt to understand the relationships between knowledge, attitudes, intentions, and behaviors with regard to food safety practices *(76, 120)*. The overall aim of the majority of the studies reviewed in this paper was to provide information for the development of effective communication strategies to promote safe food handling *(7, 55, 131, 144, 164, 168)*.

The measurement of consumer knowledge, attitudes, and behaviors can provide a basis for the formulation of health promotion programs *(166)*. Foster and Kaferstein *(67)* have stated that only when existing attitudes and practices regarding food safety are known is it possible to plan effective strategies to encourage and strengthen desirable behaviors and discourage unsuitable ones. The use of social cognition models for health-related issues has enabled the identification of the relationship between attitudes, beliefs, and behaviors and behavioral change *(47)*.

The aim of the present review paper is to critically analyze 88 consumer food safety studies. The review will provide information regarding similarities and disparities between knowledge, attitudes, intentions, self-reported practices, and actual behaviors from studies on domestic food preparation. Following a detailed discussion of the social cognitive determinants influencing food safety behaviors in the domestic environment, areas in which information is lacking will be identified. Findings will be discussed in the context of government targets and strategies for reducing foodborne disease and the development of future consumer food safety initiatives. In addition, studies will be evaluated in terms of the research method implemented for data collection, the study size, the country of origin, and the year of study completion.

MATERIALS AND METHODS

An extensive search of previous literature was conducted to locate published and unpublished consumer food safety studies. Electronic searches of computerized library databases and the screening of reference lists from relevant research papers and reports facilitated the identification of many published studies. Internet browsers were used to search the World Wide Web, and responses from the Foodsafe listserv were used to obtain many unpublished international studies. Attendance at international food safety–related conferences and personal communication with experts in the field resulted in the acquisition of additional studies.

Consumer food safety studies were examined according to social cognitive components, observed behaviors, and food safety findings. The grouping of food safety issues and concepts provided a more complete picture of what food safety behaviors consumers perform and why they may do so. Although objective comparisons have been made between findings of different studies, it is important to make allowances for the interpretation of responses to survey questions in the context of the question type, the research method used, and cultural effects.

Inclusion and exclusion criteria for reviewed consumer food safety studies. Studies included in the present review evaluated consumers' knowledge, attitudes, intentions, self-reported practices, and actual hygiene behaviors relating specifically to food preparation in the domestic kitchen. Only studies that assessed individual consumers and targeted consumer groups were included for review. Persons classed as consumers included anyone who prepared food on a regular basis and was not a professional food handler. All research methods for data collection, such as surveys, interviews, focus groups, and actual observations, were included and analyzed for review purposes. Research has indicated that actual observed food preparation behaviors of trained food handlers from food service environments are safer than those of consumers *(80)*, and therefore results of studies involving trained food industry workers were excluded to alleviate any bias of common findings and conclusions within the review. Additional studies that were excluded were those predominantly based on risk perceptions of other aspects of food safety, such as pesticide residues or bovine spongiform encephalopathy, as well as those evaluating hygiene behaviors in less developed countries.

portion of the studies in which each research method was used. Interviews were found to be the most common method for obtaining information on consumer food safety (used in 49% of the studies), followed by self-completion questionnaires (used in 26% of the studies). Focus groups were used in 8% of the studies, and the direct-observation technique was used in 17% of the studies.

Social surveys involve a quantitative method for collecting information from a population sample, usually by personal interviews or by self-completion questionnaires. Survey methods like interviews and questionnaires have been used for the assessment of participants' knowledge of food-handling practices, foods at risk for transmitting infection, and foodborne pathogens, for the determination of food safety perceptions, and for the measurement of psychological influences on food safety behaviors. Discrepancies between what is reported by participants and the actual behavior of these participants have previously been described *(42, 71, 87, 154)*. Studies using questionnaires and interviews to assess hygiene behaviors have found evidence of a tendency for participants to overreport behaviors perceived to be "good" *(42, 109, 154)*.

Focus groups, although more recently adopted, are relatively underused as a means for obtaining consumer food safety information. The focus group research method involves carefully planned group discussions designed to ascertain attitudes and perceptions regarding a defined area of interest *(101)*. Focus groups are known to be particularly effective in providing information about why people think or feel the way they do, and group interaction provides more insight into why certain opinions are held *(100)*.

Various methods, such as personal direct observation and observation through video recordings, have been used to collect information about consumers' actual food safety behaviors. Fifteen observational studies of consumer food safety practices were obtained for this review. Data were collected for 47% (7 of 15) of these studies by direct observation, whereby an observer openly watched participants prepare meals in home kitchens and concurrently recorded the steps used in the preparation of these meals. Forty three percent (3 of 7) of these direct-observation studies were conducted in South Wales *(120, 131, 176)*, 43% (3 of 7) were conducted in the United States *(15–17)*, and 14% (1 of 7) were conducted in England *(76)*. Video camera recording has been used to observe consumers' food-handling practices in the United Kingdom, Australia, and the United States. The majority (67%) of widely reported observational studies have been undertaken by the Food Research and Consultancy Unit in Cardiff, South Wales, whereby closed-circuit TV has been used to observe consumers' food preparation practices in a model domestic kitchen. A number of studies have been carried out to determine the repeatability and reproducibility of consumers' food safety behaviors *(75, 135)*. Quantification of food safety behaviors of a cross section of the population by using notational analysis and a risk-based assessment *(74, 75)* has been completed. Additional studies have evaluated food safety behaviors of targeted groups of individuals and have associated the actual microbiological isolation of *Campylobacter* and *Salmonella* with observed unsafe practices *(138)*. Moreover, the relationship between actual observed behavior and psychological variables, such as knowledge, attitudes, beliefs, and intentions, has also been investigated in an attempt to understand why consumers implement some food safety behaviors and do not implement others. In a study undertaken in Australia *(87)*, time lapse video was used to monitor food safety behaviors from single mounted cameras in home kitchens for periods of 1 or 2 weeks. In an American study *(14)*, portable video cameras were used to record the practices involved in the preparation of one meal in participants' home kitchens.

Sample sizes used for consumer food safety studies ranged from 40 to more than 13 million respondents. Telephone interviews were used for the consumer food safety studies involving the largest numbers of consumers, with 100 to 13,221,007 respondents being reached. Face-to-face interviews were used to reach 84 to 10,172 respondents, postal questionnaires were used to reach 82 to 869 respondents, and self-administered questionnaires were used to reach 62 to 824 respondents. Focus group studies and observational studies involved far fewer participants than did survey studies, largely because the focus group and observation methods may be more time-consuming and expensive. Redmond and Griffith *(133)* have discussed the validity and reliability of research methods used for consumer food safety studies.

Content analysis of consumer food safety surveys. Different types of questions have been asked in interviews and questionnaires to obtain a better understanding of why individuals perform a variety of food safety behaviors. Questions to identify social cognitive factors (attitudes, intentions, and knowledge) affecting food safety behaviors have been included in a considerable proportion of surveys, as have questions about self-reported practices (Table 5). Cognitive factors determine whether or not an individual practices health behaviors, and these factors are relevant to aspects of health promotion, because they mediate the effects of other factors such as social and demographic variables in attempts to change health behaviors *(40)*. In the majority of consumer food safety research studies, it is not possible to make direct observations of actual food preparation practices, so, as an alternative, questions are often asked of respondents to obtain self-reports of food-handling practices. Data from reviewed food safety surveys will be discussed in the context of food safety concerns, awareness, knowledge, attitudes, intentions, and self-reported practices.

A breakdown of the types of questions included in the surveys analyzed can be found in Table 5. A content analysis of the 66 food safety surveys (questionnaires and interviews) reviewed revealed that 13 (20%) surveys included only questions on self-reported practices. Only 1 (1%) survey was found to investigate only consumer attitudes, 2 (3%) surveys investigated only knowledge, and no surveys investigated only consumer intentions. Only 3 (5%) of the surveys reviewed assessed self-reported practices, attitudes, knowledge, and intentions. The majority of the surveys (41%) investigated self-reported practices along with attiterms and concepts used in health promotion initiatives are prevalent among consumers. Such misunderstandings could nullify the impact of attempts to educate consumers. Survey results have shown that up to 75% of consumers lack familiarity with the term *cross-contamination* and principles associated with cross-contamination. However, such a term is frequently used in food safety education intervention materials, e.g., as part of the "Fight-Bac" campaign in the United States *(128)* and Foodlink activities in the United Kingdom *(66)*. It is therefore possible that substantial proportions of consumers may not fully comprehend food safety education messages. It is suggested that food safety initiatives include explanations of terms to ensure that messages are effectively communicated.

Knowledge of pathogens. Consumer knowledge of pathogens was assessed in 12% of the surveys reviewed. As expected, survey questions containing the names of pathogens generated more responses indicating knowledge of those pathogens than did questions that did not mention pathogen names. For example, 79% unprompted consumers could name *Salmonella (58)*; however, when prompted, 80 to 97% of consumers indicated that they had heard of *Salmonella (8, 88, 110, 164)*. Survey results also indicated that only <5 to 21% of consumers had heard of *Campylobacter (8, 88, 110)*. One reason for consumers being more aware of *Salmonella* and *Listeria* (see Table 6) than of *Campylobacter* may be the sensationalized media food scares of the mid-1980s. It is disconcerting to realize that large proportions of consumers from the United Kingdom, the United States, and Australia still lack knowledge of *Campylobacter. Campylobacter* has been found to be responsible for the majority of cases of foodborne disease in England and Wales, the United States *(141)*, and Australia *(38)* in recent years, and its minimum infective dose is also known to be lower than those of other pathogens. Moreover, experimental investigations have suggested that *Campylobacter* may have more potential to spread during consumer food handling than other pathogens do *(139)*, thus increasing the potential risk of cross-contamination. It has been suggested that knowledge of the microbiology of foodborne pathogens may motivate consumers to use safe food storage, preparation, and cooking procedures *(8)*. However, research detailing risk perceptions and willingness to change unsafe behaviors has indicated that consumers with an awareness of specific pathogens and food safety procedures are not any more willing to change their behavior than those lacking awareness *(111)*.

Focus groups of mothers with young children and 60- to 75-year-old women commonly referred to all bacteria as "germs" *(136, 138)*. These groups also acknowledged the invisible nature and inherent presence of bacteria; for example, one respondent commented, "you can't see them, but they are there" *(136)*. Most U.S. consumers demonstrated an understanding that bacteria and improper handling of food are causes of foodborne illness *(55)*. However, misconceptions about the nature of foodborne pathogens appear to persist; for example, one respondent commented, "that is where the germs are, in the air" *(138)*.

Knowledge of hand-washing and -drying practices. The determination of knowledge about hand-washing practices has largely concentrated on the importance of hand washing in decreasing foodborne disease or the timing of hand washing during food preparation. As expected, the majority (75 to 100%) of respondents recognized that hand washing is a necessary food safety practice *(8, 24, 31, 76, 87, 102, 110)*. Although data have suggested that consumers know the correct procedure for adequate hand washing and drying *(76)*, study results have also indicated that nearly a fifth of the sampled population from the United Kingdom and the United States are unfamiliar with desirable hand-washing and -drying procedures (see Table 7). None of the consumer food safety surveys reviewed evaluated consumer knowledge of the specific procedures required for effective hand washing and drying during domestic food preparation. Although the drying process is deemed to be of critical importance in maximizing the reduction of transient and resident bacteria *(23, 115, 118)*, consumers' knowledge of specific hand-drying procedures was not specifically determined in any of the reviewed consumer food safety surveys.

Knowledge of separation of raw and cooked foods during food preparation. The microbiological risks associated with the contamination of ready-to-eat (RTE) foods prepared with unclean utensils previously used for the preparation of raw meat and poultry are considered high or very high *(138)*. A lack of knowledge of appropriate food safety practices to circumvent such risks could result in the contamination of cooked foods and potentially give rise to illness. As was the case for hand washing, many international surveys assessed this aspect of safe food handling, and the results were comparable. While surveys have sometimes reported that high percentages of people have such knowledge, large numbers of consumers (albeit small percentages) lack the appropriate knowledge. Indeed, it has been suggested that up to 36% of UK consumers and up to 22% of U.S. consumers do not recognize the importance of using separate or adequately cleaned utensils for the preparation of RTE foods after these utensils have been used in the preparation of raw meat and poultry (Table 7). Comparable data have also been obtained in New Zealand (see Table 7).

Knowledge of temperature control. Numerous microbiological surveys have found the presence of pathogenic bacteria in many foods consumed and prepared in consumers' homes on a daily basis. Pathogenic contamination of such foods indicates the need for consumer knowledge of adequate temperature control, including knowledge of heating practices, cooling principles, and refrigeration and freezing temperatures, to minimize the proliferation of any organisms present. Knowledge of adequate heating practices has been investigated in the United Kingdom, New Zealand, and the United States, whereas assessments of consumer knowledge of refrigeration temperatures have come predominantly from the United Kingdom. Data denoting consumer knowledge of cooling practices has been lacking in all surveys. Data presented in Table 7 il-

TABLE 6. *Continued*

Food safety issue	Respondents' knowledge about food safety issue as demonstrated in: UK and European surveys	U.S. and Canadian surveys	Australian and New Zealand surveys
Hand washing and drying (cont)	When prompted, 100% knew when and how it was necessary to wash hands *(76)* (UK survey)	45% knew that improper hand washing could result in food poisoning *(10)* (U.S. survey) 79% could identify each of five instances in which hand washing was necessary *(16)* (U.S. survey)	82% recognized that washing hands before handling or preparing food was a vitally important food hygiene activity *(88)* (Australian survey)[a]
Separation of raw and cooked foods during food preparation	82% knew that allowing raw food to contaminate cooked foods was hazardous *(11)* (UK survey) 64% thought that it was very important to use separate chopping boards for raw meat and other foods *(164)* (UK survey) 77% thought that it was important to use a separate chopping board for raw meat *(102)* (UK survey) When prompted, 100% answered questions correctly about use of different utensils for raw and RTE foods *(76)* (UK survey)	80% knew that putting steak on a plate that held raw meat increased the risk of food poisoning *(8)* (U.S. survey) 84% knew that keeping different foods separated from each other to avoid cross-contamination was important to prevent food poisoning *(31)* (U.S. survey) 55% correctly answered questions about cross-contamination *(16)* (U.S. survey) 78% recognized that washing cutting boards after handling raw meats and then cutting raw vegetables could result in food poisoning *(10)* (U.S. survey)	38% were unaware of the need to use separate or clean utensils for the preparation of raw and cooked foods together *(83)* (New Zealand survey) 28% agreed that one knife is all that is needed to cut up raw and cooked ingredients, as long as it is wiped with a clean damp cloth *(96)* (New Zealand survey) 97% respondents indicated that it is unsafe to use the same unwashed knife or chopping board to cut uncooked chicken and prepare a salad *(24)* (New Zealand survey)
Pathogens	When prompted, 95% knew of *Salmonella*, 92% knew of *Listeria*, and 21% knew of *Campylobacter* as causes of food poisoning *(110)* (UK survey) Unprompted, 79–97% could name *Salmonella*; <3–10% could name *Campylobacter (51, 58)* (UK surveys)	75% knew *Salmonella* was associated with raw poultry and eggs *(168)* (U.S. survey) 78% had heard of *Salmonella*, 9% had heard of *Campylobacter*, 30% had heard of *E. coli*, and 21% had heard of *Listeria (111)* (U.S. survey) 80% claimed to have heard of *Salmonella*, and <5% claimed to have heard of *C. jejuni* or *E. coli (8)* (U.S. survey)	96% had heard of *Salmonella*, 32% had heard of *Listeria*, 52% had heard of *E. coli*, and 8% had heard of *Campylobacter (88)* (Australian survey)
Foods likely to be contaminated with pathogenic bacteria	73% thought poultry was a food that might constitute a food poisoning risk *(51)* (UK survey) 60% recognized that soft or raw eggs were a possible danger to public health *(164)* (UK survey) 91% recognized poultry, 21% recognized beef, and 70% recognized meat pies and pasties as common sources of food poisoning *(110)* (UK survey)	88% thought that a rare hamburger was a high-risk food *(130)* (U.S. survey) 88% recognized that raw eggs could be a potential health risk *(7)* (U.S. survey) 56% considered poultry a high-risk food *(170)* (U.S. survey) 65% thought that meat and poultry had the greatest potential to cause food poisoning illness *(12)* (U.S. survey)	No data available

[a] Published study reported lack of knowledge.

lustrate that large proportions of consumers lack knowledge about adequate refrigeration temperatures. Surveys have indicated that up to 93% of consumers do not know that the correct refrigeration temperature is 0 to 5°C. Such knowledge is more widespread in the United States, with survey results indicating that 46 to 60% of consumers do not know the ideal refrigeration temperature. Survey findings detailing consumers' refrigerator temperatures correspond with the lack of knowledge described above. Results have shown that large proportions (up to 70%) of consumers' refrigerators exceed the recommended temperatures *(44, 90, 163)*, giving rise to conditions that encourage the proliferation of

TABLE 8. *Perception of the home as an important location for food poisoning*

Country	Consumer food safety survey findings
Quantitative findings	
Australia	77% of respondents thought the home was a likely place to acquire food poisoning *(88)*
Canada	16% of consumers believed that food safety problems were most likely to occur in the home *(31)*
United Kingdom	11% of consumers regarded the home as a likely source of food poisoning *(116)*
	9% of respondents regarded the home as a likely source of food poisoning; 61% perceived the home environment as having the potential to bring about food poisoning; 20% thought that food poisoning rarely, if ever, occurred in the home *(110)*
	35% of consumers ranked the home as a likely location to get food poisoning *(131)*
United States	16% of consumers thought the home was the most likely place for the mishandling of food *(168)*
	17% of consumers attributed foodborne illness to food prepared at home *(53)*
	23% of consumers considered foods eaten at home to pose a lower risk of foodborne illness than those eaten away from home *(170)*
	No consumers thought that the home was where food safety problems were most likely to occur; 57% believed food poisoning to be common or very common from foods prepared at home *(14)*
Qualitative findings	
United Kingdom	"You'd like to think you wouldn't get it [foodborne disease] in your own home" *(138)*
	"I would not think of my kitchen as being unsafe" *(136)*
	"I think that it [the risk of foodborne disease] is higher away from home" *(136)*
	"I think [foodborne disease is more prevalent] in establishments not necessarily in our own homes" *(138)*

appear to be consistent across all international surveys reviewed, and despite increased media and educational attention, the perception of the home as a location at which one is unlikely to get food poisoning appears to have changed little over the past 15 years.

Findings concerning consumers' perceptions of food poisoning risk from focus group studies (qualitative data) are comparable to findings from consumer food safety surveys (quantitative data). More concern was expressed about acquiring foodborne illness from locations away from the home, because the members of the focus groups perceived themselves to have more control at home *(55, 136, 138)*.

Perceptions of risk, control, and responsibility. Bruhn *(29)* has suggested that the incidence of food poisoning and the frequency of serious consequences are underestimated by consumers. This underestimation of personal risk posed by food poisoning may prevent consumers from taking appropriate steps to reduce their exposure to food-related hazards *(68, 144)*. A large proportion (90%) of UK consumers perceive that there is a very low risk of getting food poisoning from food they have prepared themselves *(131)*, and this finding supports results obtained by Frewer et al. *(68)* indicating that consumers associate the lowest personal risk of food poisoning with home-produced food. Consumers have also been reported to perceive a higher risk of food poisoning when food is prepared by others, as opposed to themselves (see Table 9). Such findings have been discussed within the framework of "optimistic bias" *(68, 131)*.

Consumer perceptions of control were studied in only two of the attitudinal surveys reviewed *(110, 131)*. Results presented in Table 9 indicate that 66 to 88% of consumers perceive themselves to have control over their own food safety. Perceptions of personal control have been evaluated, and results have indicated that consumers perceive themselves to have more control over their own food safety than others do, thus indicating judgments of optimistic bias *(132)*.

Consumers are considered to be responsible for proper food-handling practices when preparing food in the home *(7)*. However, it has been reported that consumers are frequently unaware of their role in the prevention of foodborne disease *(146)*. The majority of consumers fail to recognize the significant risks and mechanisms of bacterial growth and contamination associated with foodborne disease *(94, 146)*. Numerous studies in the United Kingdom, the United States, Canada, Australia, and New Zealand have investigated consumer perceptions of responsibility for safe food preparation. In the late 1970s, Jones and Weimer *(91)* found that most consumers underrated their individual responsibility for hygienic food preparation and relied on government inspection for the prevention of bacterial contamination of raw meat and poultry. Nearly 3 decades later, data suggest that many consumers remain unaware that food safety problems are likely to occur in their homes, believing that the responsibility for food safety lies instead with food manufacturers or restaurants *(176)*. Even though recent surveys have indicated that large proportions of consumers believe that food manufacturers are ultimately responsible for food safety, other studies have suggested that consumers are beginning to recognize their own responsibility for providing safe food (see Table 9). Elderly women and mothers with young children in the United Kingdom expressed an acceptance of personal responsibility for hygienic food proportions of consumers believed that the failure of food preparers to wash and dry their hands adequately is a major cause of food poisoning. Such findings reiterate the need for consumer food safety education regarding the microbiological risks associated with handling RTE foods with unwashed or undried hands. Improved consumer perceptions regarding the need and timing of adequate hand washing and drying may increase the implementation of the procedure and ultimately help to decrease the risk of foodborne disease.

Qualitative data obtained from focus groups have indicated a widespread unprompted understanding of the need for hand washing and drying during food preparation for "hygiene reasons" *(138)*, yet it was notable that inaccurate perceptions of correct hand-washing and -drying procedures were common. The majority of the 60- to 75-year-old women and the mothers with young children were insistent that hand washing and drying was a vitally important procedure and that they implemented this procedure effectively before, during, and after food preparation. However, thorough descriptions of hand-washing and -drying procedures were perceived to be "too time consuming" *(136, 138)*. Qualitative findings regarding the need for the use of soap for adequate hand washing did not correspond with the quantitative findings of Mathias *(110)*, which indicated that the majority of consumers have a positive attitude about the use of soap for hand washing during food preparation. Additional research is required to investigate specific attitudes toward component actions of the hand-washing and -drying process during domestic food preparation.

Attitudes toward food safety practices for the preparation of raw and cooked foods. Generally, attitudes toward safe food-handling practices regarding the use of utensils for the preparation of RTE and cooked foods were positive. It was found that 81 to 90% of consumers agreed that it is better to use different chopping boards for the preparation of raw and cooked meats *(75, 110, 131)*. Similarly, 90% of consumers believe that the use of different utensils or washed utensils for the preparation of raw and RTE foods will help to prevent food poisoning *(76)*. In addition, 100% of consumers have stated that they think the use of different utensils and/or washed utensils for the preparation of raw and RTE foods is important *(76)*. The safety of the use of wood chopping boards relative to that of the use of plastic chopping boards has previously been discussed *(6)*, and research has shown that consumers have differing attitudes toward the use of different types of chopping boards; however, there appears to be a preference for the use of plastic boards *(138)*.

Focus group study findings indicate that the unprompted understanding of the need for the use of separate and/or adequately cleaned utensils for the preparation of raw chicken and RTE foods was prevalent. For example, one respondent stated, "I've got a meat knife and a vegetable knife" *(136)*. However, many respondents considered the rinsing of chopping boards and/or knives after they have been used for raw chicken and before they are used for RTE foods to be an acceptable food safety procedure. For example, respondents stated, "I always wipe over the board . . . between preparing things," and "I just swill everything" *(136)*, and "I don't use soap, just under hot water" *(138)*. As was the case for hand washing, respondents perceived themselves to be implementing adequate food safety procedures and appeared to realize the importance and the need for the implementation of such procedures; however, the same respondents also unknowingly reported unsafe practices that may present a potential risk of cross-contamination during domestic food preparation.

Attitudes toward temperature control. Attitude areas investigated regarding temperature control can be classified into three categories: heating, cooling, and storage of foods at room temperature. Consumer attitudes toward cooking practices in the domestic kitchen have been identified in few consumer food safety surveys. Recent findings have revealed that the majority of consumers have positive attitudes toward adequately cooked foods. Even though low proportions (12 to 14%) of consumers have been found to have negative attitudes, there is significant cause for concern, especially when such proportions of consumers may represent people making food-handling errors.

Several U.S. studies have presented results of group discussions regarding the use of thermometers for assessing heating adequacy *(32, 55, 99)*. Findings have suggested that some groups of consumers are more likely than others to use thermometers to assess heating adequacy upon learning that color is not always a good indicator of heating efficacy *(55)*. Qualitative findings for focus groups regarding attitudes about heating adequacy and perceptions of adequately cooked food can be found in Table 11. Consumers indicated positive attitudes toward determination of the end of the cooking process; indeed, several U.S. consumers perceived that meat was safe when it was overcooked *(99)*. Such findings concur with those from surveys conducted in the United Kingdom, where consumer responses indicated an understanding of the purpose of and the need for adequate cooking. Most U.S. and UK consumers perceived that cooking kills the microorganisms in raw meat and poultry. Despite this perception, discussions about actual practices revealed that some respondents unknowingly follow improper handling practices when cooking at home *(55)*. For example, respondents indicated inaccurate objective means for determining the end of the cooking process.

The evaluation of attitudes toward cooling practices and the storage of foods at room temperature were researched (with surveys) by only two workers from the United Kingdom (see Table 12). It was found that 14 to 28% of consumers had negative attitudes toward the storage of foods at room temperature, and up to 84% of consumers held negative attitudes toward adequate cooling practices, thus indicating that there is confusion among consumers as to what actually constitutes acceptable and safe cooling practices.

Behavioral intentions. Behavioral intentions can be regarded as being derived from two parallel cognitive processes: the first process involves consideration of the indi-

TABLE 13. *Prevalences of self-reported unsafe food consumption practices according to U.S. consumer food safety surveys undertaken from 1977 to 2000*

Year(s)[a]	Prevalence(s) of consumption of ordering, preparation, and serving of undercooked hamburger patties	Prevalence(s) of consumption of raw, uncooked, or runny eggs or egg products
1977	15% *(91)*	No data available
1986	23% *(130)*	No data available
1994–1995	19% *(111)*, 23% *(97)*	50% *(97)*
1997–1998	4% *(159)*, 5% *(130)*, 6% *(124)*, 20% *(177)*	13% *(159)*, 50% *(177)*
1999–2000	9% *(178)*, 14% *(86)*, 17% *(113)*, 20% *(9)*, 30% *(151)*	18% *(151)*, 19% *(113)*, 48% *(86)*, 50% *(9)*, 56% *(178)*

[a] No data are available for 1987 to 1985, 1987 to 1993, or 1996.

dling RTE foods *(76)*. The same study found that most consumers intended to use separate or washed utensils the next time they prepared raw and cooked foods and were "extremely likely" or "likely" to clean all food preparation surfaces between the preparation of raw foods and the preparation of RTE foods *(76)*. Such data may indicate that consumers have knowledge of correct and important food preparation practices, but as is the case for self-reported practices, responses may be subject to social desirability bias (defined below).

Self-reported practices. The majority (96%) of interviews and questionnaires reviewed here included questions about self-reported practices. Self-reported practices are personal accounts of one's actions and may or may not reflect actual behaviors. Data from self-report questions may provide valid information on awareness or indirect knowledge about "correct" behaviors rather than precise information on actual behaviors and thus may not provide an accurate representation of what actually constitutes a respondent's true behavior. Social scientists have suggested that a respondent may claim to carry out the perceived "correct" behaviors as opposed to behaviors perceived to be undesirable in order to convey a positive image *(27)*. This concept is known as *social desirability bias* and is reported to occur more frequently with questionnaires and telephone interviews than with face-to-face interviews *(126)*. An evaluation of such data could result in misleading findings *(42)*. Several of the survey studies reviewed here acknowledged the limitations with regard to the interpretation of self-reported data *(9, 177)*. Self-reports of behavior are sometimes collected to aid in the evaluation of health promotion initiatives. A self-reported behavioral change may be a change that a respondent only perceives to have made or reports in order to convey a positive image *(95)*.

Responses to self-reported behavior questions in several survey studies have suggested that reported unsafe practices and misunderstandings about safe food-handling practices exist with respect to all factors that are known to contribute to food poisoning. An overall assessment of interview responses from a U.S. survey indicated that 98% of food preparers reported at least one unsafe practice *(169)*. In a more recent survey, carried out by Altekruse et al. *(8)*, unsafe food hygiene practices were reported by one third of the respondents. It was apparent that questions regarding hand washing and the use of separate or washed utensils for the preparation of raw and cooked foods during food preparation were the issues investigated most frequently. There were notable differences in reports of safe and unsafe practices for different food safety issues.

Reported consumption of foods with the potential to cause foodborne disease. At least 25% of the reviewed consumer food safety surveys determined the prevalence of food consumption practices that may cause foodborne disease. Indeed, several surveys have been devoted solely to this topic. The majority of the data regarding the prevalence of unsafe consumption of foods were obtained in the United States and pertain to undercooked hamburgers and raw and undercooked eggs. A substantial level of media attention has been devoted to the microbiological hazards of both of these foods because of outbreaks of foodborne disease due to *E. coli* O157:H7 and *Salmonella*. Cases of illness caused by *Salmonella* Enteritidis have frequently been attributed to the consumption of raw or lightly cooked eggs *(82)* and in the United States, outbreaks of disease caused by *E. coli* O157:H7 have been attributed to the consumption of undercooked hamburgers *(33, 34)*.

A summary of proportions of consumers who reported consuming various unsafe foods is presented in Table 13. Overall, large proportions of consumers reported eating raw foods of animal origin. Since 1977, the prevalence of the consumption of undercooked hamburgers has ranged from 4 to 30% of the sampled populations. However, some surveys undertaken since 1997 have indicated that <5% of consumers continue to report a preference for and the consumption of medium rare and rare hamburgers *(113, 159, 170)*, suggesting that a reduction in the consumption of undercooked hamburgers may have taken place. Since 1994, the prevalence of the consumption of undercooked or raw eggs has ranged from 5 to 56%. The levels of consumption of raw and undercooked eggs appear to have been consistent from the mid-1990s to the present, indicating that up to 50% of consumers may still consume raw and undercooked eggs. However, as with hamburgers, some survey studies have found as few as 5% *(113)* of consumers to report such consumption behavior. The results of a U.S. study *(145)* indicate that susceptible populations with an increased risk for foodborne disease continue to consume inadequately cooked runny eggs and pink beef burgers, which gives rise to concerns about foodborne disease.

As with other self-reported practices, it is possible that the prevalence of the consumption of unsafe foods may be higher than it has been reported to be because of the influmended *(121)*. Nevertheless, research has shown that the assessment of meat color is not an effective method for accurately evaluating the doneness of meat and poultry products *(152)*.

Self-reported cooling practices are one of the least studied aspects of consumer food safety in the surveys reviewed, featuring in at least 6% of these surveys. Most of the data regarding this subject appear to have been collected before 1995. However, the most recent findings, from 1999, indicate that 86% of Australian consumers cool leftover foods, e.g., casseroles or other foods containing meat, fish, or poultry, at room temperature *(88)*—a practice that is not considered safe *(52)*. The ability of bacterial pathogens to multiply rapidly to dangerous levels in foods that are allowed to remain warm for an extended period is a frequently implicated cause of foodborne illness *(98)*. Research conducted by Bradford et al. *(28)* demonstrates the ease with which transferred organisms can grow on RTE foodstuffs held at ambient temperatures, thus increasing the potential risk of foodborne illness.

Observed food safety behaviors. Observation is a method of data collection that is used to understand complex behavioral situations more accurately *(27, 108)*. The direct observation of human and animal behavior is believed by social scientists to be superior to other methods of data collection. This belief stems from the assumption that data gathered through the direct observation of actions reflect those behaviors directly rather than through an intermediary means such as a questionnaire *(155)*. It is difficult to directly compare observational results from different studies because data were collected and recorded by different methods, which may result in differences in findings. Nevertheless, an overall picture of consumers' actual food safety behaviors during food preparation in the domestic environment can be deduced, and areas in which unsafe handling actions require improvement can be identified.

Repeatability and reproducibility of consumer food preparation behaviors. To date, most of the information detailing actual consumer food safety behaviors has been based on the preparation of single meals. However, the consistency of consumer food safety practices has been determined in research carried out in South Wales *(75, 77, 131)*. Consumer food safety behaviors were allocated risk scores according to the frequency and implementation of unsafe practices. The results of this research showed that there were no significant differences ($P < 0.05$) between mean risk scores for repeated food preparation sessions involving the same meal, indicating that consumer food safety behaviors can be habitual *(75, 131, 135)*. Study results show that the food safety behaviors of some consumers are more consistent than those of others. Repeated meal preparation sessions presented as much overall food safety risk (from all observed food safety behaviors) as the initial food preparation sessions. The reproducibility of the generic behaviors observed in different meal preparation sessions showed that it was probable that procedures such as hand washing and drying would be implemented from one meal to the next. However, heating efficacy varied considerably between meals, possibly because of the use of different cooking methods *(75, 131)*.

Observed hand-washing and -drying behaviors. The role of hands in the transmission of disease is well established *(48)*, and the transmission of pathogens via contaminated hands is considered to be a major route of infection in cases of food poisoning. Hand washing (scrubbing and rinsing with soap and water) and hand drying have been shown to effectively remove contaminating microorganisms from hands and to reduce the spread of foodborne illness *(79, 114)*. Hand-washing practices were observed in all of the reviewed observational studies carried out in the United Kingdom, the United States, and Australia, and all of the results of these studies suggest that hand-washing practices are in need of improvement. The hand-drying process is considered to be of critical importance in maximizing the reduction of transient and resident bacteria *(79, 115)*. Research carried out in the United Kingdom has examined hand drying when determining consumer behavior with regard to the desirable decontamination of hands.

The results of observational studies (Table 15) show that consumers in Australia and the United States demonstrated better hand-washing practices than did consumers in the United Kingdom. This finding may be due to the fact that different aspects of hand washing and drying were recorded in different studies. In Australian and U.S. studies, the rinsing of hands and the use of soap were considered, whereas drying practices were included as part of the process for the adequate decontamination of hands in UK studies.

Griffith et al. *(74)* found that during 92 meal preparation sessions, adequate hand-washing and -drying procedures were required on 339 occasions. Attempts were made to decontaminate hands (or remove residue from hands) on 50% of these occasions, and 44% of these attempts consisted of rinses only. Adequate hand washing was only implemented on 6% of these occasions after handling raw meat or poultry *(74)*.

The data presented in Table 15 show comparable results for hand-washing and -drying practices observed in consumers' homes and those observed in a model domestic environment. In the model domestic kitchen, consumers from different target groups (60- to 75-year-old people, mothers with young children, and single young men) all failed to implement adequate hand-washing and -drying practices *(138)*. Another study showed that 100% of 60- to 75-year-old women failed to wash and dry their hands immediately and adequately on at least one occasion after handling raw chicken, and 28% failed to do so on more than six occasions *(134)*.

It was found in a recent study that 34% of whole-chicken packaging is contaminated with *Campylobacter* and 11% is contaminated with *Salmonella (81)*. Observations indicated that 66 to 83% of UK consumers failed to wash and dry their hands immediately and adequately after touching raw meat and poultry packaging, giving rise to a potential

TABLE 14. *Continued*

Food safety issue	Respondents' self-reported practices with regard to food safety issues in: UK and European surveys	U.S. surveys	Australian and New Zealand surveys
Hand washing (cont)			
Unsafe practices	26% of men and 17% of women said they did not always wash their hands before preparing food *(58)* (UK survey)	20% did not wash their hands with soap after handling raw meat or chicken *(177)* 19% reported not routinely washing their hands with soap after handling raw meat or chicken *(9)* 44% consistently forgot to wash their hands properly before meal preparation *(10)*	No data available
Cross-contamination			
Safe practices	59–76% always or usually used separate utensils and chopping boards for preparation of raw meat and cooked food *(46, 57, 59)* (two UK surveys, one European survey) 80% always used different utensils or wash utensils with raw and RTE foods *(75)* (UK survey)	67% stated that they washed or changed cutting boards after cutting up raw meat or poultry *(8)* 85–93% always washed the chopping board after cutting raw chicken *(124, 151)* 77–80% said they never used the same plate for raw and cooked meat *(11, 30)* 83% washed cutting boards used for cutting meat or poultry with soap and/or bleach before using the cutting board again *(55)*	No data available
Unsafe practices	30–56% used same chopping board for uncooked meat and for cooked meats *(21, 153, 175)* (UK surveys) 76% did not prepare raw and cooked foods in separate areas of the kitchen *(175)* (UK surveys) 41% were unlikely to wash utensils and chopping boards between preparation of raw food and cooked meat *(59)* (European survey)	51% said a surface used to cut uncooked meat and poultry would be also used to cut cooked meat *(7)* ~25% said they would use the cutting board after cutting raw meat or chicken without cleaning it *(97)* 19–20% reported not washing the cutting board with soap or bleach after using it to cut raw meat or chicken *(9, 177)* 10% always or sometimes used the same plate for raw and cooked meat or did not wash the plate before using it for cooked meat *(30)*	66–71% used the same chopping board or knife for raw meats and other foods *(117)* (New Zealand survey) 30% would perform an unsafe cross-contamination action when preparing raw meat and salad vegetables *(88)* (Australian survey)

risk of cross-contamination during domestic food preparation *(75, 131)*.

Observed actions presenting a risk of cross-contamination during the preparation of raw and cooked foods. Direct and indirect cross-contamination behaviors were observed during meal preparation sessions in studies conducted in the United Kingdom, the United States, and Australia. These observations indicated a substantial potential risk of the transfer of pathogenic bacteria from raw meat and poultry to RTE foods and kitchen surfaces, which could result in foodborne illness. Indeed, observational studies have revealed that direct and indirect cross-contamination behaviors were exhibited in the majority of consumer meal preparation sessions (see Table 15). In a UK study, unsafe food-handling practices were compared with actual pathogenic contamination of food products and kitchen surfaces. It was found that 17% of homemade chicken salads prepared in a model domestic environment tested positive for *Campylobacter (138)*. All such salads had become contaminated by observed indirect contamination

TABLE 16. *Intrastudy comparisons of knowledge and self-reported practices for U.S. studies*

Sample size	Food safety issue	Respondents' knowledge of food safety issue	Respondents' self-reported practices with regard to food safety issue	Reference
1,620 adults	Hand washing	86% knew that hand washing reduced the risk of food poisoning	66% reported washing their hands after handling raw meat and poultry	*8*
	Cross-contamination	80% knew that serving steak on a plate that had held raw steak increased the risk of food poisoning	67% reported cleaning a cutting board after contact with raw meat or poultry	
	Heating adequacy	67% knew that cooking meat well reduced the risk of food poisoning	71% reported serving adequately cooked hamburgers at home	
426 adults	Cross-contamination from raw to cooked foods	88% demonstrated knowledge of cross-contamination from raw to cooked foods	75% reported implementing practices to prevent cross-contamination	*7*
	Improper cooling, leaving cooked foods at room temperature	81% demonstrated knowledge of adequate cooling principles	46% reported implementing adequate cooling procedures	
	Cooking	61% demonstrated knowledge of adequate cooking	97% reported cooking foods adequately	

during the preparation of a *Campylobacter*-positive chicken piece and RTE salad vegetables *(138)*.

The preparation of raw and cooked food in the same work area of a kitchen could increase the risk of cross-contamination during food preparation. Observational study results have shown that 80 to 90% of consumers failed to use separate parts of the kitchen for the preparation of raw and cooked foods *(14, 75, 175)*.

Significant risk potential has been attributed to the failure to use separate utensils (namely, knives and chopping boards) for the preparation of raw chicken and RTE foods. Real-time microbiological analysis of food preparation practices has shown that 81% (a probability of 9 of 11) of salad vegetables prepared with an unwashed or inadequately washed and dried chopping board and/or knife previously used for raw chicken were contaminated with *Campylobacter* and/or *Salmonella* from the raw chicken *(139)*. Many of the observational studies reviewed here have reported consumer use of utensils during the preparation of raw meat and poultry and RTE foods (Table 15). Observational study results have indicated that 66 to 75% of consumers appear to wash and dry chopping boards or use separate chopping boards for raw chicken and RTE foods, whereas 23 to 61% appear to wash and dry knives or use different knives *(75, 131)*. Other observational studies have revealed that more than half of UK consumers fail to use separate or adequately washed and dried utensils between the preparation of raw foods and the preparation of RTE foods *(76, 131)*. Although substantial numbers of consumers fail to implement safe practices, some observational study results have indicated that attempts to use adequately cleaned or separate utensils to prepare raw chicken and RTE foods are made. Redmond et al. *(138)* found that although 64% consumers failed to wash and dry chopping boards or use separate chopping boards for at least one RTE food after the preparation of raw chicken, fewer consumers (36%) failed to do so during the preparation of four different RTE foods. Sixty-four percent of the consumers failed

TABLE 17. *Intrastudy comparisons of knowledge and observed behavior for U.S. studies*

Sample size	Food safety issue	Participants' knowledge of food safety issue	Participants' observed food safety behavior	Reference
121 households	Hand washing	79% correctly identified instances in which hand washing was necessary during food preparation	20% were observed to neglect hand washing practices	*16*
100 consumers	Cross-contamination	97% rated the consumption of lettuce moistened by raw poultry dripping as a "risky" food-handling behavior	98% cross-contaminated RTE foods with raw meat or raw egg during food preparation	*14*
121 households	Cooking	7% indicated knowledge regarding heating foods to an adequate temperature	81% were observed to cook their foods to proper temperatures	*16*

TABLE 20. *Results of a UK study (76) on knowledge, attitudes, intentions, self-reported practices, and actual food safety behaviors with regard to generic food handling practices*[a]

Food safety issue	Knowledge (%)[b]	Attitude (%)[c]	Intention (%)[d]	Self-reported practice (%)[e]	Actual behavior (%)[f]
Hand washing after handling of raw foods	100	100	85	75	0
Hand washing before handling of RTE foods	100	55	55	45	0
Use of different or washed utensils for raw and RTE foods	100	80	80	80	48

[a] The study involved 40 consumers.
[b] Percentage of questions answered correctly by participants.
[c] Percentage of participants considering behavior "extremely important."
[d] Percentage of participants indicating that implementation of appropriate procedure is "very likely" the next time food is prepared.
[e] Percentage of participants reporting "always" implementing procedure.
[f] Percentage of participants performing procedure adequately at all times during observed food preparation.

actual behavior *(15–17, 87)*. In addition, the correspondence between attitudes about specific actions and actual observed behaviors has also been evaluated *(74, 131)*. The following discussion presents comparable findings determined within consumer food safety studies (intrastudy comparisons) and between different studies (interstudy comparisons).

Intrastudy comparison of knowledge and self-reported practices. Analysis of results indicate that consumer food safety knowledge fail to correlate with self-reported safe home food preparation practices *(7, 8, 168)*. The principal findings are presented in Table 16. Albrecht *(7)* found that a number of respondents knew about the concepts of proper food handling but did not report putting those concepts into practice. In Altekruse et al.'s *(8)* study, 20 to 27% of consumers demonstrated that they knew of safe food-handling behaviors to reduce the risk of food poisoning but did not report the implementation of the corresponding safe practices. Such disparities were not observed for the adequate cooking of meat and poultry. More consumers reported to serve adequately cooked meat than knew that adequate cooking of meat reduces the risk of food poisoning *(8)*. Overall, surveys examining knowledge and self-reported practice have found that a respondent who knows a term or concept will not always use the corresponding safe home food preparation procedure *(168)*.

Intrastudy comparison of knowledge and observed behaviors. Assessments of knowledge and actual behavior have featured in several U.S. studies *(14, 17)* and in an Australian study *(87)* (Table 17). On the basis of research conducted in the United States, it was concluded that knowledge does not correlate with actual food-handling practices *(17)*. For example, although nearly all U.S. consumers rated the consumption of lettuce moistened with raw poultry drippings as a "risky" food-handling behavior, observations of food preparation practices showed that 98% of the same consumers cross-contaminate RTE foods with raw meat and raw egg *(14)*. Nevertheless, a lack of knowledge does not mean that the use of an unsafe practice is imminent. For example, although only 7% of consumers knew the temperatures required for the adequate cooking of foods, >80% of consumers were observed to cook their foods to proper temperatures *(17)*. Australian data also reveals significant variance between stated answers (given on a questionnaire) and observed (via video monitoring) food-handling and hygiene practices *(87)*. Nineteen percent of households claimed to have soap available in the kitchen but did not, and contrary to participant statements, almost half of the surveyed households did not use a detergent or cleaner for cleaning kitchen surfaces *(87)*. Because of such discrepancies between knowledge and actual behavior, researchers have concluded that knowledge is a poor indicator of actual behavior, and when it comes to food safety, it is difficult to measure what the general population does by what they know *(17)*.

Intrastudy comparison of attitudes and observed behaviors. Very few studies have investigated the correspondence between consumer attitudes about food-handling practices and observed behaviors (Table 18). In a study conducted in South Wales, it was found that 79% of consumers perceive that are unlikely to get food poisoning in their homes. However, observations of the same consumers' food preparation practices indicated that no participant implemented all of the high-risk food safety behaviors necessary to prevent the cross-contamination of pathogens from raw chicken during the food preparation process *(132)*. Results like these suggest that positive attitudes toward food safety concepts do not correspond with safe food-handling practices.

Intrastudy comparison of self-reported practice and observed behavior. The correspondence between self-reported practices and actual observed behavior was researched by Anderson et al. *(14)*. The results of their study show that the proportions of consumers reporting the implementation of safe food-handling procedures was substantially larger than the proportions of consumers who actually performed these procedures (Table 19). For example, although nearly all respondents reported that they washed their hands before they prepared food, less than half actually did so, indicating that self-reports of food safety practices are not always a reliable indicator of actual behavior.

TABLE 21. *Continued*

Food safety issue	Participants' knowledge	Participants' attitudes	Participants' intentions	Participants' self-reported practices	Participants' actual observed behaviors
Cross-contamination	78% knew that failure to wash a cutting board after the preparation of raw meats and then cutting raw vegetables could result in food poisoning *(10)* 64–77% knew that it was very important to use separate chopping boards for raw meat and other foods *(102, 164)* 97% knew that it was unsafe to use the same unwashed knife or chopping board to cut uncooked chicken and prepare a salad *(25)*	90% believed that the use of different utensils or washed utensils for the preparation of raw and RTE foods was very likely to prevent food poisoning *(76)* 90% agreed that it was better to use different chopping boards for the preparation of raw and cooked meats *(131)* 91% agreed that contact between raw and cooked food could cause food poisoning *(110)*	80% indicated that they were extremely likely to use separate utensils or washed utensils for raw and RTE foods the next time they prepared food *(76)* 60% would wash a work surface between the handling of a raw turkey and the handling of a cooked turkey *(169)*	59–76% always or usually used separate utensils and chopping boards for the preparation of raw meat and cooked food *(46, 57, 59)* 65–85% indicated that they washed or changed cutting boards or plates for cutting up raw meat or poultry and RTE foods *(8, 76, 124)*	52–75% failed to wash and dry chopping boards and knives for the preparation of raw chicken and ingredients *(75, 76, 138)* 83–90% did not use separate areas of the kitchen for raw and RTE foods *(14, 75, 175)*

Intrastudy comparison of knowledge, attitudes, intentions, self-reported practices, and actual behaviors. Findings obtained in South Wales concur with U.S. and Australian data on discrepancies between knowledge, self-reported practices, and actual behaviors (Table 20). Griffith et al. *(76)* investigated knowledge, attitudes, intentions, self-reported practices, and actual behaviors with regard to hand-washing and cross-contamination actions. Observations of hand washing after handling raw food and before handling RTE foods showed that despite having the knowledge of, a positive attitude toward, and the intention to perform adequate hand-washing procedures, no participants were observed to wash their hands adequately at any time before RTE food was handled or after handling raw food. Actual hand-washing behavior did not appear to be influenced by attitudes toward each food safety action, as 100% of consumers thought hand washing after handling raw foods was "extremely important" and 55% thought hand washing before handling RTE foods was "extremely important"; however, neither practice was implemented adequately during the food preparation process.

A noticeable discrepancy between cognitive components and actual behavior like that observed with regard to hand washing was also observed with regard to use of different or washed utensils for the preparation of raw and RTE foods. As with hand washing, knowledge of measures for the prevention of cross-contamination during the preparation of raw and RTE foods was demonstrated by consumers, and positive attitudes toward the relevant behaviors were held. Consumers indicated an intention to carry out the required behaviors the next time they prepared food and just over half of the study participants reported that they always cleaned surfaces between the preparation of raw foods and the preparation of RTE foods. A larger proportion of the study participants reported that they always used different or washed utensils for the preparation of raw and RTE foods. However, smaller proportions of consumers were observed to actually implement appropriate practices such as using different or washed utensils for the preparation of raw and RTE foods and adequately cleaning surfaces between the preparation of raw foods and the preparation of RTE foods.

Interstudy comparison of knowledge, attitudes, intentions, self-reported practices, and actual behaviors. A comparison of knowledge, attitudes, behavioral intentions, self-reported practices, and observed food safety behaviors with regard to some generic food-handling practices from international studies is presented in Table 21. A comparison of data from all of the reviewed consumer food safety studies reveals that large proportions (82 to 100%) of consumers reported knowing that hand washing is an important action before and after handling food and that implementation of hand washing decreases the risk of food poisoning. Results from these studies also suggest that consumers know when and how to wash their hands properly. The majority of consumers also believed that the implementation of an adequate hand-washing procedure would help to prevent food poisoning, although smaller propor-

8. Knowledge of food safety concepts does not generally correspond to self-reported practices for most food safety behaviors. For example, although 86% of consumers indicated that they knew that the implementation of adequate hand-washing procedures can reduce the risk of food poisoning, only 66% of consumers reported actually implementing such procedures.
9. A consumer's intention to perform a food safety procedure does not always result in the implementation of that procedure. For example, although 85% of consumers indicated that they intended to wash their hands after handling raw foods, no consumers were observed to do so.
10. Consumers demonstrated judgments of optimistic bias, perceiving themselves to be less at risk from foodborne disease than others and continuing to consume unsafe foods despite knowing the potential consequences of this behavior.
11. Positive attitudes about reducing the risk of foodborne disease associated with specific food-handling practices did not necessarily result in the implementation of the corresponding food safety practices.
12. Self-reported practices did not correspond to observed food safety behaviors, indicating that when food safety concepts are known, survey data may be subject to social desirability bias. Moreover, inaccurate perceptions of what constitutes "adequate practices" are widespread. For example, consumers may consider rinsing under running water "adequate hand-washing/drying" *(75)*; thus, survey responses may reflect inaccurate information about self-reported practices.
13. Comparisons of self-reported practices, knowledge, attitudes, intentions, and actual observed behaviors indicate that actual consumer food-handling behaviors may be represented more accurately by data obtained through observation than by data obtained through intermediary means.

One of the most notable conclusions extrapolated in this review is that consumer knowledge, attitudes, intentions, and self-reported practices determined by intermediary means such as interviews and questionnaires do not correspond well with actual observed behaviors. Nevertheless, the determination of consumer knowledge, attitudes, intentions, and self-reported practices with regard to food safety has provided information that can be used to facilitate the understanding of why consumers implement some food safety behaviors and not others. Although the measurement of such variables may aid in the evaluation of food safety education initiatives and provide health professionals with baseline data for use in the development of food safety interventions, direct observation of actual behaviors is thought to provide more accurate data on consumer implementation of safe food-handling practices. In UK research, direct observation was used to evaluate a community food safety education initiative that had been developed on the basis of the social marketing approach. Research results show that the observation of consumers' food preparation practices provides a reliable measure of the effectiveness of intervention material through the assessment of actual behavioral change *(134)*.

Food safety concepts that were not extensively represented in the reviewed studies include the component actions of hand washing and drying, cooling principles, and the correct storage procedures for cooked foods prepared in advance of consumption. Observational study results suggest that the procedures associated with these concepts are inadequately performed, and research is required to determine why this is so and to determine the extent of the use of unsafe practices. Such information may aid in the development of effective targeted food safety education programs to improve consumer understanding and implementation of specific food safety practices.

Content analysis of the reviewed consumer food safety surveys indicated that the psychological determinants of safe food-handling behaviors, such as attitudes and intentions, have not been studied extensively. A more complete understanding of why certain food safety practices are implemented and others are not may aid in the development of future food safety education initiatives.

Although many surveys have presented data indicating that large proportions of consumers possess adequate food safety knowledge, this review has determined that substantial proportions of populations in Europe, North America, Australia, and New Zealand appear to lack knowledge of key safe food-handling behaviors. Therefore, consumers may not even be aware that they are implementing unsafe practices. Although perceptions of the risk of foodborne disease appear to be generally accurate, a considerable number of consumers have demonstrated optimistic bias, which may impede attempts to improve food-handling practices through education. Even though majorities of consumers report practicing safe food-handling behaviors, substantial numbers of consumers report practicing unsafe behaviors. Such responses may indicate a lack of awareness of the risks arising from the use of unsafe food preparation practices, which constitutes substantial cause for concern. Observational study results have shown that despite nationwide food safety education attempts, unsafe food-handling practices are still frequently used during the preparation of food in the domestic environment. An increase in the frequency of the failure to implement safe food-handling procedures results in an increase in the potential risk of illness from food poisoning. The majority of unsafe food hygiene practices observed in the studies reviewed here were associated with cross-contamination; therefore, there is a need to minimize behaviors conducive to cross-contamination during the preparation of food. Educational efforts are required in order to reduce the risk of foodborne disease and improve consumers' food-handling behaviors in the domestic environment.

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APPENDIX 1.2

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A comparison and evaluation of research methods used in consumer food safety studies

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Abstract

Worldwide incidence of food-borne disease has increased in recent years and data suggest that inadequate food-handling behaviour in the domestic environment may be an important factor. As a consequence of this, research into aspects of consumer food safety has been undertaken, especially in the UK and USA. The overall aims of conducting such research have been to investigate aspects of consumer food safety behaviour and to utilize information in the development of effective food safety education initiatives. In the past 25 years, 87 consumer food safety studies have been undertaken using different research methodologies; 75% utilized survey techniques (questionnaires and interviews), 17% were based on direct observation, and 8% utilized focus groups. The advantages and disadvantages of the different research methods used are discussed. Similarly, different forms of reliability and validity have been considered in the context of each research method used. A comparison of results from consumer food safety studies has shown that use of different research designs and approaches has resulted in differences in the findings about consumer food safety behaviour. Survey responses have provided a more optimistic portrayal of consumer food safety behaviour than data obtained from focus groups and direct observation. Although consumers have demonstrated knowledge, positive attitudes and intentions to implement safe practices, substantially larger proportions of consumers have been observed to implement frequent malpractices. This suggests that observational data provide the most reliable information denoting consumers' actual food safety behaviour and should be used preferentially with risk-based data for the design of communication strategies.

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Introduction

Each year, millions of people world-wide suffer from food-borne disease,[1] and illness resulting from consumption of contaminated food has become one of the most widespread public health problems in the contemporary world.[2] It has been estimated that between more than 1 in 10 and 1 in 12 people suffer from food-borne disease in the UK and USA each year.[3] The vast majority of food-borne disease cases in the UK are thought to be sporadic, with the domestic kitchen as a significant point of origin of many of these cases.

The prevention of food-borne disease involves co-operation of all stages of the food chain[4,5] and no one stage has sole blame or responsibility,[6] although the consumer has been described as the 'final line of defence'.[7] Multiple food safety skills are required by the consumer, with responsibilities extending from purchasing and receiving food products to processing and providing foods for themselves and for others.[8] Implementation of proper food-handling practices can prevent cases of food-borne disease,[9] and how consumers prepare food in the kitchen affects the risk of pathogen multiplication, cross contamination to other products, and pathogen destruction by thorough cooking procedures.

The acknowledgement of the importance of adequate consumer food-handling practices has recently been widely recognized.[10–13] Although information is available about manufacturing, processing and distribution processes in the food industry, the consumer remains the least studied link in the food chain. Information available about the consumer has been considered to be largely anecdotal.[14] A considerable amount of food preparation and handling occurs in the domestic environment, so research and consumer education regarding the risk of food safety malpractices is an essential element of preventing food-borne disease.[15]

Information relating to domestic food-handling practices comes from two main sources: analysis of food poisoning outbreaks and consumer-based research studies.[16] Epidemiological studies of outbreaks have provided a considerable amount of quantitative data regarding contributory food-handling malpractices. The accuracy and availability of data is limited owing to recall difficulties of exact food consumption details and handling practices that may have been implemented some time before illness is reported. Retrospective analysis of such incidents of food-borne illness provides limited information about consumer food safety behaviour. Internationally, numerous consumer based research studies have attempted to evaluate aspects of consumers' food safety practices, with different strategies adopted for data collection, including questionnaire and interview surveys, focus group discussions and observation studies.

The purpose of conducting consumer food safety studies has been to ascertain how consumers handle food in their homes, determine what consumers know about food safety, and why some safe food-handling practices are implemented and others are not. The overall aims of the majority of studies that have been undertaken have been to provide information for the development of effective communication strategies to promote safe food-handling practices.[17–23]

Measurement of consumer knowledge, attitudes and behaviour can provide a basis for planning health promotion programmes.[24] Foster and Kaferstein[25] have stated that only when existing attitudes and practices regarding food safety are known is it possible to plan effective strategies to encourage and strengthen desirable behaviours and discourage unsuitable ones. Adoption of social cognition models to health-related issues has enabled the relationship between attitudes, beliefs and behaviour in relation to behavioural change to be identified.[26]

This paper aims to evaluate information obtained about consumer food safety behaviour according to research methods implemented for data collection. The advantages and disadvantages of different approaches used will be discussed in light of the reliability and validity of research methodology. Similarities and disparities between knowledge, attitudes, intentions, self-reported practices and specific food-handling actions in domestic food preparation will be identified according to the research method used with subsequent implications. Findings will be discussed in the context of the potential microbiological risks attributed to specific food-handling errors.

Methods

An extensive search of previous literature was conducted to locate published and unpublished consumer food safety studies. Electronic searches of computerized library databases and screening of reference lists from relevant research papers and reports facilitated the identification of many published studies. Internet browsers were utilized to search the World Wide Web and many unpublished international studies were obtained using the 'Foodsafe' listserv. Attendance at international food-safety-related conferences and personal communication with experts in the field also resulted in the acquisition of the results of several unpublished studies.

Inclusion and exclusion criteria for reviewed consumer food safety studies

Studies included in the discussion evaluated consumers' knowledge, attitudes, beliefs and intentions, self-reported practices and actual hygiene behaviours relating specifically to food preparation in the domestic kitchen. Only studies that were an assessment of individual consumers and targeted consumer groups were included for review. Persons classed as consumers included anyone who prepared food on a regular basis but who was not a professional food handler.

Research has shown that actual observed food preparation behaviours of trained food handlers may be better than that of consumers[27] and, therefore, results of studies concerning trained persons from the food industry were excluded as they could bias common findings and conclusions within the review. Additional studies that were excluded were those predominantly based on risk perceptions of other aspects of food safety such as pesticide residues or bovine spongiform encephalopathy (BSE).

Results and discussion

Research methods used for food safety studies

A variety of methods of data collection has been used for the evaluation of domestic food safety behaviour. The use of different research methods to assess consumer food safety in terms of knowledge, attitudes, self-reported practice and actual behaviour can be compared to provide a more complete representation of why consumers implement or fail to implement certain food-handling behaviours and not others. Information collected from different individual sources, using different survey designs and approaches, may provide incomplete or inconsistent data. Differences in study design and methodology have been thought to explain differences between prevalence estimates of high-risk food-handling and consumption behaviours between research studies.[28]

The majority of social research approaches for data collection can be categorized as qualitative (ethnographic) or quantitative (positivism) methods. Fundamental distinctions between the two approaches are emphasized by methods of analysis and interpretation of data; one method deals with numbers, whereas the other is concerned with words.[29] Quantitative techniques include questionnaire and structured interview methodologies, and are appropriate when the issue is known about, relatively simple and unambiguous, and amenable to valid and reliable measurement.[30] Such methods generate data that can be presented numerically and which can be subject to statistical analysis.[31] Qualitative research utilizes unstructured interviewing and focus group techniques as a means of data collection. Overall aims of this type of research are generally to study people in the natural social settings and are essential for exploring new topics and obtaining an insight into complex issues.[30] However, such techniques produce data that are not so readily open to statistical interpretation.[31] Observation of psychomotor activities can be recorded using qualitative and quantitative methods, the choice of which is largely dependent upon required outcomes.

Research methods used for collection of consumer food safety data include self-completion questionnaires, interviews (collectively known as surveys), focus groups and observation studies. Data shown in Table 1 denote the proportions of studies completed according to research methodology. Use of interviews was found to be the most common method for obtaining information on consumer food safety, accounting for 48% of studies, followed by self-completion questionnaires that accounted for 27% of studies. Research using focus groups accounted for 8% of studies and use of the direct observation technique accounted for 17% of studies.

Table 1 Methods of data collection used in consumer food safety studies ($n = 87$ studies)

Method of data collection	Frequency of use n (% of total studies)	Frequency of use n (% of total studies)
Self completion questionnaires		23 (27%)
Postal	9 (10%)	
Self administered	12 (14%)	
Online	2 (2%)	
Interviews		42 (48%)
Telephone	18 (21%)	
Face to face	24 (28%)	
Focus groups		7 (8%)
Observational studies		15 (17%)

Adapted from Redmond and Griffith.[32]

Data presented in Table 2 indicate that the majority of studies using the interview technique and self-completion questionnaires have been undertaken in USA (46%) and UK (42%), and most of the data collected using observation of consumer food safety behaviours have been from the UK. Additional observational studies have been carried out in USA and Australia. Focus groups studies used in the present discussion were conducted in the UK (England and Wales) and USA.

Sample size of all consumer food safety studies

The issues of sample size and sampling are crucial to the external validity of results obtained from all research methods. External validity relates to the generalizations of research results to the wider population of interest[30] (see Table 5). Determination of the sample size is largely determined by theoretical sampling

Table 2 Origin of studies using different research methodologies

Location	Self-completed questionnaires *n* (% of total study type)	Interviews *n* (% of total study type)	Focus groups *n* (% of total study type)	Observation *n* (% of total study type)
UK and Northern Ireland	9 (39%)	18 (43%)	4 (57%)	10 (67%)
USA	11 (48%)	19 (45%)	3 (43%)	4 (27%)
Canada	0 (0%)	1 (2%)	0 (0%)	0 (0%)
Southern Ireland	0 (0%)	1 (2%)	0 (0%)	0 (0%)
Italy	1 (4%)	0 (0%)	0 (0%)	0 (0%)
Australia	0 (0%)	1 (2%)	0 (0%)	1 (6%)
New Zealand	2 (9%)	2 (5%)	0 (0%)	0 (0%)
Total	23 (100%)	42 (100%)	7 (100%)	15 (100%)

Table 3 Survey sizes of consumer food safety studies for different research methods used

	Total no. of consumers assessed per study type (n^1)	Total numbers of studies reviewed (n^2)	Mean no. of consumers assessed per study type ($n^1 + n^2$)
Telephone interviews	13 298 839	19	699 939
Face-to-face interviews	43 413	24	1 809
On-line questionnaires	2 807	2	1 404
Postal questionnaires	4 559	9	507
Self-administered questionnaires	2 540	12	212
Observation studies	1 244	15	83
Focus groups[a]	472–590	27 (53 groups)	67–84 (~8 groups)

[a]Assuming that between 8 and 10 respondents attend each focus group.[35]

requirements and practical limitations such as time and cost.[33] It is considered to be easier to produce biased results when using a small sample, however, use of large samples may obscure weak design methods and participant variables.[34] Sample sizes used for consumer food safety studies ranged from 40 to 13 221 077 respondents (see Table 3). Analysis of the size of consumer food safety studies has shown that the largest number of consumers reached was by means of telephone interviews obtaining responses from 100 to 13 221 007 respondents. Use of face-to-face interviews was conducted using between 84 and 10 172 consumers, postal questionnaires between 82–869 consumers, and self-administered questionnaires between 62 and 824 consumers. Studies using focus groups and observation were based on fewer consumers than surveys.

Credibility of research findings

Reducing the possibility of obtaining inaccurate research findings requires attention to be given to two particular emphases on research design: reliability and validity. Reliability has been defined as 'the degree to which measurements are consistent' and validity has been defined as 'the extent to which the procedure measures what it is intended to measure'.[36] Adequate reliability is considered to be a precondition to validity,[37] and is required to give researchers confidence in data and prevent collection of worthless and misleading data. Several parameters of reliability may need to be assessed to judge the overall reliability of a research instrument. Such parameters are defined in Table 4. For research to be considered valid, it must be based on fact

Table 4 Forms of reliability required during implementation of different research methods used to collect information about consumer food safety

			Requirements for different research methods			
Reliability parameters	Meanings	Example of implementation	Questionnaires	Interviews	Focus groups	Observation
Test-retest reliability	Determination of consistency of responses to a scale when a sampled population is tested once and then again some time later.[30,34]	Administration of a survey to the same population on two occasions or repetition of observed food preparations by the same participants over a short period of time.	✓	✓	✗	✓
Internal consistency	Assessment of the consistency of results across items within a test.[38]	Use of Cronbachs alpha or split half for analysis of a food safety survey to ensure that responses are consistent.	✓	✓	✗	✗
Inter-observer reliability	Determination of the extent to which the results obtained by two or more observers/ interviewers agree for similar or same populations.[30]	Observation of a videoed food preparation session by more than one observer – comparison of results.	✗	✓	✗	✓
Intra-observer reliability	Measurement of a variation which occurs within an observer as a result of multiple exposures to the same stimulus.[39]	Observation of a videoed food preparation session on more than one occasion by the same observer – comparison of results.	✗	✗	✗	✓
Parallel-forms or alternate forms of reliability	Assessment of the consistency of two tests constructed in the same way from the same domain.[38]	Obtaining observational data detailing consumer food-handling practices using direct observation and video recordings on separate occasions.	✓	✓	✓	✓
Repeatability.	Refers to the stability of results from a measuring instrument (e.g. survey, observational checklist) on d different occasions.[34]	Recording of the same observed behaviours on a predetermined checklist or the same psychological responses on a survey on more than one occasion – followed by a comparison of results.	✓	✓	✗	✓

or evidence.[40] Measurement of a variety of forms of validity is described in Table 5. Different forms of reliability and validity will be discussed in the context of each research method used for collection of data about consumer food safety.

Data collection using survey techniques

For the purposes of collecting information about consumer food safety, interviews and questionnaires have been the predominant methods of data collection, accounting for 65 (75%) of the studies analysed. Social surveys involve a quantitative method of collecting information from a population sample, usually by personal interviews or by self-completion questionnaires. Although providing valuable information, questionnaire and interview data is largely reliant upon self-reported practices and consumer knowledge. Discrepancies between self-reported practices and actual food-handling behaviours have been reported previously.[11,42–44] Studies using questionnaires and interviews for assessing hygiene behaviours have found evidence of a tendency for over-reporting of behaviours perceived to be 'good'.[42,44,45] In light of such findings the traditional household questionnaire used alone for assessment of hygiene behaviours has been considered to be limited in its efficacy, scope and accuracy.[42] A limitation regarding data obtained from surveys includes the ability to make generalizations about specific food safety practices. For example, although surveys have shown that large proportions of consumers have reported to cook food effectively, different cooking methods have been shown to influence heating efficacy.[19] This suggests that surveys should investigate knowledge, attitudes and self-reported practices of specific cooking methods needed to achieve safe cooking temperatures for different foods, as opposed to generic practices.

Forms of reliability and validity required for the development and implementation of surveys are determined in Tables 4 and 5. Most types of reliability can be applied to consumer food safety survey techniques. Consideration of all types of validity stated in Table 5 are required when carrying out consumer food safety surveys to ensure the measurement tool (the questionnaire or interview schedule) measures what it intends to measure.[46] For example, if information regarding consumer knowledge of hand-washing and hand-drying practices is sought, validity must be assessed to ensure that information regarding a related variable is not being measured instead.

Questionnaires

Self-completion questionnaires were used to obtain information on consumer food safety for 27% of surveys reviewed. This method of data collection allows the ability for unambiguous quantitative data to be collected,[30] and there is a requirement for the format to be kept relatively simple and straightforward owing to little control over respondents' interpretation of questions.[47]

The most common methods for distribution of self-completion consumer food safety questionnaires are postal and self-administration. Postal questionnaires accounted for the 36% of the questionnaires distributed. Sending questionnaires through the post allows respondents from wide geographical areas be reached at relatively low cost. However, use of this method does not allow adequate control over external influences and verification of who actually completes the questionnaire. Response rates for postal questionnaires tend to be low,[37] for example, the response rate for a postal questionnaire administered in USA was 43%.[17] Self-administered questionnaires accounted for 48% of consumer food safety questionnaires studied. Although time consuming, this method ensures a high response rate, accurate sampling and minimum interviewer bias.[37] Examples of questionnaires administered for completion during college lectures in USA[48] or in conjunction with other research projects in UK[19,49] have obtained ≈100% response rate. In recent years, the use of the Internet as a means for conducting self-complete surveys has increased in popularity. Although access to the Internet is increasing, not all households may have access to the web and this may therefore create sample biases.[50] Online surveys accounted for 9% of consumer food safety surveys reviewed.

Questionnaire data is known to be valuable in terms of identifying what people know[51] and perceive about food safety. Some consumer food safety studies have shown that questionnaires have also been used as a measurement tool for assessing the consistency of

Table 5 Forms of validity required during implementation of different research methods for collection of information on consumer food safety

Validity parameters	Meanings	Example of implementation	Requirements for different research methods: Questionnaires	Interviews	Focus groups	Observation
Internal validity	Good internal validity occurs when any differences of measurements observed between groups are attributed solely to the hypothesised effect under investigation.[41]	Ensure measurements are a good estimate of what they are expected o measure, e.g. inadequate food preparation practices are due to (eg) inadequate knowledge of correct practices rather than lack of equipment.	✓	✓	✓	✓
External validity	The extent that results can be generalised to populations, situations and conditions.[40]	If results of a study can be applied to a wider population then a study has external validity/good generalizability, eg. food-handling actions of targeted groups of consumers.	✓	✓	✓	✓
Face validity	The extent to which a method measures what it is intended to measure; acceptability of a format to a target group.[41]	Visually assess a food safety survey or observational checklist to ensure food safety issues are addressed.	✓	✓	✓	✓
Content validity	Evaluation of the content of a test to ensure that it is representative of the area which it is intended to cover.[34]	Visually assess a food safety survey or observational checklist that (for example) is determining efficacy of hand decontamination and ensure hand-washing and hand drying issues are addressed.	✓	✓	✓	✓
Criterion validity (includes concurrent and predictive validity and diagnostic validity)	Determination of the correlation of a scale with another measure of the trait under study, ideally, by a 'gold standard' which has been used and accepted in the field.[39]	Comparison of a newly devised food safety survey/observational checklist with older surveys/checklists known to have good criterion validity.	✓	✓	✓	✓
Construct validity (includes criterion-related, convergent, concurrent and discriminant validity)	Agreement with other tests in the way that is expected; used when a 'gold standard' is not available.[41]	Comparison of results from one study with another (for example) perceptions of hand-washing from a structured survey with focus groups findings of the same subject.	✓	✓	✓	✓
Precision validity/ responsiveness to change	The ability of an instrument to detect small changes in an attribute/ measurement of the association between the change in an observed score and the change in a true value of the construct.[30]	Capability for the improvement/ deterioration of (for example) a specific food safety attitude or behaviour to be detected using a survey or observational checklist.	✓	✓	✗	✓

responses between sampled populations over periods of time. For example, a survey undertaken in New Zealand[52] was a 'conceptual replication' of a previous study.[53] Results showed a high level of consistency between the two studies, suggesting that there was a testable, baseline level of food safety understanding in the community.[52]

Interviews
Use of face-to-face interviews for data collection accounted for the largest proportion (48%) of consumer food safety surveys under discussion. Out of these interviews, 16/24 (67%) were conducted in the respondent's own home, for example, interviews conducted in the UK in 1998 used 'in-home' interviewing methods.[54] Alternative locations for face-to-face interviews included in the street or sampling points, such as at specified supermarkets.[55] Of the interviews studied, 43% were telephone surveys, for example, an Australian survey conducted by Jay *et al.*[56] and an American survey conducted by Altekruse *et al.*[57] As with postal surveys, telephone interviewing is a convenient and relatively cheap method of data collection, and there is the additional advantage of speed.[44] Although response rates may be high (69–71%),[53,58] this method is more suitable for brief questionnaires. Large-scale telephone surveys have been used in the USA as a means of assessing the prevalence of behavioural risk factors in the population.[59]

'Types' of data collected using surveys
Quantitative surveys used for collection of consumer food safety information have aimed to measure general knowledge of food safety and hygiene,[48,55,60,61] understanding and awareness of specific food safety issues,[18,19,49,62–64] general attitudes towards aspects of food safety,[19,65,66] and self-reported practices of consumers.[17,23,60,67–69] Few surveys have used the constructs of psychological theories such as The Theory of Reasoned Action (TRA)[70] and The Theory of Planned Behaviour (TPB)[71] to attempt to understand the relationships between knowledge, attitudes, intention and behaviour of food safety practices.[49,72]

Determination of knowledge is relatively straightforward and information gained is usually an accurate description of what issue is sought. Before the implementation of some food safety education initiatives, it is necessary to determine the level of knowledge consumers possess regarding behaviours targeted by the initiative. Furthermore, determination of consumer knowledge has been used to evaluate effectiveness of health promotion initiatives.[73] Evaluation of consumer attitudes is considered to be central to understanding actual behaviours. Attitude determination has been used within psychological models such as TRA and TPB, which have attempted to predict behaviour. Although some researchers have found that attitudes can influence behaviour directly,[74] other workers have not found positive correlations within the attitude–behaviour relationship.[75] Attitudes are viewed as being central to health promotion[26] as they affect responses and potential effectiveness of initiatives. Intention has been identified as the most immediate determinant of behaviour.[76] Intentions are an integral part of a variety of social cognition models such as TRA and TPB and The Health Action Process Approach (HAPA).[77] Self-reported practices are personal accounts of actions, which may or may not reflect actual behaviours. Social scientists have suggested that a respondent may claim to carry out the perceived 'correct' behaviours opposed to behaviours perceived to be undesirable thereby providing a response to represent a positive image.[30] This concept is known as 'social desirability bias' and is reported to occur more frequently in questionnaires and telephone interviews than face-to-face interviews.[37] An evaluation of such data could result in misleading findings.[42]

Data collection using focus groups

The use of focus groups as a means for obtaining information on consumer food safety information is a relatively under-utilized research method, accounting for only 8% of food safety surveys reviewed (see Table 1). Focus groups are particularly effective for providing information about *why* people think or feel in the way that they do, and group interaction provides a greater insight into why certain opinions are held.[78,79] The qualitative procedures present a more natural environment for obtaining information than during an individual interview because participants influence and are influenced by others just as they are in real life.

Forms of validity and reliability required for implementation of effective focus groups can be seen in Tables 4 and 5. As for survey techniques, validity of the measurement tool (the discussion guide) is required to obtain valid information about the food safety subject under discussion. As focus groups are open, yet guided, group discussions of different groups of consumers, it may not be possible to assess precision validity and responsiveness to change.

A series of focus groups have been carried out in USA[80] to determine what limits consumer usage of thermometers when cooking meat and poultry products. Information gained from the discussion groups has been used to aid development of an effective consumer education campaign aimed at increasing consumer thermometer usage. In England, focus groups have been used to explore public attitudes towards food safety.[65,66] Results from such groups have been used to identify consumer expectations of the new Food Standards Agency and to help development of communications strategies in relation to current food safety concerns. Formative research undertaken in South Wales utilized focus group findings to determine perceptions of behavioural determinants, intervention types and general attitudes to food safety issues. Findings were used to develop two food safety social marketing initiatives, targeting specific food safety behaviours of older women aged 60–65 years[19,20] and mothers with young children.[81]

Data collection using observation

The observation technique is a method of data collection used for understanding complex behavioural situations more accurately.[30] Observation does not depend on second-hand reported accounts of behaviour from respondents who may have put their own interpretation on events[82] and, therefore, the direct observation of human and animal behaviour may be considered by social scientists to be superior to other methods of data collection. This belief stems from the assumption that data gathered through the direct observation of actions reflect those behaviours directly rather than through an intermediary means such as a questionnaire.[83] The majority of international consumer studies that have evaluated the safety of food preparation practices have, to date, largely been based on determination of consumer knowledge and self-reported practice rather than actually measuring observed performance of actual food-handling behaviour.

Use of the observational technique as a means for data collection includes the application of a variety of different approaches. Assessment of behaviour can be made by the 'participant' or 'non-participant' observer. A participant observer is to some extent part of the group of individuals under observation, whereas a non-participant observer observes from a distance and should have no effect on the actions being observed.[34] All of the observational studies under discussion, which have evaluated food safety behaviour, have been 'non-participant' studies.

Recording of food safety behaviours

Observation methodologies may be structured or unstructured, direct or indirect. Direct, structured observation has been utilized for all of the consumer food safety observational under discussion. Structured observation is systematic, quantitative and is limited to defined, measurable and observable behavioural variables, which are determined before the actual observation is carried out.[83] Data denoting observed actions from structured observations are usually collected and recorded using a predetermined, standardized and validated 'coding schedule' or 'observational checklist'. Development of a unique observational checklist with clearly defined categories[84] has to meet a variety of criteria to ensure that an accurate measurement of behaviour is obtained.

A variety of methods for recording and analysing observed food safety practices has been used for the evaluation of consumer food safety behaviour. In the UK, a risk-based checklist and scoring system has been developed to enable quantitative assessment of food safety in the domestic kitchen.[19] Risk scores based on recent epidemiological data have been allocated to specific food-handling malpractices, using a logarithmic scale. A higher risk score represents implementation of more cumulative food safety errors and fewer control measures implemented.[85] Use of this technique has enabled comparisons to be made between different meal preparations, between specific behaviours, and between and within meals.[86] In addition to this, comparisons between participant risk scores have enabled evaluation of a hierarchy of food safety education interventions. In addition, it has been considered that use of a predetermined checklist should yield highly reliable results by virtue of its replicability.[82] Use of notational analysis is another technique that has been used for the evaluation of observed consumer food safety behaviour.[87] The technique is used for objectively and systematically monitoring, recording and studying actions and events. Notation of actions has been frequently used for sports analysis, however, its approach has been applied to consumer food safety using a specially designed computer program, thereby providing detailed data denoting food-handling malpractices.

Reliability and validity of observation studies

Observational data collected needs to be reliable. To test for reliability of recorded observations, an assessment of intra- and inter-observer reliability needs to be determined. To assess inter-observer reliability of recorded observations, the records in a checklist from one observer can be correlated with those of another observer.[34] Intra-observer reliability is a measure of the extent to which a single observer obtains consistent results when measuring the same behaviour on different occasions.[19] Inter-observer and intra-observer reliability has been determined during consumer food safety observation studies conducted in UK.[19,20] Owing to provision of detailed descriptions of a food safety checklist and training in the observational technique, results showed that differences between recording of observed food safety malpractices using a predetermined checklist were minimal.[86]

To establish reliability and validity of direct structured observational methods, the various potential for biases needs to be addressed. Observer bias is considered to be the greatest threat of reliability when using the observational technique.[82] This type of bias is a systematic difference between a true situation and that observed owing to observer variation in perceptions.[30] Another potential for bias in observational studies is owing to the reactive effect of research arrangements, known as the 'Hawthorne Effect', where behaviours may be distorted in some way simply as a result of being studied.[30,34] For example, if consumers are specifically informed that their food safety behaviours were subject of detailed observation they may consciously improve such behaviours so to convey a more positive image of themselves, and thus distort results. A study conducted in USA informed recruits for a food safety observational study that data was required 'for market research of food preparation practices and the development of a food kit' in an effort to eliminate such bias for food safety research.[88]

Control can be exercised not only of the structure of recorded data, but also over the environment in which the observations take place.[34] Observational study settings may occur in natural (uncontrolled) or laboratory (controlled) environments. There are advantages and disadvantages when carrying out observational research in both environments. Half of the reviewed observation studies obtaining information on consumer food preparation practices occurred in participant home kitchens, which can be described as the uncontrolled 'naturalistic' environment. It has been reported that observations carried out in the natural environment are more realistic than in a laboratory, which may provide a highly artificial, possibly inhibiting atmosphere. In a natural environment, *if* there is no reactivity bias, observed behaviours have been considered to be entirely genuine.[34] However, extraneous variables may be poorly controlled in the natural environment, such as consumer domestic kitchens, and may pose a greater threat to validity than in the laboratory. This may result in a greater ambiguity of observable actions and, therefore, an increased potential for observer and reactivity bias. In addition to this, replication of collected data is more difficult.[34] Direct comparisons of recorded behaviours between subjects in different environments may not necessarily be viable or possible. Research conducted in the UK has determined the consistency of observations of consumer food safety behaviours in a model domestic kitchen and in consumer home kitchens. Using data based on a risk-based observational checklist and scoring system, analysis of results have shown that there was no significant increase or decrease in overall mean risk scores between food preparations in the two locations, suggesting that key food safety behaviours were consistent.[19]

Consumer food safety observation studies

Various methods of observation that have been applied to non-participant observations include personal direct observation or observation using video recordings. Both methods have the potential for reactivity bias, however, video recording has the advantage that behaviour can be analysed after the event at any required pace.[34] This can be of great benefit because sometimes real-time recording of data is extremely difficult, especially when there are many different behaviours, such as complex food-handling actions to be recorded. Videoed observations are also advantageous when behaviours are initiated and terminated very rapidly and frequently.[83] In total, 15 observation studies of consumer food safety practices have been reviewed. Data collected for many of the studies (47%) was collected using direct observation. Observers openly watched the participants' meal preparations in home kitchens and concurrently recorded preparation. In total, 43% of direct observation studies were from the UK[19,51,72] a further 43% of the studies were from USA[89–91] and one study (14%) was conducted in England.[20] Observations using video-camera recording of consumer food-handling practice have been carried out South Wales, Australia and the USA. The majority (67%) of observation studies using video recordings have taken place in South Wales, UK. Observations of consumers' food preparation practices have occurred using CCTV in a model domestic kitchen. A variety of studies have been completed, determining the repeatability and reproducibility of consumers' food safety behaviours[19,86,92] and quantifying food safety behaviours of a cross-section of the population.[86] Additional studies have been completed determining food safety behaviours of different targeted groups of individuals and assessing the relationship between actual observed behaviour and psychological variables, such as knowledge, attitudes/beliefs and intentions,[49] and comparing observed malpractices with pathogenic isolations campylobacter and salmonella.[28] Research undertaken in Australia[43] used time-lapse video monitoring from a single mounted camera in home kitchens for periods of time lasting 1 or 2 weeks. The American study[88] used portable video cameras to record the food preparation practices of one meal preparation in participant home kitchens.

Repeatability of observed hygiene behaviours

To date, most information detailing actual consumer food safety behaviours has been based on single meal preparations. However, research carried out in the UK has determined the consistency of consumer food safety practices.[19,86,93] Repeatability refers to the consistency of food safety actions when the same meal is prepared over and over again on separate occasions. Reproducibility refers to the consistency of food safety actions when different meals are prepared repeatedly.[85] Information detailing the consistency of implementation of specific food safety errors is useful for the development of consumer food safety education initiatives. In addition to this, when assessing consumer food safety behaviour before and after interventions it is important to know how transferable the implementation of food safety behaviours are during different situations. Results have provided a more accurate picture of consumer food safety behaviours as well as validating the observation technique of food-handling practices in the model domestic environment.[19,85]

Comparisons between consumer food safety information obtained using surveys, focus groups and observation

As described previously, different research methodologies have been used internationally for the collection of information about consumer food safety. Data in Table 6 illustrate results obtained from surveys, focus groups and observational studies for generic food safety behaviours. Generally, information obtained from surveys (questionnaires and interviews) provides a positive picture of consumer food safety, whereas information obtained from focus groups appears to provide a less optimistic view of how food is prepared in the domestic environment. The gradation of concern continues when analysing actual food safety behaviours from observations of consumer meal preparations. Results indicate that many consumers frequently implement unsafe food-handling actions. Overall, it can be seen that implementation of different research methodologies to determine consumer food safety have produced inconsistent findings. Discrepancies between consumer food safety knowledge, attitudes, intention, self-reported practice and actual behaviour have been identified and previously discussed.[32]

Quantitative questionnaire and interview data indicate that large proportions of consumers have responded positively to the importance, necessity and

Table 6 Comparison of consumer food safety information obtained using surveys, focus groups and observation

	Surveys			
	Questionnaires	Interviews	Focus groups	Observational technique
Hand-washing/ hand-drying	100% consumers recognised when and how it was necessary to wash hands.[49] 95% consumers thought hand-washing is important after handling raw chicken.[19]	82% recognized that washing hands before handling or preparing food was vitally important food hygiene activity.[56] 87–92% respondents always/ usually wash hands with soap and water before handling food.[94–96]	*'I just rinse them under hot water'.*[81] *'I might wipe my hands on a towel'.*[81] *'I normally put mine under the cold tap, leave it running and . . . splash about'.*[20] *'I put washing-up liquid, Fairy, I give it a good old scrub and then run the tap'.*[20]	~75–100% failed to wash and dry hands immediately and adequately after handling raw chicken.[20,43,49,86,87,97]
Cross contamination	100% consumers answered questions correctly about use of different utensils between use of raw and RTE foods.[49]	64% thought that it was very important to use separate chopping boards for raw meat and other foods.[22] 59–76% always/usually use separate utensils, e.g. chopping board for preparation of raw meat and cooked food.[94–96]	*'I always wipe over the board . . . between preparing things'.*[81] *'I just swill everything'.*[81] *'I've got a meat knife and a vegetable knife'.*[81]	52–75% failed to wash/dry c/board and/or knife for preparation of RC then salad ingredients.[20,49,86]
Heating efficacy	96% knew that it is important to check the inside of the chicken to ensure that it is fully cooked.[98] 88% assessed end of cooking subjectively.[64]	74–92% responded that eating unddercooked meat/chicken could cause food poisoning.[99,100] 12% always use a meat thermometer to check doneness of meats.[100]	*'When its cooked all the way, its done'.*[80] *'the smell tells you it's close to being done'.*[80] *'. . . wiggling the leg, if its loose, its done'.*[80]	46–83% undercooked home-made burgers/ meatloaf and chicken.[19,86,88] 0% consumers used a meat thermometer to determine heating adequacy of roast chickens or beef burgers.[19]
Cooling	49% agreed that cooked food should be cooled at room temperature before refrigeration or freezing.[69] 84% agreed that it is acceptable to cool foods at room temperature.[19]	69% respondents knew that keeping food at room temperature/contamination of food after cooking causes food poisoning.[101]	*'I leave it in the saucepan, put the lid on, and then leave it to cool'.*[19] *'It takes forever to cool doesn't it'.*[19]	100% failed to implement all actions required for adequate cooling.[20]
Storage practices	75% knew that bacteria responsible for causing foodborne illness grow at room temperature.[60] 73% consumers answered all knowledge questions regarding storage correctly.[49]	75% consumers think that food should be refrigerated within one hour of cooking completion.[102]	Re a cooked turkey *'I left it overnight* (at room temperatures) *but covered it with a tea towel'.*[19]	57% left chicken salad at room temperature for storage.[20]

self-reported practice of hand-washing and hand-drying during food preparation. However, qualitative data from focus groups indicate that consumers do implement hand-washing malpractices. It is suggested that focus group data may represent a more accurate description of self-reported practices than survey data. Focus group results have shown that consumers are more likely to describe specific food preparation procedures, whereas responses to generic questions in surveys may be subject to social desirability bias.[32] Such findings compare favourably with observations of consumers where analysis of hand-washing and hand-drying actions showed that between 75% and 100% consumers failed to wash and dry hands immediately and adequately after handling raw chicken during food preparation. Such differences between quantitative surveys and quantitative observational studies illustrate the discrepancies in data collected about consumer food safety practices using different research methodologies. Although consumers have demonstrated knowledge, positive attitudes and intentions to implement safe practices, substantially larger proportions of consumers have been observed to implement many food-handling malpractices.

As with hand-washing and hand-drying, actions related to cross contamination, heating efficacy, cooling and storage, based on knowledge, attitudes, intentions and self-reported practices (from surveys) do not appear to be consistent with observational data. Such findings illustrate that responses to questionnaire and interviews conducted to identify aspects of domestic food safety are subject to social desirability bias.[42] Indeed, Curtis *et al.*[42] considered that data collected through direct observation of hygiene-related behaviours has greater validity than data obtained through questionnaire interviews.

Out of all of the generic food safety behaviours discussed, fewer respondents demonstrated correct knowledge of cooling practices. In addition to this, observation results indicated that no consumers implemented all of the appropriate actions required for adequate cooling. Furthermore, it appears that qualitative responses from focus groups illustrate specific actions that consumers report to implement during food preparation, by citing examples opposed to agreement or disagreement whether generic practices are implemented. For example, although three-quarters of responses in surveys indicated that consumers possessed knowledge of, and correctly implemented, appropriate storage procedures, focus group comments denoting storage procedures of a cooked turkey appeared to agree with observational data more readily than survey data.

Although questionnaire and interview surveys have been the most commonly used instruments to obtain information about consumer food safety, the validity of the findings is questionable. Other workers have examined the level of agreement between questionnaire responses and direct observation of hygiene behaviours in Bangladesh[44] and Burkina Faso.[42] Both studies determined a low degree of concordance between questionnaire responses and direct observation, findings that also support inferences made from this discussion about consumer food safety data.

Table 7 Summary of findings

- Interest in domestic food-handling has prompted implementation of consumer food safety studies from international origin, the majority of data has been collected in UK and Northern Ireland (48% studies) and USA (42%).
- Use of surveys (questionnaires and interviews) has been the most frequent method of data collection about consumer food safety, accounting for 75% of reviewed studies.
- Quantitative survey methods are important for collection of information about consumer knowledge, attitudes and self-reported practices, yet comparisons of results from such surveys with observational findings have shown that discrepancies between the methods of data collection are present.
- Survey data illustrate a more positive picture of consumer food safety than data obtained from observations of actual food preparations.
- Observation results suggest that substantial numbers of consumers' still implement unsafe food-handling practices. For example, up to 100% consumers have failed to wash/dry their hands adequately after handling raw chicken and more than half consumers fail to use separate or adequately washed and dried utensils between the use of raw meat/poultry and ready-to-eat foods.
- Observation provides the most reliable data denoting consumers actual food safety behaviour, however, the observation technique is typically time consuming and expensive.
- Focus group data can provide detailed qualitative data regarding perceptions of food safety, barriers and benefits to implementing food behaviours and perceptions of food safety education.

Conclusions

A summary of main findings from this discussion can be found in Table 7. It can be concluded that a comparison of different research methodologies used for obtaining information about consumer food safety in the domestic environment provides inconsistent findings about consumer food-handling behaviours. Although many surveys have presented data detailing that large proportions of consumers possess adequate food safety knowledge and also self-report to implement many safe food-handling actions, observation data have identified the contrary. Direct observations of consumer food safety behaviour in a model domestic environment and in consumer homes have indicated that many food safety malpractices occur on frequent occasions during food preparation. Educational efforts are required to reduce the risk of food-borne disease and improve consumers' food-handling behaviours in the domestic environment.

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APPENDIX 2.0

APPENDIX 2.1

Pathogens associated with reported sources of foodborne disease outbreaks and associated prevalence of such pathogens.

Food	Microbiological survey data: prevalence of foodborne pathogens in foods.		Pathogens associated with reported sources of foodborne disease outbreaks.	
Raw poultry (including chicken and turkey and associated products).	*Salmonella* spp.	7 - 48% (ACMSF, 1996; FSA, 2001; Geilnausen *et al.* 1996; Harrison *et al.* 2001; ICRT, 1994; PHLS, 1993; Roberts,1991; Uyttendaele *et al.* 1999a; Wilson *et al.* 1996).	*Campylobacter jejuni* HS11	Chargrilled chicken (Anon, 1999f), chicken liver pate (Anon, 2002b).
	Campylobacter spp.	28 - 83% (Atanassova and Ring, 1999; Bailey *et al.* 2000; Flynn *et al.* 1994; FSA, 2001; Geilnausen *et al.* 1996; Harrison *et al.* 2001; ICRT, 1994; Rayes *et al.* 1983; Uyttendaele *et al.* 1999a).	*Campylobacter*	Chicken casserole (Anon, 2002d).
			Salmonella typhimurium DT104	Chicken drumsticks (Anon, 1997), turkey (Anon, 2001e), cooked chicken and turkey (Anon, 2002a).
	Listeria spp.	11 - 60% (Breer and Schoffer, 1988; Farber *et al.* 1989♦; Pini and Gilbert, 1988♦; Uyttendaele *et al.* 1999a; Wilson, 1995).	*Salmonella enteritidis* PT6	Chicken nuggets, chicken sandwich (Anon, 2000a).
			Salmonella heidleberg	Chicken (Anon, 1999b).
	Escherichia coli	81% (Guthertz *et al.* 1976).	*Salmonella enteritidis* PT4	Turkey sandwich (Anon, 1999e), chicken (Anon, 2000c) chicken fried rice, (Anon, 2001b), chicken pieces (Anon, 2001f).
	Clostridium perfringens	52% (Guthertz *et al.* 1976).	*Salmonella bredeney*	Chicken (Anon, 2000d).
	Staphylococcus aureus	80% (Guthertz *et al.* 1976).	*Salmonella kottbus*	Turkey (Anon, 2001c).
			Salmonella infantis	Chicken drumsticks (Anon, 2001f).
	Yersinia enterocolitica	4 - 16% (Guthertz *et al.* 1976; Nortje *et al.* 1999).	*Clostridium perfringens*	Chicken curry (Anon, 1997), chicken (Anon, 1999g), coronation chicken, turkey (Anon, 2000c), roast chicken and gravy (Anon, 2001h).
	Bacillus cereus	2% (Nortje *et al.* 1999).		
Raw red meat (including pork, beef, lamb and associated products).	*Salmonella* spp	3 - 65% (Banks and Board, 1983; Farber *et al.* 1988; PHLS, 1993).	*E.coli* 0157:H7	Hamburgers (Ryan *et al.* 1996), beef stew (Krantz, 1997), home-cooked hamburgers (Turney *et al.* 1994), meat products (Anon, 2001b), beef-burger (Anon, 2001e), beef-burger (Anon, 2002c), beef stew (Anon, 2002c).
	Campylobacter spp.	1.6 - 5.1% (Stern *et al.* 1985; Turnball and Rose, 1982).		
	Listeria spp.	77 - 81% (Breer and Schoffer, 1988; Farber *et al.* 1989♦).		
	Escherichia coli 0157:H7	1.4- 3.9% (ACMSF, 1995*; Chapman *et al.* 2000*; Doyle and Schoeni, 1987*).	*Salmonella typhimurium* DT104	Beef (Davies *et al.* 1996).
			Salmonella typhimurium DT170	Beef (Anon, 2000c).
	Yersinia enterocolitica	22% (Nortje *et al.* 1999).	*Salmonella enteritidis*	Roast beef (Anon, 2001b).
	Staphylococcus aureus	37 – 46% (Duitschauer *et al.* 1977; Farber *et al.* 1988)	*Salmonella enteritidis* PT14B	Meatballs (Anon, 2000b).
			Salmonella hadar	Roast beef (Anon, 1999h).
	Bacillus cereus	3 – 16% (Konuma *et al.* 1988; Nortje *et al.* 1999; Sly and Ross, 1982).		

♦ = Includes isolation of *Listeria monocytogenes*, * = *E.coli* 0157:H7 isolated.

APPENDIX 2.1 *(continued).*

Food	Microbiological survey data: prevalence of foodborne pathogens in foods.		Pathogens associated with reported sources of foodborne disease outbreaks.	
Eggs.	*Salmonella* spp.	<0.1 – 4% (ACMSF, 1993; Humphrey *et al.* 1991; PHLS, 1993; Wilson *et al.* 1998; Wilson, 1995)	*Salmonella* spp.	Tiramisu made with RSE, scrambled eggs (Anon, 1999d).
			Salmonella enteritidis PT4	Lemon mousse made with raw shell eggs (Anon, 1999a), raw shell eggs (Anon, 1999c), raw undercooked eggs, (Coyle *et al.* 1988), home-made mousse made with raw egg (Anon, 1996a), Egg based deserts (Cowden *et al.* 1989), soft boiled eggs (Anon, 1997), raw egg (Anon, 2002a), egg fried rice, (Anon, 2001b), egg fried rice (Anon, 2002a), soft fried eggs (Anon, 2002c), eggs (Anon, 2002d), scrambled eggs (Anon, 2002e).
			Salmonella enteritidis PT6	Egg sandwiches, Tiramisu, chocolate mousse and lemon mousse all made with raw eggs (Anon, 2000a), tiramisu (Anon, 2002c).
			Salmonella enteritidis PT8	Chocolate Mousse (Anon, 2001e).
			Salmonella enteritidis PT1	Egg sandwich (Anon, 1999a).
			Salmonella typhimurium	Sausage and egg sandwich (Anon, 2001c).
			Salmonella indiana	Egg sandwiches (Anon, 2001a), (Anon, 2001f).
RTE vegetables / salad vegetables.	*Listeria* spp.	2 –50% (Laine & Michard, 1988; Lin *et al.* 1996◆; Odumenu *et al.* 1997◆; Sizmur and Walker, 1988◆; Velani and Roberts, 1991◆; Uyttendaele *et al.* 1999b).	*Campylobacter*	Lettuce (Anon, 2001b).
			Salmonella typhimurium DT170	Lettuce (Anon, 2000c).
	Bacillus cereus	9% (Kaneko *et al.* 1999).	*Salmonella newport*	Salad (Anon, 2001d), pre-packed salad (Anon, 2002f).
	Escherichia coli	4 – 13% (Kaneko *et al.* 1999; Lin *et al.* 1996).	*Salmonella virchow*	Salad (Anon, 2002c).
Rice.	*Bacillus cereus*	3% (Sly and Ross, 1982).	*Bacillus cereus*	Fried rice (Khodr *et al.* 1994).
RTE cooked meats.	*Salmonella* spp.	<0.1 – 0.3% (FSA, 2000◄; PHLS, 1993).	*Staphylococcus aureus*	Cooked ham (Ward *et al.* 1997), cooked ham (Anon, 2001g).
	Campylobacter	<0.1% (MAFF, 1996c).	*Salmonella typhimurium*	Cooked meat (Anon, 2002a), cooked chicken and turkey (Anon, 2002b).
	Listeria spp.	4 – 23% (Farber and Daley, 1994; FSA, 2000◄◆; Gilbert *et al.* 1989◆; MAFF, 1996a◆; MAFF, 1996b◆; MAFF, 1996c; Uyttendaele *et al.* 1999b; Wilson, 1995).	*Salmonella enteritidis*	Cooked meats (Anon, 1999a), cooked turkey (Anon, 2001c).
			Salmonella enteritidis PT4	Ham sandwich (Anon, 2002c).
	Clostridium perfringens	<0.1% (FSA, 2000◄).	*Salmonella* spp.	Cooked turkey (Luby *et al.* 1993).
			Salmonella hadar	Cooked meat salad (Faustini *et al.* 1998).
	Staphylococcus aureus	0.7 –19% (Duitschauer, 1977, FSA, 2000◄; MAFF, 1996a.).	*E.coli* 0157:H7	Cold cooked meats (Anon, 2000c).
			Salmonella thompson PT23	Cooked chicken (Anon, 2000c).

◆ = Includes isolation of *Listeria monocytogenes*, * = *E.coli* 0157:H7 isolated, ◄ = only cooked chilled chicken portions.

APPENDIX 2.2

Contamination of chicken samples from *Salmonella* spp. and *Campylobacter* spp.

Study	Location	*n*	Samples analysed.	*Salmonella* +ve	*Campylobacter* +ve
Hood *et al.* (1988).	UK	46	Whole raw fresh retail chickens.		48% total sample *C.jejuni.*
Roberts, (1991).	UK	292	Raw chilled and frozen whole chickens.	48% total sample.	
PHLS, (1993).	UK	713	Raw chicken samples.		18% total sample.
ICRT, (1994).	UK	160	Raw fresh and frozen chicken pieces and carcasses from retail establishments.	36% total sample.	41% total sample.
ACMSF, (1996).	UK	562	Whole raw chilled and frozen chickens from retail sale.	37% total sample.	
Anon, (1996b).	UK	160	Raw fresh and frozen chicken pieces and carcasses from retail establishments.	20% total sample.	37% total sample.
Harrison *et al.* (2001).	UK (Wales)	300	Whole chicken, chicken breast and skin, chicken pieces.	28% total sample.	68% total sample.
FSA, (2001).	UK	4881	Raw fresh and frozen chicken pieces and carcasses from retail establishments.	5.8% total sample (fresh = 4%; frozen = 10.8%).	50% total sample (fresh = 63%; frozen = 33%).
Jorgensen *et al.* (2002).	UK	241	Whole raw chickens purchased on retail outlets.	25% total sample.	83% total sample.
Wilson *et al.* (1996).	Northern Ireland	140	Raw chilled and frozen retail whole chickens.	7% total sample.	
Flynn *et al.* (1994).	Northern Ireland	153	Raw fresh retail chicken wings.		65% total sample *C.jejuni* and / or *C.coli.*
ICRT, (1994).	Europe	1707	Raw fresh and frozen chicken pieces and carcasses from retail establishments from 14 European countries.	21% total sample.	28% total sample.
Atanassova and Ring (1999).	Germany	509	Whole raw fresh chickens (broiler carcasses).		30% total sample.
Geilnausen *et al.* (1996).	Germany, Holland, France	1853	Raw fresh chicken breast samples.	20% total sample.	33% total sample.
Uyttendaele *et al.* (1999a).	Belgium	772	Raw chicken carcass and products from 5 European countries.	37% total sample.	29% total sample *C.jejuni* and / or *C.coli.*
Rayes *et al.* (1983).	USA	265	Raw fresh and frozen turkey wings from supermarkets.		62% total sample *C.jejuni.*
Kinde *et al.* (1983).	USA	94	Fresh packaged chicken wings.		83% total sample.
Rayes *et al.* (1983).	USA	265	Fresh turkey wings.		62% total sample.
Stern *et al.* (1985).	USA	360	Whole raw fresh chickens.		30% total sample *C.jejuni* and / or *C.coli.*

NB. Shaded cells = no samples taken.

APPENDIX 2.3

International contributory factors associated with reported outbreaks of foodborne disease.

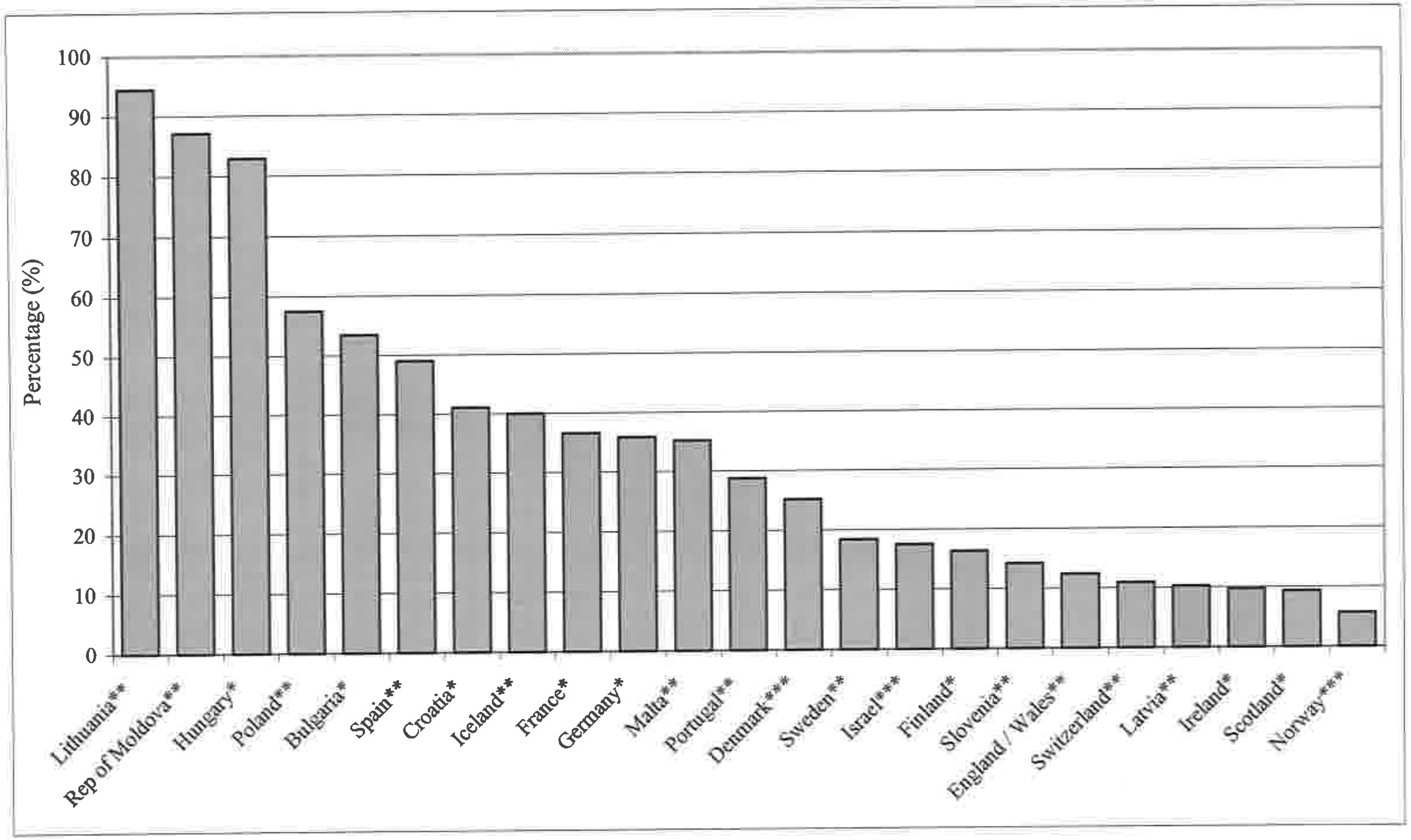
Food handling malpractice.	Implicated contributory factor of foodborne disease.			
	Year(s)	Location	*n*	Finding
Cross contamination (including inadequate hand-washing and drying, failure to use adequately washed and dried utensils / separate utensils for preparation of raw and cooked foods, inadequate handling and other).	1993-1998	England and Wales	1162	25% outbreaks (Tirado & Schmidt, 2000)
	1992-1993	England and Wales	279	36% outbreaks (Cowden *et al.* 1995)
	1995-1996	England and Wales	231	39% outbreaks (Ryan *et al.* 1996)
	1992-1994	Europe	2207	16% outbreaks (Schmidt, 1995)
Contaminated equipment.	1983-1987	USA	704	15% outbreaks (Bean *et al.* 1990)
	1993-1997	USA	655	18% outbreaks (Olsen *et al.* 2000)
	1992-1994	Europe	2207	6% outbreaks (Schmidt, 1995)
	1980-1995	Australia	70	19% outbreaks (CDNANZ, 1997)
Inadequate heat treatment (including inadequate reheating, undercooking).	1992-1993	England and Wales	279	43% outbreaks (Cowden *et al.* 1995)
	1995-1996	England and Wales	231	50% outbreaks (Ryan *et al.* 1996)
	1993-1998	England and Wales	1162	29% outbreaks (Tirado & Schmidt, 2000)
	1983-1987	USA	704	17% outbreaks (Bean *et al.* 1990)
	1993-1997	USA	655	24% outbreaks (Olsen *et al.* 2000)
	1992-1994	Europe	2207	11% outbreaks (Schmidt, 1995)
	1980-1995	Australia	70	27% outbreaks (CDNANZ, 1997)
	1980-1991	USA	1528	20% outbreaks (Weingold *et al.* 1994)
	1988-1989	France	920	19% outbreaks (Schmidt, 1995)
Improper hot holding.	1983-1987	USA	704	35% outbreaks (Bean *et al.* 1990)
	1993-1997	USA	655	41% outbreaks (Olsen *et al.* 2000)
	1980-1995	Australia	70	20% outbreaks (CDNANZ, 1997)
	1980-1991	USA	1528	17% outbreaks (Weingold *et al.* 1994)
Inadequate cooling.	1992-1994	Europe	2207	19% outbreaks (Schmidt, 1995)
	1970-1982	England and Wales	1479	32% outbreaks (Roberts, 1985)
	1980-1991	USA	1528	11% outbreaks (Weingold *et al.* 1994)
	1988-1989	France	920	53% outbreaks (Schmidt, 1995)
Inadequate storage (including storage at ambient temperature, inadequate refrigeration).	1992-1993	England and Wales	279	46% outbreaks (Cowden *et al.* 1995)
	1995-1996	England and Wales	231	45% outbreaks (Ryan *et al.* 1996)
	1993-1998	England and Wales	1162	28% outbreaks (Tirado & Schmidt, 2000)
	1977-1982	USA	766	21% outbreaks (Bryan, 1988)
Inadequate thawing.	1970-1982	England and Wales	1479	6% outbreaks (Roberts, 1985)
Preparation of food too far in advance.	1970-1982	England and Wales	1479	57% outbreaks (Roberts, 1985)
	1961-1982	USA	1918	22% outbreaks (Bryan, 1988)
	1980-1991	USA	1528	10% outbreaks (Weingold *et al.* 1994)
	1988-1989	France	920	42% outbreaks (Schmidt, 1995)
Poor personal hygiene.	1983-1987	USA	704	18% outbreaks (Bean *et al.* 1990)
	1993-1997	USA	655	19% outbreaks (Olsen *et al.* 2000)
	1980-1995	Australia	70	8 % outbreaks (CDNANZ, 1997)

APPENDIX 2.4

(a) International and national incidence of foodborne disease attributable to the home.

Country.	Years of data collection.	Incidence.	Reference.
Australia.	1999	Suggested between 20-40 % of foodborne illness arise from private homes.	ANZFA, 1999.
Canada.	1982	14 % incidents (outbreaks and cases) caused by mishandling of foods in homes.	Todd, 1988.
England and Wales, UK.	1992-1993	17 % general foodborne outbreaks of infectious intestinal disease (IID) associated with food prepared in private house and served elsewhere.	Cowden *et al*. 1995.
England and Wales, UK.	1993-1998	12 % general foodborne outbreaks of foodborne disease attributed to food consumed in a private house.	Tirado and Schmidt, 2000.
England and Wales, UK.	1970-1979	20 % general and family outbreaks of food poisoning associated with family homes as the place of consumption or origin of food incriminated.	Roberts, 1982.
Europe.	1993-1998	42 % outbreaks occurred in the private home.	FAO / WHO, 2002.
France.	1993-1997	40 % foodborne disease outbreaks (microbiologically confirmed and suspected) associated to the private home (the place where food was eaten).	Tirado and Schmidt, 2000.
Germany.	1993-1998	36 % foodborne disease outbreaks associated with the private home (the place where food was eaten).	Tirado and Schmidt, 2000.
Ireland.	1997-1998	10 % foodborne disease outbreaks associated with the private home (the place where food was eaten).	Tirado and Schmidt, 2000.
New Zealand.	1997	~50% cases of foodborne illness have been reported to be caused by poor handling techniques in the domestic kitchen.	Bloomfield and Neal, 1997.
Scotland, UK.	1996-1998	9 % foodborne disease outbreaks associated with the private home as the outbreaks setting.	Tirado and Schmidt, 2000.
Spain.	1993-1998	49 % foodborne disease outbreak associated with the private home (the place where food was eaten or acquired).	Tirado and Schmidt, 2000.
Sweden.	1992-1997	19-22 % outbreaks and single cases attributed to food consumed in the home.	Linquvist *et al*. 2000.
Switzerland.	1993-1998	11 % foodborne disease outbreaks associated with the private home (the place where food was eaten).	Tirado and Schmidt, 2000.
USA.	1993-1997	20 % reported bacterial foodborne disease outbreaks from place where food was eaten.	Olsen *et al*. 2000.

APPENDIX 2.4 (b) European incidence of reported foodborne outbreaks associated with the private home (Tirado and Schmidt, 2000).



Key: * Outbreaks of foodborne disease caused by food eaten or contaminated in the private home.

** Outbreaks of foodborne disease where food was eaten / acquired in the private home.

*** Outbreaks of foodborne disease where food was prepared / contaminated in the private home.

APPENDIX 2.5

Comparison of KNOWLEDGE of common food safety issues from some consumer food safety surveys that were undertaken in UK, USA, Australia and New Zealand.

Food safety issue.	UK† / Europe÷ surveys.	USA◇ / Canada* surveys.	Australia▲ / New Zealand◆ surveys.
Knowledge of adequate cooking.	20%* consumers knew what the temperature should be inside a piece of meat when it was well cooked (Worsfold, 1994†). 89% thought undercooking is a risk factor associated with food poisoning (Mathias, 1999†). 15%* knew the correct temperature a beef burger needed to reach to be safe to eat (Griffith *et al.* 2001†).	67% think cooking meat well decreases the risk of food poisoning (Altekruse *et al.* 1996◇). 74-92% knew that eating undercooked meat / chicken could cause food poisoning (ADA / Conagra, 1999◇; CFIA, 1998*). 7%* did not know of cooking ingredient to a proper temperature (Audits International, 1999◇).	93%* consumers did not think that the best way to see if a roast chicken is cooked is to see that is dark brown all over (Hodges, 1993◆). 96% answered that it is important to check the inside of the chicken to ensure that it is fully cooked (Bloomfield and Neal, 1997◆).
Knowledge of cooling principles.	69%* respondents knew that keeping food at room temperature / contamination of food after cooking causes food poisoning (Mathias, 1999†).	49% agreed that cooked food should be cooled at room temperature before refrigeration or freezing (Bruhn and Schultz, 1999◇).	79% respondents knew that foods cool more quickly when cooled in a shallow dish (Hodges, 1993◆). 90% knew that a casserole should be cool before placing into the fridge for storage (Hodges, 1993◆).
Knowledge of storage temperatures of foods.	13% knew the correct temperature at which chilled foods should be kept (Spriegal, 1991†). 7-11% knew the correct recommended fridge temperature (DHSS, NIHSSB, 1998†; FSAI, 1998÷). 37% respondents knew the correct fridge temperature was 0-5°C (FDF, 2001†). 50%* participants knew the correct temperature of a refrigerator (Griffith *et al.* 2001†).	56% consumers knew the refrigerator should be kept below 40°F (5°C) (Albrecht, 1995◇). 60% adults know the ideal temperature settings for a refrigerator and a freezer to store food (Endres *et al.* 2001◇). 75% knew that bacteria responsible for causing foodborne illness grow at room temperature (Meer and Misner, 2000◇).	32%* consumers did not know correct refrigeration temperatures (Jay *et al.* 1999B▲).
Knowledge separation of raw and cooked foods during <u>storage</u>.	75% of respondents were unaware of potential risks associated with storing raw meat and poultry on upper shelves of refrigerators (Sammarco and Ripabeli, 1997÷).	69% thought that failing to keep foods separate during preparation and storage could cause food poisoning / foodborne illness (CFIA, 1998*). 79% know how to avoid cross contamination of RTE foods with juices from raw animals (Meer and Misner, 2000◇).	18% consumers agreed that it was better to store raw food above cooked food in the fridge (a further 32% did not know) (Hodges, 1993◆). 10% agreed that it was better to store cooked food above raw food in the fridge (Kerslake, 1995◆).
Understanding of food safety terms / concepts.	44% lacked understanding of term disinfectant, 26% detergent, and 22% sterilization (Sammarco and Ripabeli, 1997÷).	75% respondents reported to understand the concept of cross contamination (Albrecht, 1995◇).	Unprompted, 49%* knew of the meaning of the term cross contamination (Jay *et al.* 1999b▲). Overall high awareness of cross contamination by 38% respondents (Hodges, 1993◆).

APPENDIX 2.5 *(continued)*

Food safety issue.	UK[†] / Europe[÷] surveys.	USA[◊] / Canada[*] surveys.	Australia[▲] / New Zealand[◆] surveys.
Knowledge of hand-washing / drying actions.	37% adults thought that insufficient hand-washing was hazardous (MAFF, 1988[†]). 95% respondents thought that washing hands before preparing food was very important (Lader, 1999[†]). When prompted 80% consumers thought poor hand-washing was a risk factor associated with food poisoning (Mathias, 1999[†]). When prompted 100% consumers knew when and how it was necessary to wash hands (Griffith *et al.* 2001[†]).	86% knew that washing hands before preparing food decreases the risk of food poisoning (Altekruse *et al.* 1996[◊]). 75% consumers knew that the most important thing they can do to keep food safe from germs is to wash their hands (CFIA, 1998[*]). 45% knew that improper hand-washing could result in food poisoning (ADA / Conagra, 1999[◊]). 79% of all participants could identify each of 5 instances when hand-washing is necessary (Audits International, 1999[◊]).	87-99% respondents knew that hand-washing should occur after visiting the toilet, patting a cat or dog or after smoking a cigarette (Bloomfield and Neal, 1997[◆]). 82% thought that it was important to wash hands before and after preparing food (Jay *et al.* 1999b[▲]). 82%[*] recognized that washing hands before handling or preparing food was vitally important food hygiene activity (Jay *et al.* 1999b[▲]).
Knowledge of separation of raw and cooked foods during food preparation.	82% consumers knew that allowing raw food to contaminate cooked foods was hazardous (MAFF, 1988[†]). 64% thought that it was very important to use separate chopping boards for raw meat and other foods (Walker, 1996[†]). 77% people thought that it was important to use a separate chopping board for raw meat (Lader, 1999[†]). When prompted, 100% consumers answered questions correctly about use of different utensils between use of raw and RTE foods (Griffith *et al.* 2001[†]).	80% knew that putting steak on a plate that held raw meat increases the risk of food poisoning (Altekruse *et al.* 1996[◊]). 84%[*] knew that keeping different foods separated from each other to avoid cross contamination is important to prevent food poisoning (CFIA, 1998[*]). 55%[*] correctly answered questions about cross contamination (Audits International, 1999[◊]). 78% recognized that failure to wash cutting boards after handling raw meats and then cutting raw vegetables could result in food poisoning (ADA / Conagra, 1999)[◊].	38% consumers = unaware of the need to use separate / clean utensils when preparation of raw and cooked foods together. (Hodges, 1993[◆]). 28% respondents agreed that one knife is all that is needed to cut up raw and cooked ingredients, as long as it is wiped with a clean damp cloth (Kerslake, 1995[◆]). 97% respondents indicated that it is unsafe to use the same unwashed knife / chopping board to cut uncooked chicken and prepare a salad (Bloomfield and Neal, 1997[◆]).
Knowledge of pathogens.	When promoted, 95% knew *Salmonella*, 92% knew *Listeria* and 21% knew that *Campylobacter* were causes of food poisoning (Mathias, 1999[†]). Unprompted, 79-97% consumers could name *Salmonella*, <3-10% *Campylobacter* (Evans, 1992[†]; FDF, 2001[†]).	75% consumers knew *Salmonella* was associated with raw poultry and eggs (Williamson *et al.* 1992[◊]). 78% heard of *Salmonella*, 9% *Campylobacter*, 30% *E.coli*, 21% *Listeria* (McIntosh *et al.* 1994[◊]). 80% claimed to have heard of *Salmonella* and <5% claimed to have heard of *C. jejuni* or *C. coli* (Altekruse *et al.* 1996[◊]).	96% sample had heard of *Salmonella*, 32% *Listeria*, 52% *E.coli*, 8% *Campylobacter* (Jay *et al.* 1999b[▲]).
Knowledge of foods likely to be contaminated with pathogenic bacteria.	73% thought poultry is a food that might constitute a food poisoning risk (Evans, 1992[†]). 60% recognized that soft or raw eggs were a possible danger to public health (Walker, 1996[†]). 91% recognized poultry, 21% beef, 70% meat pies / pasties as common sources of food poisoning (Mathias, 1999[†]).	88% thought that a rare hamburger was a high-risk food (Raab and Woodburn, 1997[◊]). 88% recognized raw eggs could be a potential health risk (Albrecht, 1995[◊]). 56% considered poultry to be high risk for food poisoning (Woodburn and Raab, 1997[◊]). 65% thought meat / poultry have the greatest potential to cause food poisoning illness (ADA / Conagra, 2000[◊]).	No data available.

**= Published data reported lack of knowledge*

APPENDIX 2.6

Comparison of SELF-REPORTED PRACTICES of common food safety issues from some consumer food safety surveys undertaken in UK, USA, Australia and New Zealand.

Food safety issue.	UK[†] / Europe[÷] surveys.	USA[◇] surveys.	Australia[▲] / New Zealand[◆] surveys.
Reported cooking practices.	81% tend to cook meat / poultry for longer than recommended (NCC, 1991[†]). 88% assessed end of cooking subjectively (Beddows, 1983[†]). 85-92% always / usually ensure that food which you cook or heat up is piping hot throughout (FDF, 1996[†]; FSAI, 1998[÷]).	28% consider a hamburger that is pink inside to be cooked, (Nunnery, 1997[◇]). 12% always use a meat thermometer to check doneness of meats (ADA / Conagra, 1999[◇]). 76% do not regularly use a meat / food thermometer to measure the doneness of meats / poultry (ADA / Conagra, 2000[◇]).	No data available.
Reported cooling practices.	35% reported leaving leftover cooked chicken at room temperature for 2-4 hours (Beddows, 1983[†]). 29% people who prepare meals in advance stored cooked meals on work surface and 22% stored food in the saucepan (Mathias, 1999[†]).	Almost 50% respondents incorrectly thought that cooked food should be cooled at room temperature before refrigerating or freezing (Bruhn and Schultz, 1999[◇]). 45% respondents inappropriately left foods at room temperature after heating (Albrecht, 1995[◇]). Leftover stew would be stored in a deep container by 54% respondents, only 32% would store it in a shallow container (Williamson *et al.* 1992[◇]). 65% respondents said they would immediately refrigerate chicken after cooking, however, 29% would let the chicken sit on the counter until it reached room temperature then refrigerate (Williamson *et al.* 1992[◇]).	86% reported they would cool leftover casserole or other food with meat / fish or poultry at room temperature (Jay *et al.* 1999b[▲]).
Reported storage practices.	48% store raw meat / poultry on top shelf, middle shelf, a further 12% store raw foods / poultry wherever there is space in the fridge (Worsfold, 1994[†]). 12% shoppers stated that they store uncooked meat at the top of the fridge (Spriegal, 1991[†]). 91% said they kept raw meat, fish and poultry separate from other foods (Lader, 1999[†]). 57-68% respondents keep raw food below cooked food in the fridge (DHSS and NIHSSB, 1998[†]; FDF, 1996[†]; FSAI, 1998[÷]).	>20% respondents reported placing meat, poultry, or fish on a refrigerator shelf above other foods (Li Cohen and Bruhn, 2001[◇]).	41% respondents said they stored meat on top or middle shelves of the fridge (Jay *et al.* 1999b[▲]).

APPENDIX 2.6 *(continued).*

Food safety issue.		UK[†] / Europe[÷] surveys.	USA surveys.	Australia[▲] / New Zealand[◆] surveys.
Reported hand-washing actions.	*Report of safe practice*	87-92% respondents always / usually wash hands with soap and water before handling food (FDF, 1996, FSAI, 1998; DHSS and NIHSSB, 1998)[†]. 75% always wash and dry hands after handling raw foods (Griffith *et al.* 2001[†]).	66-76% said they wash their hands after handling raw meat / poultry (Altekruse *et al.* 1996; FDA / FSIS, 2000). 72-93% said they almost always washed their hands after handling raw meat or poultry (Shiferaw *et al.* 2000; Nunnery, 1997).	62% always wash hands after handling raw meat / poultry (Ministry of Health, 1995[◆]). 82% said that they washed their hands with soap or detergent (Jay *et al.* 1999b[▲]).
	Report of unsafe practice	26% men and 17% women said they did not always wash their hands before preparing food (FDF, 2001[†]).	20% do not wash hands with soap after handling raw meat / chicken (Yang *et al.* 1998). 19% reported to not routinely wash hands with soap after handling raw meat or chicken (Altekruse *et al.* 1999). 44% consistently forget to wash their hands properly before meal preparation (ADA / Conagra, 1999).	No data available.
Reported cross contamination actions: Separation of raw and cooked foods during food preparation.	*Report of safe practice*	59-76% always / usually use separate utensils eg chopping board for preparation of raw meat and cooked food (DHSS and NIHSSB, 1998[†]; FDF, 1996[†]; FSAI, 1998[÷]). 80% always use different utensils or wash utensils in between use with raw or RTE foods (Griffith *et al.* 1999[†]).	67% stated they wash or change cutting boards after cutting up raw meat / poultry (Altekruse *et al.* 1996). 85-93% always wash chopping board after cutting raw chicken (Nunnery, 1997; Shiferaw *et al.* 2000). 77-80% consumers said they never used the same plate for raw and cooked meat (ADA / Conagra, 2000; Bruhn and Schultz, 1999). 83% participants wash cutting boards used for cutting meat / poultry with soap and /or bleach before using the cutting board again (FDA / FSIS, 2000).	No data available.
	Report of unsafe practice	30-56% who used chopping board for uncooked meat also used the same board for cooked meats (Spriegal, 1991[†]; Beddows, 1983[†]; Worsfold, 1994[†]). 76% do not prepare raw and cooked foods in separate areas of the kitchen, (Worsfold, 1994[†]). 41% weren't likely to wash utensil and chopping boards between preparation of raw food and cooked meat (FSAI, 1998[÷]).	51% said a surface used to cut uncooked meat and poultry would be also used to cut cooked meat (Albrecht, 1995). ~25% said they would use the cutting board after cutting raw meat or chicken without cleaning it (Klontz *et al.* 1995). 19-20% reported not washing cutting board with soap / bleach after using it to cut raw meat / chicken (Altekruse *et al.* 1999; Yang *et al.* 1998) 10% always or sometimes use the same plate for raw and cooked meat or do not wash the plate before using it for cooked meat (Bruhn and Schultz, 1999).	66-71% use the same chopping board / knife for cutting raw meats and other foods (Ministry of Health, 1995[◆]). 30% would perform an unsafe cross contamination action when preparing raw meat and salad vegetables (Jay et al, 1999b[▲]).

APPENDIX 2.7

Intra-study comparisons of knowledge and self-reported practices.

Country of origin.	Sample size.	Food safety issue.	Knowledge of food safety issue.	Self-reported practice of food safety issue.	Reference
USA.	1,620 adults.	Implementation of hand washing.	86% knew implementation of hand-washing actions reduce the risk of food poisoning.	66% consumers reported to wash their hands after handling raw meat and poultry	Altekruse *et al.* 1996.
		Cross contamination.	80% consumers knew that serving steak on a plate that had held raw steak increased the risk of food poisoning	67% reported to clean a cutting board after contact with raw meat / poultry	
		Heating adequacy.	67% knew that cooking meat until well done reduces the risk of food poisoning	71% reported to serve adequately cooked hamburgers at home	
USA.	426 adults.	Cross contamination from raw to cooked foods.	88% demonstrated knowledge of cross contamination from raw to cooked foods.	75% consumers who have reported to practice the concept.	Albrecht, 1995.
		Improper cooling – leaving cooked foods at room temperature.	81% demonstrated knowledge of adequate cooling principles.	46% consumers reported to practice the adequate cooling principles.	
		Cooking.	61% demonstrated knowledge of adequate cooking.	97% consumers reported to cook foods adequately	
USA.	1,000 adults.	Heating adequacy.	74% know that eating meat and chicken not cooked to proper temperatures may cause food poisoning.	12% always use a meat thermometer to check 'doneness' of meat.	ADA, Conagra, 1999.

APPENDIX 2.8

Intra-study comparisons of knowledge and observed behaviour.

Country of origin.	Sample size.	Food safety issue.	Knowledge of food safety issue.	Food safety behaviour	Reference
USA.	121 house-holds.	Hand-washing.	79% of participants correctly identified instances when hand-washing was necessary during food preparation.	20% of these participants were observed to neglect hand-washing practices.	Audits Interna-tional, 1999.
USA.	100 consu-mers.	Cross contamination.	97% rated eating lettuce moistened by raw poultry dripping as 'risky' food handling behaviour.	98% cross-contaminated RTE foods with raw meat / raw egg during food preparation.	Anderson *et al.* 2000.
USA.	121 house-holds.	Cooking.	7% of participants indicated knowledge of heating foods to an adequate temperature.	81% participants were observed to cook their foods to proper temperatures.	Audits Interna-tional, 1999.

APPENDIX 2.9

Intra-study comparisons of self-reported practice and observed behaviour.

(adapted from Anderson _et al._ 2000).

Country of origin = USA.

Sample size of study = 100 consumers.

Food safety issue.	Self-reported practice of food safety issue.	Food safety behaviour.
Hand-washing.	87% reported hand-washing all or most of the time before food preparation.	45% attempted to wash hands before beginning to prepare food.
Cooking.	30% reported to own a food thermometer.	5% used a food thermometer to determine doneness of their meat entrée.

APPENDIX 2.10

Inter-study comparisons between knowledge, attitudes, self-reported practices and actual observed generic food safety behaviours.

Food safety issue.	Knowledge.	Attitudes.	Self-reported practices.	Actual observed behaviour.
Hand-washing / drying.	82-100% knew that it was necessary to wash hands before and after preparing food (Griffith *et al.* 2001; Jay *et al.* 1999b; Lader, 1999). 86% knew that washing hands before preparing food decreases the risk of food poisoning (Altekruse *et al.* 1996).	100% consumers believed that washing and drying of hands after handling raw food was very important (Griffith *et al.* 2001). 95% believed that if hands were washed and dried after handling raw foods it is very likely that food poisoning would be prevented (Griffith *et al.* 2001)	87-92% respondents always wash hands with soap and water before handling food (DHSS and NIHSSB, 1998; FDF, 1996; FSAI, 1998). 62-78% always wash and dry hands after handling raw foods (Altekruse *et al.* 1996; Griffith *et al.* 2001; Ministry of Health, 1995; Nunnery, 1997).	~75-100% failed to wash and dry hands immediately and adequately after handling raw chicken (Griffith *et al.* 1999; Griffith *et al.* 2001; Jay *et al.* 1999a; Worsfold, 1994).
Cross contamination.	78% knew that failure to wash a cutting board after preparation of raw meats and then cutting raw vegetables could result in food poisoning (ADA / Conagra, 1999). 64-77% knew that it was very important to use separate chopping boards for raw meat and other foods (Lader, 1999; Walker, 1996). 97% knew that it is unsafe to use the same unwashed knife / chopping board to cut uncooked chicken and prepare a salad (Bloomfield and Neal, 1997).	90% believed that if different utensils / washed utensils for preparation of raw and RTE foods were used it is very likely that food poisoning would be prevented (Griffith *et al.* 2001). 91% agreed that contact between raw and cooked food can cause food poisoning (Mathias, 1999).	59-76% always / usually use separate utensils eg chopping board for preparation of raw meat and cooked food (DHSS and NIHSSB, 1998; FDF, 1996; FSAI, 1998). 65-85% stated they wash or change cutting boards / plates for cutting up raw meat / poultry and RTE foods (Altekruse *et al.* 1996; Nunnery, 1997; Griffith *et al.* 2001)	52-75% failed to wash / dry c/board and / or knife for preparation of RC then salad ingredients (Griffith *et al.* 1999; Griffith *et al.* 2001). 83-90% did not use separate areas of the kitchen for raw and RTE foods (Anderson *et al.* 2000; Griffith *et al.* 1999; Worsfold, 1994).

APPENDIX 2.10 *(continued).*

Food safety issue.	Knowledge.	Attitudes.	Self-reported practice.	Actual observed behaviour.
Heating efficacy.	96% knew that it is important to check the inside of the chicken to ensure that it is fully cooked (Bloomfield and Neal, 1997). 85% did not know the correct temperature a beef burger needed to reach to be safe to eat (Griffith *et al.* 2001).	40-64% believed that food not being heated / cooked properly was a main cause of food poisoning in the home (DHSS and NIHSSB, 1998; FDF, 1993; FDF, 1996; FSAI, 1998). 86% agreed that cooking food properly prevents food poisoning (Mathias, 1999).	85-92% always ensure that food which you cook or heat up is piping hot throughout (FDF, 1996; FSAI, 1998).	46-83% undercooked home-made burgers / meatloaf and chicken (Griffith *et al.* 1999; Anderson *et al.* 2000)
Cooling.	31% respondents did not know that keeping food at room temp / contamination of food after cooking causes food poisoning (Mathias, 1999).	No data available	86% reported they would cool leftover casserole or other food with meat / fish or poultry at room temperature (Jay *et al.* 1999b).	No data available
Storage of foods.	75% consumers think that food should be refrigerated within one hour of cooking completion (ADA / Conagra, 2000). 73% consumers answered all knowledge questions regarding storage correctly (Griffith *et al.* 2001).	No data available	45% respondents inappropriately reported to leave foods at room temperature after heating (Albrecht, 1995).	No data available

APPENDIX 3.0

QUESTIONNAIRE 1:

ATTITUDES AND PERCEPTIONS TOWARDS FOOD PREPARATION BEHAVIOURS

Please read all of the instructions carefully.

After completion of all questions
return to Elizabeth before leaving UWIC.

YOUR ANSWERS WILL BE TREATED IN THE STRICTEST OF CONFIDENCE

SECTION A

Instructions: By ticking the appropriate box, please indicate your level of <u>agreement / disagreement</u> with <u>each</u> of the following statements.

	Strongly Agree	Agree	Neither Agree or disagree	Disagree	Strongly Disagree
	⇩	⇩	⇩	⇩	⇩
E.G Delia Smith's cooking is always impressive.	☐	☐	☑	☐	☐
Following manufacturers instructions on food packaging is not essential.	☐	☐	☐	☐	☐
Cooking skills are on the decline.	☐	☐	☐	☐	☐
It is better to use different chopping boards for the preparation of raw and cooked meats.	☐	☐	☐	☐	☐
It is important to follow recipe instructions.	☐	☐	☐	☐	☐
Preparation of food in advance does not increase the risk of becoming ill.	☐	☐	☐	☐	☐
Eating convenience Chicken Korma is a more nutritious option than homemade Chicken Korma.	☐	☐	☐	☐	☐
Inadequate cooking of food increases the risk of being ill.	☐	☐	☐	☐	☐
It is essential to clean the work surface after food preparation using an anti bacterial spray.	☐	☐	☐	☐	☐
Convenience meals are much safer to eat than meals made from raw ingredients.	☐	☐	☐	☐	☐
It is not important to check the temperature of the refrigerator regularly.	☐	☐	☐	☐	☐
It is unacceptable to store cooked meats at room temperature.	☐	☐	☐	☐	☐
Consumption of low fat products is healthier than full fat products.	☐	☐	☐	☐	☐
Washing hands after handling cooked, sliced ham is not necessary	☐	☐	☐	☐	☐
Eating runny eggs is undesirable.	☐	☐	☐	☐	☐
Expensive utensils are necessary for good food preparation.	☐	☐	☐	☐	☐
Good hygiene is more important when handling raw foods than when handling cooked foods.	☐	☐	☐	☐	☐
Increased consumption of vitamins and minerals can reduce the risk of catching colds.	☐	☐	☐	☐	☐
It is all right to taste food with fingers during food preparation.	☐	☐	☐	☐	☐
Cooked foods, once cooled should be refrigerated or frozen immediately.	☐	☐	☐	☐	☐
Raw meat bought fresh from a butcher is of better quality than raw meat bought from the supermarket.	☐	☐	☐	☐	☐
It is acceptable to eat beef-burgers that are cooked to 'medium-rare' (slightly pink in the middle).	☐	☐	☐	☐	☐
Pre-packaged raw meats are free from germs.	☐	☐	☐	☐	☐

SECTION A CONTINUED

	Strongly Agree	Agree	Neither Agree or disagree	Disagree	Strongly Disagree
	⇩	⇩	⇩	⇩	⇩
A meat thermometer is not particularly useful when cooking meat.	❑	❑	❑	❑	❑
Keeping food at a luke warm temperature for later consumption is acceptable.	❑	❑	❑	❑	❑
The use of electrical domestic appliances is essential for good food preparation.	❑	❑	❑	❑	❑
It is essential for hot food to be cooled down quickly for storage.	❑	❑	❑	❑	❑
Grilling is a better cooking method than frying.	❑	❑	❑	❑	❑
Food manufacturers are ultimately responsible for the safety of their foods.	❑	❑	❑	❑	❑
It is not all right to leave cooked rice in a bowl on a kitchen work surface overnight.	❑	❑	❑	❑	❑
There is a need for Home Economics teaching in schools	❑	❑	❑	❑	❑
It is all right to eat food if the outside looks well cooked.	❑	❑	❑	❑	❑
Ethnic foods (e.g. Chinese, Thai) taste nicer than traditional British varieties (meat, vegetables, potatoes).	❑	❑	❑	❑	❑
There is no need to wash hands before handling raw chicken.	❑	❑	❑	❑	❑
Paper towels are more useful in the kitchen than J cloths.	❑	❑	❑	❑	❑
Ensuring that frozen food has been thoroughly defrosted before cooking is not necessary.	❑	❑	❑	❑	❑
Cookbooks are useful sources of food safety information.	❑	❑	❑	❑	❑
It is acceptable to eat foods containing raw egg.	❑	❑	❑	❑	❑
Food that is more expensive is likely to have a higher nutritional content.	❑	❑	❑	❑	❑
Reheating food to a warm temperature is acceptable.	❑	❑	❑	❑	❑
TV cooking programmes are useful sources of food hygiene information.	❑	❑	❑	❑	❑
Preparing food whilst suffering from an upset stomach is not a good idea.	❑	❑	❑	❑	❑
Expensive cookbooks have more complicated recipes than cheaper cookbooks.	❑	❑	❑	❑	❑
It is acceptable to cool foods at room temperature.	❑	❑	❑	❑	❑
A microwave thermometer is not a particularly useful gadget to have in the domestic kitchen.	❑	❑	❑	❑	❑
The use of clean utensils / equipment is essential when handling cooked foods.	❑	❑	❑	❑	❑
It is safe to eat steak that has been cooked 'rare' or 'medium-rare'.	❑	❑	❑	❑	❑
It is not necessary to cool portions of left over (e.g.) casseroles with cold water.	❑	❑	❑	❑	❑

SECTION B

Instructions: Please circle a number on the lines below to show how strongly you feel about each of the statements:

➔ ***EXAMPLE: How much control do you have over what foods you buy at the supermarket?***

No control at all 1 2 3 4 5 6 7 8 9 10 **Full control**

➔ How much control do you feel that you have over your own food safety?

No control at all 1 2 3 4 5 6 7 8 9 10 **Full control**

➔ How much control over the nutritional content of the foods do you feel that you have?

No control at all 1 2 3 4 5 6 7 8 9 10 **Full control**

➔ How much control do you think other people have over food safety during their own food preparation?

No control at all 1 2 3 4 5 6 7 8 9 10 **Full control**

➔ What do you consider the <u>risk</u> of illness to be after your own food preparation?

Very Low risk 1 2 3 4 5 6 7 8 9 10 **Very high risk**

➔ What risk is there that you will cut yourself while using a knife?

Very Low risk 1 2 3 4 5 6 7 8 9 10 **Very high risk**

➔ What do you consider the <u>risk</u> of other people experiencing food poisoning to be, after their own food preparation?

Very Low risk 1 2 3 4 5 6 7 8 9 10 **Very high risk**

➔ How much responsibility do you accept for the nutritional quality of your diet?

No responsibility at all 1 2 3 4 5 6 7 8 9 10 **Total responsib-ility**

➔ How much responsibility for your own food safety do you have?

No responsibility at all 1 2 3 4 5 6 7 8 9 10 **Total responsib-ility**

SECTION C

Instructions: Rank each place of food consumption. State '1' in the relevant box, where you would expect to be served the <u>least nutritionally balanced</u> meal, through to '11' where you would expect to be served the <u>most nutritionally balanced</u> meal.

Supermarket restaurant	❑	Hospital / Old persons home	❑
5 star hotel / restaurant	❑	Parents / friends house	❑
2 star hotel / restaurant	❑	Ethnic restaurant (e.g. Chinese, Thai)	❑
Own home	❑	University / school / work canteen	❑
Takeaway van	❑	Pub	❑
		Fast food establishment (e.g. McDonalds)	❑

Rank each place of food consumption. State '1' in the relevant box, where you would <u>least</u> expect to get <u>food poisoning</u>, through to '11' where you would <u>most</u> expect to get <u>food poisoning</u>.

Supermarket restaurant	❑	Hospital / Old persons home	❑
5 star hotel / restaurant	❑	Parents / friends house	❑
2 star hotel / restaurant	❑	Ethnic restaurant (e.g. Chinese, Thai)	❑
Own home	❑	University / school / work canteen	❑
Takeaway van	❑	Pub	❑
		Fast food establishment (e.g. McDonalds)	❑

Thank-you for completing this questionnaire.

APPENDIX 3.2

Spearmans *rho* correlations of attitudes towards food safety behaviours ($p<0.05$).

Attitude statement	Attitude statement	*n*	*r*
Reheating food to a warm temperature is acceptable.	Keeping food at a luke warm temperature for later consumption is acceptable	*94*	0.519
Cooked foods, once cooled should be refrigerated or frozen immediately.	It is essential for hot food to be cooled down quickly for storage	*97*	0.504
The use of clean utensils / equipment is essential when handling cooked foods	It is better to use different chopping boards for the preparation of raw and cooked meats.	*93*	0.455
Cooked foods, once cooled should be refrigerated or frozen immediately.	It is better to use different chopping boards for the preparation of raw and cooked meats.	*98*	0.454
Preparing food whilst suffering from an upset stomach is not a good idea.	It is essential for hot food to be cooled down quickly for storage	*97*	0.421
It is essential for hot food to be cooled down quickly for storage	It is not all right to leave cooked rice in a bowl on a kitchen work surface overnight	*94*	0.407
It is unacceptable to store cooked meats at room temperature.	Inadequate cooking of food increases the risk of being ill.	*99*	0.399
Reheating food to a warm temperature is acceptable.	Pre-packaged raw meats are free from germs.	*98*	0.389
Cooked foods, once cooled should be refrigerated or frozen immediately.	Inadequate cooking of food increases the risk of being ill.	*99*	0.359
Cooked foods, once cooled should be refrigerated or frozen immediately.	The use of clean utensils / equipment is essential when handling cooked foods	*94*	0.358
Cooked foods, once cooled should be refrigerated or frozen immediately.	It is not all right to leave cooked rice in a bowl on a kitchen work surface overnight	*94*	0.346
A microwave thermometer is not a particularly useful gadget to have in the domestic kitchen	It is all right to taste food with fingers during food preparation.	*92*	0.335
Reheating food to a warm temperature is acceptable.	It is all right to eat food if the outside looks well cooked.	*94*	0.334
The use of clean utensils / equipment is essential when handling cooked foods	It is unacceptable to store cooked meats at room temperature.	*93*	0.333
Ensuring that frozen food has been thoroughly defrosted before cooking is not necessary.	There is no need to wash hands before handling raw chicken	*92*	0.331
It is essential to clean the work surface after food preparation using an anti bacterial spray.	It is better to use different chopping boards for the preparation of raw and cooked meats.	*97*	0.330
Inadequate cooking of food increases the risk of being ill.	It is essential for hot food to be cooled down quickly for storage	*98*	0.320
It is essential to clean the work surface after food preparation using an anti bacterial spray	Pre-packaged raw meats are free from germs.	*98*	0.317
Pre-packaged raw meats are free from germs.	Inadequate cooking of food increases the risk of being ill.	*100*	-0.322
Pre-packaged raw meats are free from germs.	It is unacceptable to store cooked meats at room temperature.	*99*	-0.345
Cooked foods, once cooled should be refrigerated or frozen immediately.	Keeping food at a luke warm temperature for later consumption is acceptable	*95*	-0.355
Preparing food whilst suffering from an upset stomach is not a good idea.	Reheating food to a warm temperature is acceptable.	*97*	-0.367
The use of clean utensils / equipment is essential when handling cooked foods	Reheating food to a warm temperature is acceptable.	*94*	-0.370
Preparing food whilst suffering from an upset stomach is not a good idea.	Keeping food at a luke warm temperature for later consumption is acceptable	*93*	-0.371
It is unacceptable to store cooked meats at room temperature.	Keeping food at a luke warm temperature for later consumption is acceptable	*94*	-0.397
It is acceptable to cool foods at room temperature	It is essential for hot food to be cooled down quickly for storage	*93*	-0.404
Inadequate cooking of food increases the risk of being ill.	Reheating food to a warm temperature is acceptable.	*98*	-0.423
It is essential for hot food to be cooled down quickly for storage	Keeping food at a luke warm temperature for later consumption is acceptable	*94*	-0.440

APPENDIX 3.3

Spearmans *rho* correlation coefficients between ranked perceptions of risk, control and responsibility.

		Personal Control for food safety	Other peoples control for food safety	Risk of illness after own food preparation	Risk of others experiencing illness after their own food preparation.	Personal responsibility for food safety.
Personal Control for food safety	Correlation	1.000				
	Sig. (2-tailed)	.				
	n	98				
Other peoples control for food safety	Correlation	**0.568**●**	1.000			
	Sig. (2-tailed)	**0.000**	.			
	n	**93**	93			
Risk of illness after own food preparation	Correlation	**-0.266**◗**	-0.183	1.000		
	Sig. (2-tailed)	**0.008**	0.081	.		
	n	**97**	92	97		
Risk of others experiencing illness after their own food prep.	Correlation	0.063	0.014	**0.196**	1.000	
	Sig. (2-tailed)	0.546	0.893	**0.061**	.	
	n	93	92	**92**	93	
Personal responsibility for food safety.	Correlation	**0.570**●**	**0.439**●**	**-0.409**●**	0.022	1.000
	Sig. (2-tailed)	**0.000**	**0.000**	**0.000**	0.834	.
	n	**96**	**92**	**95**	92	96

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

◗ = Correlation is significant at 0.05 level (2 tailed) with Bonferroni correction (0.01)

● = Correlation is significant at 0.01 level (2 tailed) with Bonferroni correction (0.0002)

APPENDIX 3.4

Spearmans *rho* correlation coefficients between ranked locations denoting perceived expectation for getting food poisoning (*n*=78).

Location	Ethnic restaurant.	Fast-food restaurant.	5 Star hotel	Hospital / OAP home.	Own home	Friends / family home	Pub	Supermarket	Takeaway van	2 Star hotel	Canteen
Ethnic restaurant	1.00										
Fast-food	-0.064	1.00									
5 Star hotel	**-0.302****	**-0.26***	1.00								
Hospital / OAP home	0.059	-0.04	-0.19	1.00							
Own home	**-0.35**◗**	**-0.40**◗**	0.13	-0.26	1.00						
Friends / family home	-0.21	**-0.41**◗**	0.10	-0.10	**0.41****	1.00					
Pub	-0.10	-0.09	-0.08	-0.37	0.08	-0.11	1.00				
Supermarket	-0.14	-0.19	0.03	-0.13	0.08	-0.02	0.01	1.00			
Takeaway van	**0.42**◗**	**0.34**◗**	**-0.44****	0.05	**-0.48**◗**	**-0.42**◗**	0.04	**-0.29***	1.00		
2 Star hotel	-0.07	-0.22	**0.29***	**-0.23***	0.08	-0.06	-0.08	0.20	-0.18	1.00	
Canteen	-0.07	0.06	-0.05	0.10	0.02	-0.16	-0.16	**-0.28***	0.14	**-0.30****	1.00

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

◗ = Correlation is significant at 0.05 level (2 tailed) with Bonferroni correction (0.0045).

●= Correlation is significant at 0.01 level (2 tailed) with Bonferroni correction (0.0009)

APPENDIX 4.0

APPENDIX 4.1

Covering letter sent to participants with Questionnaire 2.

University of Wales Institute, Cardiff
School of Applied Sciences,
Colchester Avenue, Cardiff CF23 9XR
Tel 029 2041 6452

Xx xxxx xxxx

Dear

On behalf of the UWIC Food Research Group, I would like to thank-you for your co-operation and participation in previous parts of the research project.

Enclosed is a questionnaire concerning food safety education issues which should take about 20 minutes to complete. Once you have completed *all* of the questions, please return the questionnaire in the prepaid and addressed envelope as soon as possible (before xxth xxxx xxxx).

As a token of thanks for your time and co-operation of completing and returning the questionnaire, I will send you a **£5 voucher** for Sainsbury's, Tesco's or Marks and Spencers on return of the fully completed questionnaire. Please state your name and address on the final sheet of this questionnaire and indicate which voucher type you would like to be sent.

As with the information gained from the food preparation sessions, all data collected during the course of the study will be treated with **complete confidentiality**. If you have any problems with the questionnaire, please do not hesitate to contact me at UWIC on Cardiff 2041 6452. I am extremely grateful for your participation and help with my research.

I look forward to receiving your questionnaire.

Thank you again for your helpful co-operation, without your help the majority of my research would not be possible.

Yours Sincerely,

Elizabeth Redmond (Research Assistant)

QUESTIONNAIRE 2:
ATTITUDES AND PERCEPTIONS TOWARDS FOOD SAFETY EDUCATION

Please read all of the instructions for each question and return the fully completed questionnaire to Elizabeth Redmond at UWIC in the enclosed prepaid envelope.

YOUR ANSWERS WILL BE TREATED IN THE STRICTEST OF CONFIDENCE

SECTION A: ATTITUDES TO FOOD HYGIENE INFORMATION SOURCES.

A.1 By ticking the appropriate box, please indicate your level of <u>agreement / disagreement</u> with <u>each</u> of the following statements.

	Strongly Agree	**Agree**	**Neither Agree or disagree**	**Disagree**	**Strongly Disagree**
	⇩	⇩	⇩	⇩	⇩
Delia Smith's cooking is always impressive.	☐	☐	☑	☐	☐
• I do not need to be given any food safety advice.	☐	☐	☐	☐	☐
• I do not feel that enough food safety advice is available to me.	☐	☐	☐	☐	☐
• I have never acted upon any food safety advice in the past.	☐	☐	☐	☐	☐
• Information about the risks of inadequate food safety practices *will not* have any effect upon my current food preparation practices.	☐	☐	☐	☐	☐
• I am more likely to take notice of messages about specific food safety behaviours than generalised messages.	☐	☐	☐	☐	☐
• No information given to me is likely to change my food safety behaviour.	☐	☐	☐	☐	☐
• I think I know all of the food safety precautions necessary for safe food preparation.	☐	☐	☐	☐	☐
• I am confident that my current food preparation behaviours do not give rise to a risk of food poisoning.	☐	☐	☐	☐	☐
• My current food safety behaviours do not need improvement.	☐	☐	☐	☐	☐
• I am willing to listen or read any information on food safety.	☐	☐	☐	☐	☐
• I am not prepared to listen or read any advice regarding food safety.	☐	☐	☐	☐	☐
• Other people need advice concerning food safety more than I do.	☐	☐	☐	☐	☐
• I always carry out all the necessary food safety precautions that I know during food preparation.	☐	☐	☐	☐	☐
• Information about the risks of inadequate food safety practices *may* change my current food preparation practices.	☐	☐	☐	☐	☐
• I am unlikely to act upon information given to me in the future concerning food safety.	☐	☐	☐	☐	☐
• Other people take more notice of food safety advice than I do.	☐	☐	☐	☐	☐

	Strongly Agree ⇩	Agree ⇩	Neither Agree or disagree ⇩	Disagree ⇩	Strongly Disagree ⇩
• Personal experience of food poisoning has a greater chance of improving food safety behaviour than education	❑	❑	❑	❑	❑
• I am likely to read food safety advice stated on food packaging.	❑	❑	❑	❑	❑
• I sometimes carry out all the necessary food safety precautions that I know during food preparation.	❑	❑	❑	❑	❑
• Information regarding the consequences of inadequate food safety practices is likely to alter my food preparation behaviour.	❑	❑	❑	❑	❑
• Hearing stories about cases of food poisoning will lead to improvements in my food safety behaviour.	❑	❑	❑	❑	❑
• I do not like hearing the symptoms and medical details about food poisoning.	❑	❑	❑	❑	❑
• I never carry out all the necessary food safety precautions that I know during food preparation.	❑	❑	❑	❑	❑
• Information about the risks of inadequate food safety practices would *definitely* make me change my current food preparation practices.	❑	❑	❑	❑	❑
• I am likely to pay no attention to food safety advice on food packaging.	❑	❑	❑	❑	❑
• There is a need for food safety to be taught in schools.	❑	❑	❑	❑	❑
• It is important for TV chefs to carry out all necessary food safety practices when preparing food on television shows.	❑	❑	❑	❑	❑

SECTION B: FOOD SAFETY LEAFLETS

B.1 Have you ever received a food safety leaflet posted through your door? *(✓one only)* Yes ❑ No ❑

B.2 Do you ever pick up food safety leaflets while outside the home? *(✓one only)* Yes ❑ No ❑

B.3 Likelihood of picking food safety leaflets up.
Please circle a number on each line below to show how likely you are pick up food safety leaflets up from the following locations.

	Extremely LIKELY									**Extremely UNLIKELY**
Example: Town Hall	1	2	3	4	5	6	7	8	9	10
Doctor surgery / clinic	1	2	3	4	5	6	7	8	9	10
Dentist	1	2	3	4	5	6	7	8	9	10
Supermarket	1	2	3	4	5	6	7	8	9	10
Schools / colleges	1	2	3	4	5	6	7	8	9	10
Magazines / Newspapers	1	2	3	4	5	6	7	8	9	10
Library	1	2	3	4	5	6	7	8	9	10
Environmental Health Dept	1	2	3	4	5	6	7	8	9	10

B.4 How likely are you to <u>read</u> food safety leaflets that you have picked up? *(circle the likelihood)*

1	2	3	4	5	6	7	8	9	10

SECTION C: TELEVISION

C.1 Have you ever watched any television cookery programmes? *(✓one only)* Yes ❑ No ❑

If 'yes' which of the following television cookery programmes have you watched? *(✓as many as necessary)*

Can't Cook Won't Cook	❑	The Good Food Show	❑
Ready Steady Cook	❑	Ken Hom	❑
Late lunch	❑	The Naked Chef	❑
Masterchef	❑	Yan Can Cook	❑
Delia Smith	❑	Food and Drink	❑
Two Fat Ladies	❑	Gary Rhodes	❑

C.2 How likely are you to watch a television cookery programme? *(✓one only)*

Extremely likely	❑
Likely	❑
Neither likely or unlikely	❑
Unlikely	❑
Extremely unlikely	❑

C.3 How would you rate the majority of TV chef's food safety behaviour? ***(✓one only)***

- Excellent ❑
- Good ❑
- Average ❑
- Poor ❑
- Very poor ❑

C.4 Do you think that television chefs should demonstrate good food safety practices? ***(✓one only)***

Yes ❑ No ❑

C.5 Do you think you pick up good food safety habits from TV cooking programmes? ***(✓one only)***

Yes ❑ No ❑

C.6 Have you ever watched any television documentaries on food safety? ***(✓one only)***

Yes ❑ No ❑

C.7 How likely are you to watch a television documentary on food safety? ***(✓one only)***

- Extremely likely ❑
- Likely ❑
- Neither likely or unlikely ❑
- Unlikely ❑
- Extremely unlikely ❑

SECTION D: SOURCES OF FOOD SAFETY INFORMATION

D.1 Have you seen any food safety information from the following sources in the past 6 months? ***(✓as many as necessary)***

- Leaflet ❑
- Recipes ❑
- Television cooking programmes ❑
- Television documentaries ❑
- Television other (ie morning TV / the news) ❑
- Food packaging ❑
- Magazine articles ❑
- Poster ❑
- Friends ❑
- Family ❑
- Schools ❑
- University ❑
- T-towels / magnets ❑
- Radio programme ❑
- Advice from doctor, health visitor or equivalent ❑

D.2 Preference of receiving food safety information from the following sources. ***Please circle a number on each line below to show which source of food safety information you would prefer.***

	MOST PREFERABLE source									**LEAST PREFERABLE source**
Example: Source	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Leaflet.	1	2	3	4	5	6	7	8	9	10
Television Cooking Programme.	1	2	3	4	5	6	7	8	9	10
Television other (e.g. morning TV / the news).	1	2	3	4	5	6	7	8	9	10
Television documentaries.	1	2	3	4	5	6	7	8	9	10
Radio programmes.	1	2	3	4	5	6	7	8	9	10
Magazine articles.	1	2	3	4	5	6	7	8	9	10
Recipes.	1	2	3	4	5	6	7	8	9	10
Food packaging.	1	2	3	4	5	6	7	8	9	10
Posters with food safety information.	1	2	3	4	5	6	7	8	9	10
Fridge magnets with food safety information.	1	2	3	4	5	6	7	8	9	10
T-Towels with food safety information.	1	2	3	4	5	6	7	8	9	10
Advice from schools / colleges.	1	2	3	4	5	6	7	8	9	10
Advice from family.	1	2	3	4	5	6	7	8	9	10
Advice from friends.	1	2	3	4	5	6	7	8	9	10
Advice from doctor, health visitor or equivalent.	1	2	3	4	5	6	7	8	9	10

SECTION E: CREDIBILITY AND TRUST OF FOOD SAFETY INFROMATION FROM DIFFERENT SOURCES

E.1 Credibility / trustworthiness of food safety information from different organisations.

Firstly, circle a number on each line below to show how trustworthy / credible you think information provided from each following organisation is.

	MOST trustworthy									**LEAST trustworthy**
Example: Hospital	1	2	3	4	5	6	7	8	9	10
Food Standards Agency.	1	2	3	4	5	6	7	8	9	10
Environmental Health Depts.	1	2	3	4	5	6	7	8	9	10
Health Education Authority.	1	2	3	4	5	6	7	8	9	10
Medical Council.	1	2	3	4	5	6	7	8	9	10
Government authorities.	1	2	3	4	5	6	7	8	9	10
Supermarkets.	1	2	3	4	5	6	7	8	9	10
Commercial Advisory Councils (e.g. Domestos).	1	2	3	4	5	6	7	8	9	10
Product Specific Advisory Councils (e.g. Dairy Council).	1	2	3	4	5	6	7	8	9	10
Food and Drink Federation.	1	2	3	4	5	6	7	8	9	10
Health Promotion Units.	1	2	3	4	5	6	7	8	9	10

E.2 The following people listed below can promote food safety information.

Circle a number on each line below to show who you would be likely / unlikely to believe as a source of food safety information.

	EXTREMELY LIKELY to believe									EXTREMELY UNLIKELY to believe
Example: Accountant	1	2	3	4	5	6	7	8	9	10
Scientist.	1	2	3	4	5	6	7	8	9	10
Nurse.	1	2	3	4	5	6	7	8	9	10
Chief Medical Officer.	1	2	3	4	5	6	7	8	9	10
Environ. Health Officer.	1	2	3	4	5	6	7	8	9	10
Teacher / Lecturer.	1	2	3	4	5	6	7	8	9	10
Midwife.	1	2	3	4	5	6	7	8	9	10
Medical Doctor.	1	2	3	4	5	6	7	8	9	10
Politician.	1	2	3	4	5	6	7	8	9	10
Television Chef.	1	2	3	4	5	6	7	8	9	10
Shop assistant / manager.	1	2	3	4	5	6	7	8	9	10
News reader.	1	2	3	4	5	6	7	8	9	10
Health visitor.	1	2	3	4	5	6	7	8	9	10
Farmer.	1	2	3	4	5	6	7	8	9	10
Health Educator.	1	2	3	4	5	6	7	8	9	10
Familiar TV personality.	1	2	3	4	5	6	7	8	9	10

Thank you for completing this Questionnaire.

Please return to Elizabeth in the enclosed pre-paid envelope.

I will send a £5 voucher for SAINSBURY'S, TESCO'S or MARKS AND SPENCERS as a token of thanks for return of a fully completed questionnaire.

Please state type of voucher that you would like:

Please complete:

Name and Address to send your vouchers:

....

....

....

Post code: ....

APPENDIX 4.3

Spearmans *rho* correlations between attitudes towards food safety education *(p<0.05 ᵇ)*.

Attitude statement	Attitude statement	*n*	*r*
No information given to me is likely to change my food safety behaviour.	Information about the risks of inadequate food safety practices *will not* have any effect upon my current food preparation practices.	*61*	0.701
No information given to me is likely to change my food safety behaviour.	I have never acted upon any food safety advice in the past.	*61*	0.612
I am unlikely to act upon information given to me in the future concerning food safety.	No information given to me is likely to change my food safety behaviour.	*61*	0.609
Information about the risks of inadequate food safety practices *will not* have any effect upon my current food preparation practices.	I have never acted upon any food safety advice in the past.	*61*	0.578
My current food safety behaviours do not need improvement.	I think I know all of the food safety precautions necessary for safe food preparation.	*61*	0.546
I am confident that my current food preparation behaviours do not give rise to a risk of food poisoning.	I always carry out all the necessary food safety precautions that I know during food preparation.	*61*	0.541
I am unlikely to act upon information given to me in the future concerning food safety.	Information about the risks of inadequate food safety practices *will not* have any effect upon my current food preparation practices.	*61*	0.535
I am unlikely to act upon information given to me in the future concerning food safety.	I have never acted upon any food safety advice in the past.	*61*	0.528
Other people take more notice of food safety advice than I do.	I am not prepared to listen or read any advice regarding food safety.	*61*	0.527
Information about the risks of inadequate food safety practices would *definitely* make me change my current food preparation practices	Information regarding the consequences of inadequate food safety practices is likely to alter my food preparation behaviour	*61*	0.526
I am willing to listen or read any information on food safety.	Information about the risks of inadequate food safety practices would *definitely* make me change my current food preparation practices	*61*	0.507
I am unlikely to act upon information given to me in the future concerning food safety.	I am not prepared to listen or read any advice regarding food safety.	*61*	0.494
I am not prepared to listen or read any advice regarding food safety.	No information given to me is likely to change my food safety behaviour.	*61*	0.485
My current food safety behaviours do not need improvement.	I am confident that my current food preparation behaviours do not give rise to a risk of food poisoning.	*61*	0.483
I am not prepared to listen or read any advice regarding food safety.	Information about the risks of inadequate food safety practices *will not* have any effect upon my current food preparation practices.	*61*	0.462
I am confident that my current food preparation behaviours do not give rise to a risk of food poisoning.	I think I know all of the food safety precautions necessary for safe food preparation.	*61*	0.407
I am willing to listen or read any information on food safety.	Information regarding the consequences of inadequate food safety practices is likely to alter my food preparation behaviour.	*61*	0.403
Information about the risks of inadequate food safety practices would *definitely* make me change my current food preparation practices	Information about the risks of inadequate food safety practices *may* change my current food preparation practices	*61*	0.403
Information regarding the consequences of inadequate food safety practices is likely to alter my food preparation behaviour.	I have never acted upon any food safety advice in the past.	*61*	-0.400
Other people take more notice of food safety advice than I do.	I am willing to listen or read any information on food safety.	*61*	-0.402
I am unlikely to act upon information given to me in the future concerning food safety.	I am willing to listen or read any information on food safety.	*61*	-0.407
Information regarding the consequences of inadequate food safety practices is likely to alter my food preparation behaviour.	Information about the risks of inadequate food safety practices *will not* have any effect upon my current food preparation practices.	*61*	-0.532
I am not prepared to listen or read any advice regarding food safety.	I am willing to listen or read any information on food safety.	*61*	-0.561

APPENDIX 4.4

Correlations between likely locations for picking up food safety leaflets (*n*=61).

Locations	Super-market.	Magazines newspapers	Doctors surgery / clinic.	Dentist.	Library.	Environ. Health Dept.	Schools / colleges.
Supermarket.	1.000						
Magazines / newspapers.	0.596**●	1.000					
Doctors surgery / clinic.	0.273*	0.326*	1.000				
Dentist.	0.227	0.421**●	0.655**●	1.000			
Library .	0.530**●	0.558**●	0.563**●	0.417**●	1.000		
Environmental Health Dept.	0.104	0.305*	0.369*◗	0.326*	0.490**●	1.000	
Schools / colleges.	0.213	0.236	0.463**●	0.429**●	0.347**◗	0.506**●	1.000

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

◗ = Correlation is significant at 0.05 level (2 tailed) with Bonferroni correction (0.007).

● = Correlation is significant at 0.01 level (2 tailed) with Bonferroni correction (0.001).

APPENDIX 4.5

Sample exposure to food safety information

during the 6 months before the survey (*n*=61).

Information source.	Respondents who have stated they have seen food safety information source *n* (%).	
Food packaging.	36 (59)	MOST frequently seen source of food safety information in the past 6 months.
Magazine articles.	25 (41)	
TV cookery programmes.	21 (34)	
Leaflet.	16 (26)	
TV documentaries.	13 (21)	
Recipes.	12 (20)	
Family.	11 (18)	
Radio programmes.	11 (18)	
TV other (morning TV, news programmes).	10 (16)	
Advice from doctor, health visitor or equivalent	6 (10)	
Friends.	6 (10)	
Schools.	5 (8)	
Poster.	3 (5)	
University.	1 (2)	
T'towels / magnets.	1 (2)	LEAST frequently seen source of food safety information in the past 6 months.

APPENDIX 4.6 Correlations between preferable sources of food safety information (n=61).

	Food packaging	Advice from doctor, health visitor.	Leaflets.	TV documentary.	Recipes.	TV Cooking programme.	Magazine articles.	Posters with food safety info.	TV (Other).	Radio programmes.	Advice from family.	Advice from schools / college.	Advice from friends.	Fridge magnets.	T-Towels.
Food packaging.	1.000														
Advice from doctor / health visitor.	0.344**	1.000													
Leaflets.	0.244	0.254*	1.000												
TV documentaries.	0.288*	0.317*	0.226	1.000											
Recipes.	0.493**●	0.225	0.286*	0.106	1.000										
TV cookery programmes.	0.242	0.437**●	0.228	0.443**●	0.232	1.000									
Magazine articles.	0.076	0.169	0.300*	0.413*◗	0.095	0.350**	1.000								
Posters .	0.494**●	0.477**●	0.238	0.221	0.346**	0.282*	0.122	1.000							
TV (Other).	0.179	0.174	0.229	0.386**◗	-0.016	0.216	0.220	0.356**	1.000						
Radio programmes.	0.028	0.014	0.138	0.412**◗	0.019	-0.085	0.351**	-0.018	0.244	1.000					
Advice from family.	0.103	0.218	0.356**	0.308*	-0.026	0.297*	0.252	0.324*	0.418**◗	0.312	1.000				
Advice from schools / college.	0.253*	0.317*	0.406**▲	0.374**●	0.051	0.383**◗	0.187	0.165	0.181	0.085	0.417**◗	1.000			
Advice from friends.	0.124	0.202	0.283*	0.321*	-0.118	0.173	0.199	0.227	0.330**	0.466**●	0.811**●	0.364**	1.000		
Fridge magnets.	0.112	0.105	0.160	0.006	0.267*	0.334**	0.072	0.324*	0.169	0.001	0.356**	0.191	0.376**◗	1.000	
T-towels.	0.073	0.023	0.079	-0.055	0.284*	0.312*	0.024	0.268*	0.175	-0.036	0.306*	0.150	0.279*	0.910**●	1.000

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

◗ = Correlation is significant at 0.05 level (2 tailed) with Bonferroni correction (0.003).

● = Correlation is significant at 0.01 level (2 tailed) with Bonferroni correction (0.0006).

APPENDIX 4.7

Correlations between ranked perceptions of credibility / trustworthiness for listed organisations (*n*=61).

	Environmental Health Department	Food Standards Agency	Health Education Authority	Health Promotion Units	Medical Council	Product specific councils	Commerical Hygiene Advisory	Food and Drink Federation	Supermarkets	Government Authorities
Environmental Health Department.	1.000									
Food Standards Agency	0.738**●	1.000								
Health Education Authority	0.764**●	0.694**●	1.000							
Health Promotion Units	0.452**●	0.667**●	0.533**●	1.000						
Medical Council	0.623**●	0.574**●	0.642**●	0.397*◗	1.000					
Product specific councils	0.415**●	0.467**●	0.417**●	0.494**●	0.585**●	1.000				
Commercial Hygiene Advisory	0.174	0.143	0.249	0.365**▲	0.418**●	0.527**●	1.000			
Food and Drink Federation	0.477**●	0.448**●	0.416**●	0.513**●	0.524**●	0.731**●	0.472**●	1.000		
Supermarkets	0.361*◗	0.201	0.284*	0.207	0.275*	0.341**	0.280	0.442**●	1.000	
Government Authorities	0.259*	0.466**●	0.450**●	0.372**	0.539**●	0.418**●	0.407**●	0.392**◗	0.293*	1.000

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

◗ = Correlation is significant at 0.05 level (2 tailed) with Bonferroni correction (0.005).

●= Correlation is significant at 0.01 level (2 tailed) with Bonferroni correction (0.001).

APPENDIX 4.8

Correlations between the likelihood of believing food safety information promoted by specific spokepersons (*n*=61).

Spokesperson	EHO	Chief Medical Officer	Medical doctor	Health Educator	Scientist	Health visitor	Nurse	Televisi on Chef	Midwife	Teacher, lecturer	News-reader	Shop assistant, manager	Farmer	Familiar TV persona-lity	Politic-ian
EHO.	1.000														
Chief Medical Officer.	0.761**●	1.000													
Medical doctor.	0.543**●	0.604**●	1.000												
Health Educator.	0.526**●	0.530**●	0.581**●	1.000											
Scientist.	0.409**◗	0.628**●	0.520**●	0.383**◗	1.000										
Health visitor.	0.497**●	0.594**●	0.519**●	0.478**●	0.557**●	1.000									
Nurse.	0.446**	0.618**●	0.462**●	0.432**●	0.552**●	0.649**●	1.000								
Television Chef.	0.373**◗	0.337**◗	0.294*	0.364**	0.327	0.446**●	0.198	1.000							
Midwife.	0.493**●	0.555**●	0.597**●	0.490**●	0.573**●	0.710**●	0.601**●	0.258*	1.000						
Teacher / lecturer.	0.439**●	0.527**●	0.425**●	0.370**◗	0.547**●	0.509**●	0.514**●	0.152	0.674**●	1.000					
Newsreader.	0.065	0.211	0.111	0.164	0.244	0.170	0.124	0.158	0.042	0.088	1.000				
Shop assistant / manager.	0.327*	0.395**◗	0.220	0.331**	0.228	0.425**●	0.320*	0.423**●	0.296*	0.278*	0.323*	1.000			
Farmer.	0.302*	0.245	0.214	0.436**◗	0.120	0.217	0.157	0.087	0.257*	0.321*	0.274*	0.515**●	1.000		
Familiar TV personality.	0.147	0.214	0.248	0.351**	0.235	0.330**◗	0.238	0.101	0.407**◗	0.297*	0.267*	0.437**●	0.671**●	1.000	
Politician.	0.091	0.357**	0.112	0.263*	0.362**	0.220	0.091	0.169	0.169	0.339**	0.455**●	0.362**	0.336**	0.352**	1.000

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

◗ = Correlation is significant at 0.05 level (2 tailed) with Bonferroni correction (0.003).

● = Correlation is significant at 0.01 level (2 tailed) with Bonferroni correction (0.0006).

APPENDIX 5.0

APPENDIX 5.1

Recipes for meal preparation session 1.

HOME-MADE CHICKEN KORMA AND TURMERIC RICE FOLLOWED BY HOME-MADE CHOCOLATE MOUSSE.

Home-made Chicken Korma with Tumeric Rice.

Ingredients.

- 200g / 8oz chicken breasts with skin.
- 50g / 2oz (¼ jar) Korma Curry Paste.
- 30ml / 2 tbsp yogurt.
- 30ml / 2 tbsp oil.
- 250ml / 10floz water.
- 2 medium sized fresh red tomatoes.
- 1 large onion.
- Salt and pepper.
- 100g / 4oz basmati rice.
- ½ tsp turmeric.

Method.

1. Skin and cut chicken into appropriate sizes.
2. Heat oil in a large saucepan.
3. Finely dice onion and fry in oil until soft.
4. Fry chicken to seal.
5. Stir in Korma curry paste and fry for a further 5 minutes.
6. Add water to the curry.
7. Chop fresh tomatoes, add to the curry.
8. Bring to the boil, cover and simmer over a moderate heat for approximately 45 minutes, season to taste.
9. Bring a separate, medium sized saucepan of water to the boil.
10. Add rice and tumeric and return to the boil, cook uncovered for approximately 10 minutes.
11. Remove curry from heat and stir in yogurt.
12. Remove rice from the heat and drain and rinse with boiling water.

Serve for one meal and retain a second portion for an evening meal / meal the following day.

Home-made Chocolate Mousse.

Ingredients.

- 50g / 2oz plain chocolate.
- 25g / 1 oz caster sugar.
- 3 tsp gelatine.
- 75ml / 3 floz whipping cream.
- 25g / 1oz plain chocolate, grated to decorate.
- grated rind and juice of ½ orange.
- 15ml / 1 tsp water.
- 1 tsp Marsala.
- 1 egg.
- 1 egg yolk.

Method.

1. Place the chocolate and water in a small glass bowl and heat in the microwave for 2 minutes on the medium low setting (stirring half way through), then cool.
2. Meanwhile whisk (using an electric hand whisk) the egg, egg yolk, sugar and orange rind in a large glass bowl above a saucepan of boiling water, until thick and mousse like.
3. Measure juice from the freshly squeezed orange, adding water to make up to 2 tbsp if necessary.
4. Soak the gelatine in the orange juice in a second large glass bowl for a few minutes and then place over the saucepan of boiled, simmering water and stir until gelatine has dissolved.
5. Add Marsala to the gelatine and orange juice and then mix with the mousse mixture and melted chocolate.
6. Whip the cream lightly until soft peaks are gained.
7. Cool mousse until thickening, then stir in half of the cream and spoon into a serving bowl / small serving bowls.
8. Decorate with the remaining cream and the grated chocolate.

Serve one mousse portion for a meal with the Chocolate Mousse and keep a second portion for an evening meal / meal the following day.

APPENDIX 5.2

Recipes for meal preparation session 2.

HOME-MADE BEEF-BURGER, CHICKEN AND PASTA SALAD AND EGG AND HAM SANDWICHES.

Home-made Egg and Ham Sandwiches.

Ingredients.

- 4 slices of bread, white or brown.
- Low fat spread, margarine or butter.
- 2 eggs.
- 4 slices of smoked ham.
- 25g / 1oz mayonnaise.
- salt and pepper.

Method.

1. Boil the eggs.
2. Shell eggs and place into a mixing bowl.
3. Mash eggs, season using salt and pepper if desired, and bind with mayonnaise.
4. Remove smoked ham from packaging.
5. Make 4 sandwiches using spread, smoked ham and egg mayonnaise and serve 2 sandwiches.

Retain 2 sandwiches for a packed lunch the following day.

Home-made Chicken and Pasta Salad.

Ingredients.

- 1 chicken breast.
- 50g / 2oz Fusilli pasta shapes.
- ¼ Iceberg lettuce, chopped.
- ¼ cucumber, diced.
- 1 tomato, chopped .
- 1 carrot, grated.
- 2 tbsp chopped parsley.
- 60 ml / 4 tbsp mayonnaise.
- 15 ml / 1 tbsp vegetable oil.

Method.

1. Place Fusilli pasta in a saucepan of boiling water.
2. Add salt to taste if desired.
3. Boil Fusilli pasta for 9 - 11 minutes (10 - 12 minutes for whole-wheat Fusilli).
4. Chop chicken into suitably sized pieces and shallow fry using 1 tbsp vegetable oil.
5. Prepare all salad vegetables.
6. Drain pasta and cool.
7. Toss all salad ingredients together with chicken pieces and drained pasta.
8. Bind salad with mayonnaise.

Serve one portion of the salad and keep the remaining salad for a meal 'the following day'.

Homemade Beef-Burger.

Ingredients.

- 200g / 8oz minced beef.
- 1 small onion, chopped finely.
- 2 tbsp chopped parsley.
- 1 egg, beaten.
- 2 tbsp flour.
- 15 ml / 1 tbsp Worcestershire Sauce.
- salt and pepper.
- 25g / 1oz Grated English Medium Cheddar Cheese.
- Iceberg Lettuce, chopped.
- 1 medium sized red tomato.
- 1 Granary / Bakers Best White Bread roll.

Method.

1. Mix the minced beef, onions, parsley, Worcestershire Sauce and as much salt and pepper as desired.
2. Bind using beaten egg.
3. Divide into at least 2 equal portions and shape using seasoned flour.
4. Heat under the grill until cooked.
5. Serve 1 burger with bread roll, lettuce, cheese and tomato.

Keep the 2nd burger for part of a meal the following day.

Serve the meal on the table, using heatproof mats and leave the kitchen as you would in your own home.

APPENDIX 5.3

Recipes for meal preparation session 3.

TRADITIONAL ROAST CHICKEN MEAL WITH VEGETABLES FOLLOWED BY HOME-MADE ZABAGLIONE.

Traditional Roast Chicken Dinner.

Ingredients.
- 1 small chicken, defrosted (454g / ~1lb).
- 100g / 4oz sausage meat.
- 75g / 3 oz stuffing.
- 250ml / 10 floz water.
- 4 potatoes.
- 3 fresh raw carrots.

Methods.
1. Prepare chicken (defrosted).
2. Reconstitute stuffing and mix with sausage meat.
3. Cook stuffing, sausage meat and chicken following retailers instructions.
4. Peel and chop potatoes and place in a saucepan of boiling water until cooked.
5. Peel and chop carrots and cook in boiling water until tender.
6. Carve meat and serve meal for one person.

Keep the leftovers for use the following day.

Homemade Zabaglione.

Ingredients.
- 4 egg yolks.
- 75g / 3 oz caster sugar.
- 100ml / 2 floz Marsala.
- 1 large lemon.
- crisp biscuits.

Method
1. Beat the egg yolks and sugar together in a large heatproof bowl.
2. Beat the Marsala into the mixture.
3. Grate the lemon rind and add for flavour.
4. Place the bowl over a saucepan of simmering water and heat, whisking the mixture until it is very thick and creamy.
5. Place 2 crisp biscuits on the base of the serving glasses.
6. Pour the Zabaglione into serving glasses.
7. Serve with a crisp biscuit for one person and retain a remaining portions for a meal the next day.

Serve the meal on the table, using heatproof mats and leave the kitchen as you would in your own home.

APPENDIX 5.4

OBSERVATIONAL CHECKLIST (VIDEO):

Home-made Chicken Korma

and Turmeric Rice with Chocolate Mousse.

For definitions of terms used in this scoresheet, see 'definitions' in the main thesis.

Participant Number .... Practical ID ....

Observational Checklist (Video)
Home-made Chicken Korma and Turmeric Rice with Chocolate Mousse

Chicken Korma with Turmeric Rice

Handling and Preparation

Handwashing Actions

Handwashing after touching inside of raw chicken packaging (RCP)

Occasion	*1 2 3 4 5 Count*
Washes hands immediately after touching RCP	☐☐☐☐☐......
Contamination of the kitchen before washing	☐☐☐☐☐......
• Touches tap before washing	☐☐☐☐☐......
• Touches tap after washing	☐☐☐☐☐......
Contamination of kitchen items within kitchen	☐☐☐☐☐......
Adequacy of washing / drying hands	
• Washes thoroughly with hot water	☐☐☐☐☐......
• Use of soap / detergent	☐☐☐☐☐......
• Rinsed with water	☐☐☐☐☐......
• No washing	☐☐☐☐☐......
• Drying using clean hand towel	☐☐☐☐☐......
• Drying using paper towel	☐☐☐☐☐......
• Use of T towel	☐☐☐☐☐......
• Use of unclean hand towel	☐☐☐☐☐......
• Wipes hands on clothes	☐☐☐☐☐......
• No drying	☐☐☐☐☐......
• Wipes hands on cloth	☐☐☐☐☐......
→ Adequate Washing	☐☐☐☐☐......
→ Inadequate washing	☐☐☐☐☐......
→ No washing	☐☐☐☐☐......
→ Adequate drying	☐☐☐☐☐......
→ Inadequate drying	☐☐☐☐☐......
→ No drying	☐☐☐☐☐......

Washes hands after touching raw chicken (RC)

Occasion	*1 2 3 4 5 Count*
Washes hands immediately after touching RC	☐☐☐☐☐......
Contamination of the kitchen before washing	☐☐☐☐☐......
• Touches tap before washing	☐☐☐☐☐......
• Touches tap after washing	☐☐☐☐☐......
Contamination of kitchen items within kitchen	☐☐☐☐☐......
Adequacy of washing / drying hands	
• Washes thoroughly with hot water	☐☐☐☐☐......
• Use of soap / detergent	☐☐☐☐☐......
• Rinsed with water	☐☐☐☐☐......
• No washing	☐☐☐☐☐......
• Drying using clean hand towel	☐☐☐☐☐......
• Drying using paper towel	☐☐☐☐☐......
• Use of T towel	☐☐☐☐☐......
• Use of unclean hand towel	☐☐☐☐☐......
• Wipes hands on clothes	☐☐☐☐☐......
• No drying	☐☐☐☐☐......
• Wipes hands on cloth	☐☐☐☐☐......
→ Adequate Washing	☐☐☐☐☐......
→ Inadequate washing	☐☐☐☐☐......
→ No washing	☐☐☐☐☐......
→ Adequate drying	☐☐☐☐☐......
→ Inadequate drying	☐☐☐☐☐......
→ No drying	☐☐☐☐☐......

Use of Equipment and Utensils for preparation of raw chicken and then onion or tomatoes

Preparation of onion / tomato before handles RC ☐

	Onion	Tomato	*Database*
Chopping Boards			
• Use of same chopping board	☐	☐	....
• Use of separate chopping board	☐	☐	....
Adequacy of washing / drying chopping boards between uses			
• Scrub with hot water	☐	☐	....
• Use of detergent	☐	☐	....
• Rinsed with water	☐	☐	....
• Wiped with cloth	☐	☐	....
• Wiped with t-towel	☐	☐	....
• No washing	☐	☐	....
• Drying using paper towel	☐	☐	....
• Use of clean t-towel	☐	☐	....
• Use of unclean t-towel	☐	☐	....
• Use of hand towel	☐	☐	....
• No drying	☐	☐	....
Knives			
• Use of same knife	☐	☐	....
• Use of separate knives	☐	☐	....
Adequacy of washing / drying chopping boards between uses			
• Scrub with hot water	☐	☐	....
• Use of detergent	☐	☐	....
• Rinsed with water	☐	☐	....
• Wiped with cloth	☐	☐	....
• Wiped with t-towel	☐	☐	....
• No washing	☐	☐	....
• Drying using paper towel	☐	☐	....
• Use of clean t-towel	☐	☐	....
• Use of unclean t-towel	☐	☐	....
• Use of hand towel	☐	☐	....
• No drying	☐	☐	....
Equipment / Utensils			
• Use of same equipment / utensils	☐	☐	....
• Use of separate equipment / utensils	☐	☐	....
Adequacy of washing / drying chopping boards between uses			
• Scrub with hot water	☐	☐	....
• Use of detergent	☐	☐	....
• Rinsed with water	☐	☐	....
• Wiped with cloth	☐	☐	....
• Wiped with t-towel	☐	☐	....
• No washing	☐	☐	....
• Drying using paper towel	☐	☐	....
• Use of clean t-towel	☐	☐	....
• Use of unclean t-towel	☐	☐	....
• Use of hand towel	☐	☐	....
• No drying	☐	☐	....

Participant Number .... Practical ID ....

HOME-MADE CHICKEN KORMA cont.

Preparation Actions.

- Raw meat is washed under running water (contamination of preparation environment) ☐
- Direct contamination of preparation environment from raw chicken. ☐☐☐☐☐...............

  Preparation environment is followed by efficient cleaning of contaminated area ☐☐☐☐☐...............
- Potential contamination of preparation environment from utensils potentially contaminated with raw chicken. ☐☐☐☐☐...............

  Preparation environment is followed by efficient cleaning of contaminated area ☐☐☐☐☐...............
- Potential contamination of preparation environment from raw meat packaging. ☐

  Preparation environment is followed by efficient cleaning of contaminated area ☐
- Failure to wash potentially contaminated utensils immediately after use ☐
- Chicken is cut into large uneven pieces (inconsistent heat penetration). ☐

Heating

- Chicken pieces are not heated for 8 minutes. ☐
- Length of time Chicken Korma is simmered for ....minutes
- Length of time rice is heated for ....minutes

Post Heating Contamination (CU, U, H, CH)

- Potential contamination of Chicken Korma during heating ....
- Potential contamination of Chicken Korma after removal from heat (serving) ....
- Potential contamination of portion of Chicken Korma for storage ....

Database : Total number of contamination of korma after removal from heat with U or H > ....

Database : Total number of contamination of korma after removal from heat with CU or CH > ....

- Potential contamination of Turmeric Rice during heating ....
- Potential contamination of Turmeric Rice after removal from heat (serving) ....
- Potential contamination of portion of Turmeric Rice for storage ....

Database : Total number of contamination of rice after removal from heat with U or H > ....

Database : Total number of contamination of rice after removal from heat with CU or CH > ....

Cooling and Post Heating Storage (for consumption ~ 24 -36 hours time)

- Covering of Chicken Korma during cooling ☐
- Chicken Korma remains in the saucepan for cooling ☐
- No stirring of Chicken Korma during cooling ☐
- Chicken Korma is refrigerated within 30 mins removal from heat ☐
- Chicken Korma is not transferred to a separate container for storage ☐
- Chicken Korma is not covered for storage ☐
- Chicken Korma is stored below raw ingredients in UWIC fridge ☐
- **Chicken Korma is left at room temperature** ☐

- Covering of Turmeric Rice during cooling ☐
- Turmeric Rice remains in the saucepan for cooling ☐
- Turmeric Rice is not cooled rapidly using cold water ☐
- No stirring of Turmeric Rice during cooling ☐
- Turmeric Rice is refrigerated within 30 mins removal from heat ☐
- Turmeric Rice is not transferred to a separate container for storage ☐
- Turmeric Rice is not covered for storage ☐
- Turmeric Rice is stored below raw ingredients in UWIC fridge ☐
- **Turmeric Rice is left at room temperature** ☐

Refrigerated storage

- Chicken Korma is refrigerated within 30 minutes after removal from heat ☐
- State covering of Chicken Korma for storage ....
- Chicken Korma is not covered for storage ☐
- State shelf Chicken Korma is refrigerated on ....
- Refrigerated Chicken Korma is stored below raw ingredients in UWIC fridge ☐
- 2nd portion of chicken korma is thrown away ☐

Refrigerated storage

- Turmeric Rice is refrigerated within 30 minutes after removal from heat ☐
- State covering of Turmeric Rice for storage ....
- Turmeric Rice is not covered for storage ☐
- State shelf Turmeric Rice is refrigerated on ....
- Refrigerated Turmeric Rice is stored below raw ingredients in UWIC fridge ☐
- 2nd portion of Rice is thrown away ☐

Participant Number ……………………………… Practical ID ………………………………

Chocolate Mousse

Handling and Preparation.

Hand-washing Actions.

Handwashing after touching inside of Raw Egg Shells (RES)

Occasion	*1 2 3 4 5 Count*
Washes hands immediately after touching RES	☐☐☐☐☐……
Contamination of the kitchen before washing	☐☐☐☐☐……
• Touches tap before washing	☐☐☐☐☐……
• Touches tap after washing	☐☐☐☐☐……
Contamination of kitchen items within kitchen	☐☐☐☐☐……
Adequacy of washing / drying hands	
• Washes thoroughly with hot water	☐☐☐☐☐……
• Use of soap / detergent	☐☐☐☐☐……
• Rinsed with water	☐☐☐☐☐……
• No washing	☐☐☐☐☐……
• Drying using clean hand towel	☐☐☐☐☐……
• Drying using paper towel	☐☐☐☐☐……
• Use of T towel	☐☐☐☐☐……
• Use of unclean hand towel	☐☐☐☐☐……
• Wipes hands on clothes	☐☐☐☐☐……
• No drying	☐☐☐☐☐……
• Wipes hands on cloth	☐☐☐☐☐……
→ Adequate Washing	☐☐☐☐☐……
→ Inadequate washing	☐☐☐☐☐……
→ No washing	☐☐☐☐☐……
→ Adequate drying	☐☐☐☐☐……
→ Inadequate drying	☐☐☐☐☐……
→ No drying	☐☐☐☐☐……

Washes hands after touching Raw Egg (RE)

Occasion	*1 2 3 4 5 Count*
Washes hands immediately after touching RE	☐☐☐☐☐……
Contamination of the kitchen before washing	☐☐☐☐☐……
• Touches tap before washing	☐☐☐☐☐……
• Touches tap after washing	☐☐☐☐☐……
Contamination of kitchen items within kitchen	☐☐☐☐☐……
Adequacy of washing / drying hands	
• Washes thoroughly with hot water	☐☐☐☐☐……
• Use of soap / detergent	☐☐☐☐☐……
• Rinsed with water	☐☐☐☐☐……
• No washing	☐☐☐☐☐……
• Drying using clean hand towel	☐☐☐☐☐……
• Drying using paper towel	☐☐☐☐☐……
• Use of T towel	☐☐☐☐☐……
• Use of unclean hand towel	☐☐☐☐☐……
• Wipes hands on clothes	☐☐☐☐☐……
• No drying	☐☐☐☐☐……
• Wipes hands on cloth	☐☐☐☐☐……
→ Adequate Washing	☐☐☐☐☐……
→ Inadequate washing	☐☐☐☐☐……
→ No washing	☐☐☐☐☐……
→ Adequate drying	☐☐☐☐☐……
→ Inadequate drying	☐☐☐☐☐……
→ No drying	☐☐☐☐☐……

Use of Equipment and Utensils for prep. of raw meat and then orange / chocolate for the mousse mixture

Chocolate Mousse is prepared before raw meat (Korma) ☐

	Chocolate	Orange	*Database*
Chopping Boards			
• Use of same chopping board	☐	☐	……
• Use of separate chopping board	☐	☐	……
Adequacy of washing / drying chopping boards between uses			
• Scrub with hot water	☐	☐	……
• Use of detergent	☐	☐	……
• Rinsed with water	☐	☐	……
• Wiped with cloth	☐	☐	……
• Wiped with t-towel	☐	☐	……
• No washing	☐	☐	……
• Drying using paper towel	☐	☐	……
• Use of clean t-towel	☐	☐	……
• Use of unclean t-towel	☐	☐	……
• Use of hand towel	☐	☐	……
• No drying	☐	☐	……
Knives			
• Use of same knife	☐	☐	……
• Use of separate knives	☐	☐	……
Adequacy of washing / drying chopping boards between uses			
• Scrub with hot water	☐	☐	……
• Use of detergent	☐	☐	……
• Rinsed with water	☐	☐	……
• Wiped with cloth	☐	☐	……
• Wiped with t-towel	☐	☐	……
• No washing	☐	☐	……
• Drying using paper towel	☐	☐	……
• Use of clean t-towel	☐	☐	……
• Use of unclean t-towel	☐	☐	……
• Use of hand towel	☐	☐	……
• No drying	☐	☐	……
Equipment / Utensils			
• Use of same equipment / utensils	☐	☐	……
• Use of separate equipment / utensils	☐	☐	……
Adequacy of washing / drying chopping boards between uses			
• Scrub with hot water	☐	☐	……
• Use of detergent	☐	☐	……
• Rinsed with water	☐	☐	……
• Wiped with cloth	☐	☐	……
• Wiped with t-towel	☐	☐	……
• No washing	☐	☐	……
• Drying using paper towel	☐	☐	……
• Use of clean t-towel	☐	☐	……
• Use of unclean t-towel	☐	☐	……
• Use of hand towel	☐	☐	……
• No drying	☐	☐	……

Participant Number .... Practical ID ....

HOME-MADE CHOCOLATE MOUSSE

Preparation Actions.

- Egg shells potentially contaminate work surface ☐☐☐☐☐..............
  - Preparation environment is followed by efficient cleaning of contaminated area ☐☐☐☐☐..............
- Raw egg potentially contaminates work surface ☐☐☐☐☐..............
  - Preparation environment is followed by efficient cleaning of contaminated area ☐☐☐☐☐..............
- Potential contamination of preparation environment from utensils potentially contaminated with raw egg ☐☐☐☐☐..............
  - Preparation environment is followed by efficient cleaning of contaminated area ☐☐☐☐☐..............

Raw egg mixture contaminates work surface ☐☐☐☐☐..............

Preparation environment is followed by efficient cleaning of contaminated area ☐☐☐☐☐..............

- Failure to wash potentially contaminated utensils immediately after use ☐
- Failure to wash orange before use ☐

The **same** equipment / utensils are used for production of the raw egg mixture and the whipped cream.

- Use of same equipment / utensils ☐
- Use of separate equipment / utensils ☐

Adequacy of washing / drying equipment / utensils between uses

- Scrub with hot water ☐
- Use of detergent ☐
- Rinsed with water ☐
- Wiped with cloth ☐
- Wiped with t-towel ☐
- No washing ☐
- Drying using paper towel ☐
- Use of clean t-towel ☐
- Use of unclean t-towel ☐
- Use of hand towel ☐
- No drying ☐

Heating

- Length of time mousse is heated for over boiling water ....

Post Heating Contamination (CU, U, H, CH)

- Potential contamination of Mousse mixture during heating ....
- Potential contamination of Mousse mixture after removal from heat ....
- Potential contamination of portion of Mousse for storage ....

Database : Total number of contamination of mousse after removal from heat with U or H > ....

Database : Total number of contamination of mousse after removal from heat with CU or CH > ....

Cooling and Post Heating Storage (for consumption ~ 24 -36 hours time)

- Covering of mousse during cooling ☐
- Use of large container for cooling exceeding 7 - 8cm in depth ☐
- Mousse is not transferred to separate container for storage ☐
- **Mousse is left at room temperature** ☐

Refrigerated Storage

- Mousse is not covered ☐
- State covering ....
- Refrigerated mousse is stored below raw ingredients in UWIC fridge ☐
- State shelf Mousse is refrigerated on ....

2nd portion of mousse is thrown away ☐

APPENDIX 5.5

Summary of findings from time-temperature measurements for all heated food products.

Homemade food product	Time to reach to target temperature (75°C for 30 seconds) (DoH and MAFF, 1996).
Chicken pieces for Chicken Korma (*n*=5)	8 minutes
Chocolate Mousse (*n*=5)	12 minutes
Beef-burgers (*n*=5)	25 minutes
Chicken pieces for chicken salad (*n*=5)	6 minutes
Boiled eggs for egg and ham sandwich (*n*=5)	12 minutes to boil egg (Baker *et al.* 1983)
Roast chicken (*n*=5)	90 minutes
Sausage meat (*n*=5)	25 minutes
Zabaglione (*n*=5)	12 minutes

APPENDIX 5.6

Microbiological verification of meal preparations.

Food product	Heating and cooling methods	Microbiological test	Mean values after heating >75°C for 30 seconds (DoH and MAFF, 1996)	Mean values after cooling <10°C within 90 minutes (Sprenger, 1995)	Microbiological quality according to PHLS guidelines for RTE foods (Gilbert et al, 2000).
Chicken Korma (n=5)	*Heating method (cooking chicken pieces only)*: Chicken pieces 2cm^3, large hob plate, electric source No. 6 for frying onion until soft (with 2tbsp of vegetable oil) addition of chicken pieces, moving constantly, fry until sealed (3 minutes) and fried with korma paste for further 5 minutes. *Cooling method (cooling of whole korma)*: Half the portion of korma was placed into an appropriate sized bowl, left at room temperature for 30 minutes, then covered with clingfilm and placed on the top shelf of the refrigerator for 60 minutes*.	APC	0.8×10^1	0.8×10^1	Satisfactory
		Enterobacteriaceae	NG	NG	Satisfactory
		S.aureus	absent	absent	Satisfactory
		Salmonella	Not detected in 25g	-	Satisfactory
Chocolate Mousse (n=5)	*Heating method*: All ingredients placed into a glass Pyrex bowl and placed over a large saucepan of boiling water (heated on a large hob plate). Use of electric hand mixer on speed 2 for 12 minutes. *Cooling method*: Cooled in small (8cm diameter x 4cm depth) dishes, 30 minutes at room temperature, followed by 60 minutes refrigeration on the top shelf covered in clingfilm.	APC	1.0×10^3	4.2×10^2	Acceptable
		Enterobacteriaceae	NG	NG	Satisfactory
		S.aureus	absent	absent	Satisfactory
		Salmonella	Not detected in 25g	-	Satisfactory
Rice (n=5)	*Heating method*: Rice was placed into boiling water for 10-12 minutes. *Cooling method*: Cooked rice was placed in a sieve under running cold water for 5 minutes and then placed into a small bowl and placed on the top shelf of the refrigerator, covered in clingfilm.	*B.cereus*	absent	absent	Satisfactory
Beef-burgers (n=5)	*Heating method*: Raw burgers were all 7-8cm diameter, 2cm depth before heating. Heated for 25 minutes on the grill pan, temperature no. 3-4, 7cm from heat source, turned every 5 minutes. *Cooling method*: Placed onto a plate for 30 minutes at room temperature, and then placed on the top shelf of the refrigerator, uncovered for 60 minutes*.	APC	0.1×10^1	0.4×10^1	Satisfactory
		Enterobacteriaceae	NG	NG	Satisfactory
		S.aureus	absent	absent	Satisfactory
		Salmonella	Not detected in 25g	-	Satisfactory
Chicken salad (n=5)	*Heating method (chicken pieces only:* Chicken pieces 2cm^3. Large hob plate, electric heat source 3-4, use of preheated frying pan with 1tbsp vegetable oil. Constantly movement of cooking chicken pieces for 6 minutes *Cooling method (chicken pieces with salad)*: Chicken pieces placed onto a plate to cool for >30 minutes, then added to rest of salad ingredients and placed onto top shelf of the refrigerator (2°C), (no covering)*.	APC	6.5×10^2	1.6×10^3	Satisfactory
		Enterobacteriaceae	1.7×10^1	4.5×10^2	Acceptable
		S.aureus	NG	NG	Satisfactory
		Salmonella	Not detected in 25g	-	Satisfactory

Key: NG = no growth; '-' = no sample analysed; 'absent' = absence of pathogen; * =Time-temperature experiments showed that covering foods within 90 minutes of cooling prevented the internal temperature of food products to reach the recommended <10°C within 90 minutes after heating.

APPENDIX 5.6 *(continued).*

Food product	Heating and cooling methods	Microbiological test	After heating >75°C for 30 seconds	After cooling <10°C within 90 minutes	Microbiological quality according to PHLS guidelines for RTE foods (Gilbert et al, 2000).
Boiled eggs for egg and ham sandwich (*n*=5)	*Heating method*: Medium sized raw eggs were immersed into boiling water and boiled for 12 minutes. *Cooling method*: Boiled eggs placed into a bowl of cold tap water (with shell) for 15 minutes. Eggs were then removed from the shell and placed into a fresh bowl of cold water for another 15 minutes. The egg was then mashed with mayonnaise and placed into sandwiches. The sandwiches were then sealed in a sandwich bag, which was placed on the top shelf of the refrigerator.	APC	NG	NG	Satisfactory
		Enterobacteriaceae	NG	NG	Satisfactory
		S.aureus	absent	absent	Satisfactory
		Salmonella	Not detected in 25g	-	Satisfactory
Roast chicken (*n*=5)	*Heating method*: A 1.3 kg chicken carccass was placed into a roasting tray, covered in foil and heated at 190°C for 90 minutes. *Cooling method*: Chicken meat was removed from the chicken carcass and placed onto a plate for cooling, all pieces were less than 1cm thickness. Chicken pieces were left at room temperature fro 30 minutes, followed by 60 minutes on the top shelf of the refrigerator (uncovered)*.	APC	NG	0.8×10^1	Satisfactory
		Enterobacteriaceae	NG	NG	Satisfactory
		S.aureus	absent	absent	Satisfactory
		Salmonella	Not detected in 25g	-	Satisfactory
Sausage meat balls (*n*=5)	*Heating method*: Sausage meat mixed with stuffing, rolled into balls of ~3cm diameter, placed onto a greased baking tray, heated in a preheated oven at 190°C for 25 minutes (manufacturers instructions). *Cooling method*: Sausage and stuffing balls were placed onto a clean plate and left at room temperature for 30 minutes, then transferred to the top shelf of the refrigerator for a further 60 minutes.	APC	1.0×10^1	2.6×10^1	Satisfactory
		Enterobacteriaceae	NG	NG	Satisfactory
		S.aureus	absent	absent	Satisfactory
		Salmonella	Not detected in 25g	-	Satisfactory
Zabaglione (*n*=5)	*Heating method*: All ingredients placed into a glass Pyrex bowl and placed over a large saucepan of boiling water (heated on a large hob plate). Use of electric hand mixer on speed 2 for 12 minutes. *Cooling method*: Cooled in small (8cm diameter x 4cm depth) dishes, 30 minutes at room temperature, followed by 60 minutes refrigeration on the top shelf covered in clingfilm.	APC	NG	0.6×10^1	Satisfactory
		Enterobacteriaceae	NG	NG	Satisfactory
		S.aureus	absent	absent	Satisfactory
		Salmonella	Not detected in 25g	-	Satisfactory

Key: NG = no growth; '-' = no sample analysed; 'absent' = absence of pathogen; * =Time-temperature experiments showed that covering foods within 90 minutes of cooling prevented the internal temperature of food products to reach the recommended <10°C within 90 minutes after heating.

APPENDIX 5.7

Microbiological methods.

In the model domestic kitchen, 10g sample of each food product was aseptically placed in a sterile stomacher bag (Isotron, plc, B6500) and immediately taken for microbiological analysis. In the laboratory, 90ml of maximum recovery diluent (MRD) was added to the 10g-food product, which was subsequently stomached for up to 60 seconds using a stomacher (Steward, laboratory blender, 400).

For detection of aerobic plate counts (APC's) for all food products 1ml aliquots of each dilution of stomached homogenate were plated out using the pour plate technique (Collins *et al.* 1989) and plate count agar (PCA) (Oxoid, CM325). Such plates were inverted and incubated at 30°C for 48 hours (Roberts *et al.* 1995).

For detection of *Enterobacteriaceae* for all food products 1ml aliquots of each dilution of stomached homogenate were plated out using the pour plate technique and a double layer of Violet Red Bile Glucose Agar (VRBGA) (Oxoid CM485). VRBGA plates were inverted and incubated at 30°C for 24-48 hours (Bridson, 1998).

Direct enumeration using Baird Parker Agar Base (Oxoid CM275) was used for analysis of *Staphylococcus aureus* contamination from all food products. Rapid Staphylase Tests (Oxoid DR595) were used as a confirmation test for positive colonies. Using aseptic techniques, 0.1ml of the stomached homogenate was pipetted and then spread (using an aseptic spreader) onto Baird Parker agar plates which were incubated at 37°C for 48 hours (Roberts *et al.* 1995). After incubation plates were counted and suspect colonies were confirmed using the Rapid Staphylase (coagulase) test.

Salmonella Rapid Tests (Oxoid FT201 and CM857) were used for detection of *Salmonella* in all food products. In the model domestic kitchen, 25g of the food products were transferred (using aseptic techniques) into sterile stomacher bags and in the laboratory 225ml of Buffered Peptone Water (BPW) (Oxoid CM509) was added. This homogenate was pre-enriched at 37°C for 18 hours. Rapid Salmonella Vessels were prepared following the manufacturers instructions (Oxoid, 1997) and 1ml of the enriched homogenate was then pippeted into the rapid salmonella vessel. This was then incubated at 41°C for 24 hours. Results were determined according to manufacturers instructions and guides.

APPENDIX 5.8

DESCRIPTION OF SCORING SYSTEM:

Home-made Chicken Korma and Turmeric Rice

with Chocolate Mousse.

INADEQUATE PRACTICE	FOOD SAFETY RISK SCORE.
Handling and Preparation	
Washing and drying of hands after handling raw chicken packaging.	
• No washing and drying of hands *OR* washing and drying of hands immediately after handling raw chicken packaging after contamination of equipment, utensils or preparation environment after handling raw chicken packaging *OR* inadequate washing and drying of hands immediately after handling raw chicken packaging.	100 per malpractice.
• Adequate washing / and drying of hands immediately after handling raw chicken packaging.	0
Washing and drying of hands after handling raw chicken.	
• No washing and drying of hands *OR* washing and drying of hands immediately after handling raw chicken after contamination of equipment, utensils or preparation environment after handling raw chicken *OR* inadequate washing and drying of hands immediately after handling raw chicken.	100 per malpractice.
• Adequate washing / and drying of hands immediately after handling raw chicken.	0
Washing and drying of chopping boards / knives / equipment / utensils after preparation of raw chicken and before ready-to-eat (RTE) foods / fruit / vegetables.	
• No washing and drying *OR* inadequate washing and drying of the same chopping board for preparation of raw chicken and then vegetables for the Chicken Korma.	100 per food prepared.
• Use of separate chopping boards for preparation of raw chicken and then vegetables for the Chicken Korma *OR* adequate washing and drying of chopping board for preparation of raw chicken and then then vegetables for the Chicken Korma *OR* preparation of then vegetables for the Chicken Korma before preparation of raw chicken.	0
• No washing and drying *OR* inadequate washing and drying of the same knife for raw chicken and then vegetables for the Chicken Korma.	100 per food prepared.
• Use of separate knives for preparation of raw chicken and then vegetables for the Chicken Korma *OR* adequate washing and drying of knives for preparation of raw chicken and then vegetables for the Chicken Korma *OR* preparation of then vegetables for the Chicken Korma before preparation of raw chicken.	0
• No washing and drying *OR* inadequate washing and drying of the same equipment / utensils for raw chicken and then vegetables for the Chicken Korma.	100 per food prepared.
• Use of separate equipment / utensils for preparation of raw chicken and then vegetables for the Chicken Korma *OR* adequate washing and drying of equipment / utensils for preparation of raw chicken and then vegetables for the Chicken Korma *OR* preparation of then vegetables for the Chicken Korma before preparation of raw chicken.	0
Handling of raw chicken and potential contamination of the preparation environment.	
• Washes raw meat.	100
• Potential contamination of the preparation environment with **raw chicken**.	100 per malpractice
⇒ Potential contamination of the preparation environment followed by efficient cleaning* of contaminated area.	0
• Potential contamination of the preparation environment with **utensils** contaminated with raw chicken.	100 per malpractice
⇒ Potential contamination of the preparation environment followed by efficient cleaning* of contaminated area.	0
• Potential contamination of the preparation environment with **raw chicken packaging**.	100 per malpractice
⇒ Potential contamination of the preparation environment followed by efficient cleaning* of contaminated area.	0
• Failure to wash / dry utensils / equipment potentially contamination with raw chicken immediately after use.	100
• Chicken pieces are cut into large uneven pieces	10

*According to guidelines outlined in Griffith *et al.* (1999).

INADEQUATE PRACTICE	FOOD SAFETY RISK SCORE.
Heating.	
• Failure to heat chicken korma efficiently (chicken pieces need to be heated for at least 8 minutes).	1000
Post-heating handling.	
• Potential contamination of korma with unclean utensils or hands after removal from heat.	100 per contamination
• Potential contamination of korma with potentially contaminated utensils or contaminated hands after removal from heat.	1000 per contamination
• Potential contamination of rice with unclean utensils or hands after removal from heat.	100 per contamination
• Potential contamination of rice with potentially contaminated utensils or contaminated hands after removal from heat.	1000 per contamination
• Potential contamination of chicken korma with unclean utensils or hands for storage.	100 per contamination
• Potential contamination of chicken korma with potentially contaminated utensils or contaminated hands for storage.	1000 per contamination
• Potential contamination of rice with unclean utensils or hands for storage.	100 per contamination
• Potential contamination of rice with potentially contaminated utensils or contaminated hands for storage.	1000 per contamination
Cooling and post-heating storage.	
• **Chicken korma** is covered during cooling.	10
• Chicken Korma remains in saucepan for cooling.	10
• Chicken Korma is not stirred during cooling.	10
• Chicken Korma is refrigerated within 30 minutes of removal from heat .	10
• Chicken Korma is not transferred to separate container.	10
• Chicken Korma is not covered.	10
• Chicken Korma is storage below raw ingredients (shelf 2 or 3).	10
• Chicken Korma is left at room temperature.	100
• **Turmeric Rice** is covered during cooling.	10
• Turmeric Rice remains in saucepan for cooling.	10
• Turmeric Rice is not cooled using cold water.	10
• Turmeric rice is not stirred during cooling.	10
• Turmeric Rice is refrigerated within 30 minutes of removal from heat.	10
• Turmeric Rice is not transferred to separate container.	10
• Turmeric Rice is not covered.	10
• Turmeric Rice is storage below raw ingredients (shelf 2 or 3).	10
• Turmeric Rice is left at room temperature.	100

INADEQUATE PRACTICE.	FOOD SAFETY RISK SCORE.
Handling and preparation.	
Washing and drying of hands after handling raw egg shells.	
• No washing and drying of hands *OR* washing and drying of hands immediately after handling raw egg shells after contamination of equipment, utensils or preparation environment after handling raw eggs shells *OR* inadequate washing and drying of hands immediately after handling raw egg shells.	100 per malpractice
• Adequate washing / and drying of hands immediately after handling raw egg shells.	0
Washing and Drying of hands after handling raw egg.	
• No washing and drying of hands *OR* washing and drying of hands immediately after handling raw egg after contamination of equipment, utensils or preparation environment immediately after handling raw egg *OR* inadequate washing and drying of hands immediately after handling raw egg.	100 per malpractice
• Adequate washing / and drying of hands immediately after handling raw egg.	0
Washing and drying of chopping boards / knives / equipment / utensils after raw chicken and before RTE foods / fruit / vegetables.	
• No washing and drying *OR* inadequate washing and drying of the same chopping board used for preparation of raw chicken and then ingredients for home-made chocolate mousse.	100 per malpractice
• Use of separate chopping boards for preparation of raw chicken and then ingredients for the home-made chocolate mousse *OR* adequate washing and drying of chopping board used for preparation of raw chicken and then ingredients for home-made chocolate mousse *OR* preparation of chocolate mousse before handling of raw chicken.	0
• No washing and drying *OR* inadequate washing and drying of the same knife used for preparation of raw chicken and then ingredients for home-made chocolate mousse.	100 per malpractice
• Use of separate knives for preparation of raw chicken and then ingredients for the home-made chocolate mousse *OR* adequate washing and drying of knives used for preparation of raw chicken and then ingredients for home-made chocolate mousse *OR* preparation of chocolate mousse before handling of raw chicken.	0
• No washing and drying *OR* inadequate washing and drying of the same equipment / utensils used for preparation of raw chicken and then ingredients for home-made chocolate mousse.	100 per malpractice
• Use of separate equipment / utensils for preparation of raw chicken and then ingredients for the home-made chocolate mousse *OR* adequate washing and drying of chopping board used for preparation of raw chicken and then ingredients for home-made chocolate mousse *OR* preparation of chocolate mousse before handling of raw chicken.	0
Handling of raw egg and potential contamination of preparation environment.	
• Potential contamination of preparation environment with **raw egg shells.**	100 per malpractice
⇒ Potential contamination of preparation environment followed by efficient cleaning of contaminated area.	0
• Potential contamination of preparation environment with **raw egg.**	100 per malpractice
⇒ Potential contamination of preparation environment followed by efficient cleaning of contaminated area.	0
• Potential contamination of preparation environment with **utensils** contaminated with raw egg.	100 per malpractice
⇒ Potential contamination of preparation environment followed by efficient cleaning of contaminated area.	0
• Potential contamination of preparation environment with **raw egg mixture.**	100 per malpractice
⇒ Potential contamination of preparation environment followed by efficient cleaning of contaminated area.	0
• Failure to wash / dry potentially contaminated utensils / equipment immediately after use.	100
• Failure to wash orange before use.	10
• No washing and drying *OR* inadequate washing and drying of the same equipment / utensils for raw egg and then whipping cream.	100 per malpractice
• Use of separate equipment / utensils for raw egg and then whipping cream *OR* adequate washing and drying of equipment / utensils for raw chicken and then raw egg and then whipping cream.	0

*According to guidelines outlined in Griffith *et al.* (1999).

INADEQUATE PRACTICE	FOOD SAFETY RISK SCORE.
Heating.	
• Failure to heat raw shell egg mixture efficiently (12 minutes above boiling water).	1000
Post-heating handling.	
• Potential contamination of mousse with unclean utensils or hands during heating.	100 per contamination
• Potential contamination of mousse with potentially contaminated utensils or contaminated hands during heating.	1000 per contamination
• Potential contamination of mousse with unclean utensils or hands after removal from heat.	100 per contamination
• Potential contamination of mousse with potentially contaminated utensils or contaminated hands after removal from heat.	1000 per contamination
• Potential contamination of mousse with unclean utensils or hands for storage.	100 per contamination
• Potential contamination of mousse with potentially contaminated utensils or contaminated hands for storage.	1000 per contamination
Cooling and post-heating storage.	
• **Chocolate Mousse** is covered during cooling.	10
• Chocolate Mousse remains in large bowl for cooling.	10
• Chocolate Mousse is not transferred to separate container for storage.	10
• Chocolate Mousse is not covered.	10
• Chocolate Mousse is storage below raw ingredients (shelf 2 or 3).	10
• Chocolate Mousse is left at room temperature.	100

For definitions of terms used in this scoresheet, see 'definitions' in the main thesis.

APPENDIX 5.9

SCORESHEET:

Home-made Chicken Korma and Turmeric Rice

with Chocolate Mousse.

INADEQUATE PRACTICE.	FOOD SAFETY RISK SCORE.
Handling and Preparation.	
Failure to wash and dry hands adequately after handling raw chicken packaging.	
Failure to wash and dry hands adequately after handling raw chicken.	
Failure to implement safe practices: use of chopping boards for preparation of raw chicken and then vegetables (for Chicken Korma).	
Failure to implement safe practices: use of knives for preparation of raw chicken and then vegetables (for Chicken Korma).	
Failure to implement safe practices: use of utensils / equipment for preparation of raw vegetables (for Chicken Korma).	
Handling of raw chicken and contamination of preparation environment.	
Washes raw chicken.	
Potential contamination of preparation environment with **raw chicken***.	
Potential contamination of preparation environment with **utensils** contaminated with raw chicken*.	
Potential contamination of preparation environment with **raw chicken packaging***.	
Failure to wash / dry utensils / equipment potentially contaminated with raw chicken immediately after use.	
Chicken pieces are cut into large uneven pieces.	
Heating.	
Failure to heat chicken korma efficiently (chicken pieces are heated for <8 minutes).	
Post-heating handling.	
Potential contamination of Chicken Korma with unclean utensils or hands after removal from heat.	
Potential contamination of Chicken Korma with potentially contaminated utensils / hands after removal from the heat.	
Potential contamination of rice with unclean utensils or hands after removal from heat.	
Potential contamination of rice with potentially contaminated utensils / hands after removal from heat.	
Potential contamination of Chicken Korma with unclean utensils or hands for storage.	
Potential contamination of Chicken Korma with potentially contaminated utensils or hands for storage.	
Potential contamination of rice with unclean utensils or hands for storage.	
Potential contamination of rice with potentially contaminated utensils or hands for storage.	
Cooling and Post Heating Storage.	
Chicken Korma is covered during cooling.	
Chicken Korma remains in saucepan for cooling.	
Chicken Korma is not stirred during cooling.	
Chicken Korma is refrigerated within 30 minutes of removal from heat.	
Chicken Korma is not transferred to separate container.	
Chicken Korma is not covered for storage.	
Chicken Korma is storage below raw ingredients (shelf 2 or 3).	
Chicken Korma is left at room temperature.	
Turmeric Rice is covered during cooling.	
Turmeric Rice remains in saucepan for cooling.	
Turmeric Rice is not cooled using cold water.	
Turmeric rice is not stirred during cooling.	
Turmeric Rice is refrigerated within 30 minutes of removal from heat.	
Turmeric Rice is not transferred to separate container.	
Turmeric Rice is not covered for storage.	
Turmeric Rice is storage below raw ingredients (shelf 2 or 3).	
Turmeric Rice is left at room temperature.	

*According to guidelines outlined in Griffith *et al.* (1999).

INADEQUATE PRACTICE	FOOD SAFETY RISK SCORE.
Failure to wash and dry hands adequately after handling raw egg shells.	
Failure to wash and dry hands adequately after handling raw egg.	
Failure to implement safe practices: use of chopping boards for preparation of raw chicken and then ready to eat foods / fruit (for Chocolate Mousse).	
Failure to implement safe practices: use of knives for preparation of raw chicken and then ready to eat foods / fruit (for Chocolate Mousse).	
Failure to implement safe practices: use of utensils / equipment for preparation of raw chicken and then ready to eat foods / fruit (for Chocolate Mousse).	
Handling of raw egg and potential contamination of preparation environment.	
Potential contamination of preparation environment with **raw egg shell***.	
Potential contamination of preparation environment with **raw egg***.	
Potential contamination of preparation environment with **utensils** contaminated with raw egg*.	
Potential contamination of preparation environment with **raw egg mixture***.	
Failure to wash / dry potentially contaminated utensils / equipment immediately after use.	
Failure to implement safe practices: use of equipment / utensils for preparation of raw egg and then whipping cream.	
Heating.	
Failure to heat raw shell egg mixture efficiently (for <12 minutes).	
Post-heating handling.	
Potential contamination of mousse with unclean utensils or hands during heating.	
Potential contamination of mousse with potentially contaminated utensils or contaminated hands during heating.	
Potential contamination of mousse with unclean utensils or hands after removal from heat.	
Potential contamination of mousse with potentially contaminated utensils or contaminated hands after removal from heat.	
Potential contamination of mousse with unclean utensils or hands for storage.	
Potential contamination of mousse with potentially contaminated utensils or contaminated hands for storage.	
Cooling and post-heating storage.	
Chocolate Mousse is covered during cooling.	
Chocolate Mousse remains in large bowl for cooling.	
Chocolate Mousse is not transferred to separate container for storage.	
Chocolate Mousse is not covered.	
Chocolate Mousse is storage below raw ingredients (shelf 2 or 3).	
Chocolate Mousse is left at room temperature.	

*According to guidelines outlined in Griffith *et al.* (1999).

For definitions of terms used in this scoresheet, see 'definitions' in the main thesis.

APPENDIX 5.10

Recruitment questionnaire.

Research & Marketing Ltd.
Edena House,
East Canal Wharf,
Cardiff, CF1 5AQ

R&M

8	4	3	2						

Job Number   Int no.   Seq no.

UWIC RECRUITMENT

Introduction: Good morning / afternoon / evening. I'm from Research and Marketing Ltd., we have been asked by the University of Wales Institute Cardiff, to recruit people for a research project they are undertaking about food, cooking and nutrition.

They are asking people to come you UWIC at Colchester Avenue for about 2 hours and take part in cooking a simple meal in a domestic kitchen. All ingredients will be provided. Everyone who does this will receive a £15 voucher from Sainsburys, Marks and Spencers or Tescos.

Would you consider taking part?

❑ YES
❑ NO

If 'YES' Can you answer some simple classification questions please – so that I can match my quota.
Are you a vegetarian?

IF 'YES' EXPLAIN THE DISHES CONTAIN MEAT ---------------THAKE AND CLOSE
IF 'NO' -------------------CONTINUE

Q1. To which of these age groups do you belong? FOU ☐

16-24 ❑
25-34 ❑
35-44 ❑
45-54 ❑
55-64 ❑
65+ ❑

Q2. What is the occupation of your head of household? FOU ☐

____

Q3. What is your own occupation – if Head of Household please indicate 'as above'. FOU ☐

____

Q4. How often do you prepare your own meals or your familys / household meals? FOU ☐

Once or twice a day or more ❑ >>>>>>>>> CONTINUE INTERVIEW
More than twice a week ❑ >>>>>>>>> CONTINUE INTERVIEW
Less than once a week ❑ >>>>>>>>> THANK AND CLOSE
Very rarely ❑ >>>>>>>>> THANK AND CLOSE

Q5.	Are you a professional cook or chef?			FOU
	Yes	❑	>>>>>>>>> CONTINUE INTERVIEW	☐
	No	❑	>>>>>>>>> THANK AND CLOSE	

Q6.	Are you employed:		
	Full time (30 hours or more per week)	❑	FOU
	Part time (less tha 30 hours per week)	❑	☐
	Unemployed – seeking work	❑	
	Housewife – not seeking work	❑	
	Retired	❑	
	Student (full time)	❑	
	Student (part time)	❑	

			FOU
Q7.	Record (do not ask) Gender:		☐
	Male	❑	
	Female	❑	

			FOU
Q8.	How many adults are in your household?		☐
	Adults	❑	
	Children under 16 years	❑	

Q9.	Marital status:		FOU
	Married or living with partner	❑	☐
	Single, divorced or widowed	❑	

Q10. NAME OF RESPONDENT: ______________________

ADDRESS: ______________________

____

____

TELEPHONE NUMBER: ______________________

EXPLAIN:

Elizabeth Redmond from UWIC will be given your name and telephone number and may ring to make an appointment for you to come – this can be day-time or one evening to suit you.

You may telephone her yourself during usual office hours if you prefer on 02920 416452.

APPENDIX 5.11

Telephone Protocol.

☎ 1. My name is Elizabeth Redmond from the University of Wales Institute in Cardiff.
I understand that you have recently agreed to participate in a cooking session here at UWIC (Research and Marketing)

☎ 2. **Location** for practical: Colchester Avenue campus of UWIC. - familiar?

☎ 3. Each cooking session is expected to about **1-2 hours**.

☎ 4. All **equipment and ingredients** that is needed will be provided for.

☎ 5. What participant will be doing: Cooking and serving a Home-made meal (give participant choice of meal i.e. Korma, Burger or Roast)

6. Meal is prepared in kitchen equipped with usual domestic equipment.
In the kitchen on your own, so nothing to worry about.

☎ 7. As a token of our thanks you will be given a £15 **voucher.** Vouchers can be from either Sainsburys, Marks and Spencers or Tescos - give participant choice. FIND OUT.

Everything OK so far?? any questions

☎ 8. **Date / time arrangements** of the first practical session - at convenience of participants time / within prepared time-table as kitchen also used for teaching

☎ 9. Are **directions** to UWIC required? / What method of transport?
<u>Bus</u> - relevant bus numbers along Newport Road and Colchester Avenue will be sent to you.
<u>Car</u> - Staff Car park, buzz for assistance at the barrier, porters will allow you through

☎ 10. **Entrance** to the campus through central sliding double doors, into the foyer - reception desk., ask for me and the porter will know that you are coming and will ring me so I can come down and meet you.

☎ 11. Information gained will be treated with a **confidential nature**

☎ 12. Information that you will be **sent** includes: clarification of date and time of visit, a map of UWIC location with bus routes / numbers, and (chosen) recipes.

☎ 13. **Reiterate date, day and time of practical and place**, Look forward to seeing them then.
Not to worry about anything, hopefully enjoy practical too!

APPENDIX 5.12

Letter sent to participants prior to attending food preparation session.

xx xxxxx xxxx

xxxxxxxxxxxx,
xxxxx xxxx xxxxx,
xxxxxx,
Cardiff, CFxx xxx

Dear ....,

On behalf of the UWIC Food Research Group, I would like to thank-you for agreeing to participate in the pilot food preparation practical sessions. As you will recall from our recent telephone conversation, we have made the following arrangements for the practical.

Date: ***Day, Date***
Time: ***x pm***
Location: **Reception Desk, Colchester Avenue Campus of UWIC**
Inform porter of your arrival and wait in UWIC entrance foyer

As previously discussed, you are required to prepare and serve the following meal. If you wish, you may repeat this practical on another occasion in UWIC and similarly in your own home. No special culinary skills are needed.

Home-made Chicken Korma / Tumeric Rice followed by home-made Chocolate Mousse

I have taken this opportunity to enclose the relevant recipe, so that you can familiarise yourself with the preparation methods. I have also enclosed a map of the location of the Colchester Avenue Campus of UWIC, and details of relevant bus routes. If you are travelling by car, please use the front car park and inform reception of your arrival at the barrier.

I am extremely grateful for your participation with the research. As a token of our thanks you will be given vouchers from either Sainsburys, Marks and Spencers, or Tescos. Data collected during the course of the study will be treated with **complete confidentiality**.

If I can be of any further assistance, please do not hesitate to contact me at UWIC on Cardiff 20416452. Should you not be able to attend the practical session, please contact me as soon as possible.

I look forward to meeting you.

Yours Sincerely,

Elizabeth Redmond (Research Assistant)

APPENDIX 5.13

Protocol for meal preparation sessions.

Meet participants in UWIC foyer

Thank participant for coming ~ introduction of myself Elizabeth Redmond (Research Assistant) that you are going to be preparing the meals for.

Standard Questions ~ conversation

Manage to find UWIC all right? How did participant travel to UWIC? From where? Information re UWIC e.g. New Building, weather etc.

Immediately go to consumer kitchens (tell participant). We have attempted to recreate a typical domestic environment. Set the kitchen out with standard kitchen equipment.

Reiterate what food is to be prepared: ......

Consumer Science Kitchen

On arrival to consumer science kitchen, conduct introductory chat

Review fact sheets previously sent to participant , ask if there were any questions

Give participant simple, written instructions for cooker and microwave controls

Familiarisation with kitchen - explanation of where everything is stored (open cupboards), demonstration of cooker and microwave controls. additionally give a brief explanation of how all the electrical equipment such as electric hand mixer, kettle works (very basic and standard)

Emphasise - no tricks, just prepare food as you would in your own home

All information gained from the practicals will be treated with a confidential nature

Instructions are to be followed as near to exact as possible; Each meal is to be served for one person and a second portion is to be retained for a later date; Each Home-made meal is to be served at the table. Inform participant to keep a second portion for later consumption i.e. for a meal 24 / 36 hours ahead (scenario e.g. for tomorrows lunch).

Completion of the practical will occur when meals are served and the kitchen is left as it would be in the home, leave the kitchens as you would in your in your own home (e.g.) if you wipe up immediately, please do so, if not please don't.

Reiterate what the plan of action is:

Clarify queries with participant

Familiarisation with kitchen

Preparation of chosen meal

Each meal is to be served for one person and a <u>second portion is to be retained for a meal the following day</u>. (scenario)

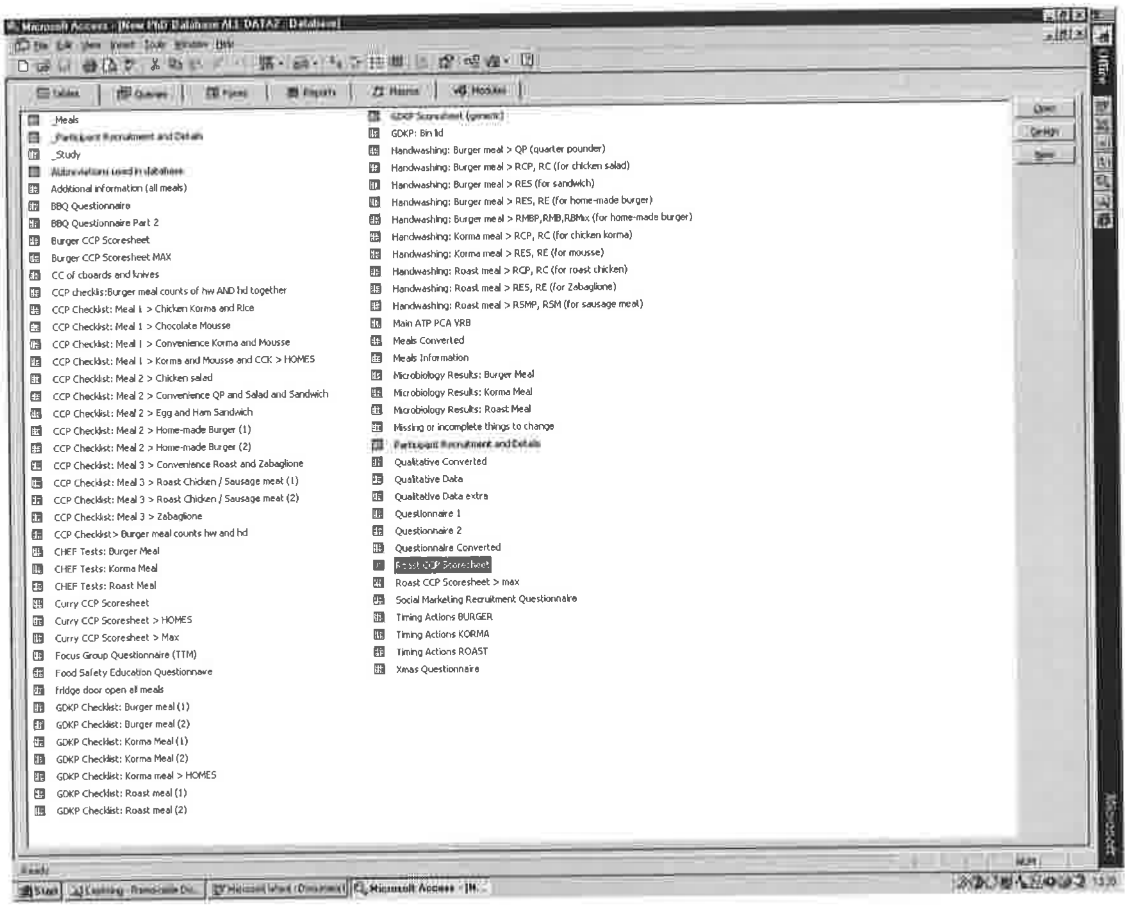
Serve 2 individual portions using mats and cutlery (one home-made and the other convenience)

Clear kitchen and leave it as you would in your own home (e.g.) if washing up is left to dry naturally, then (e.g.) this should be done, if everything is washed and dried...

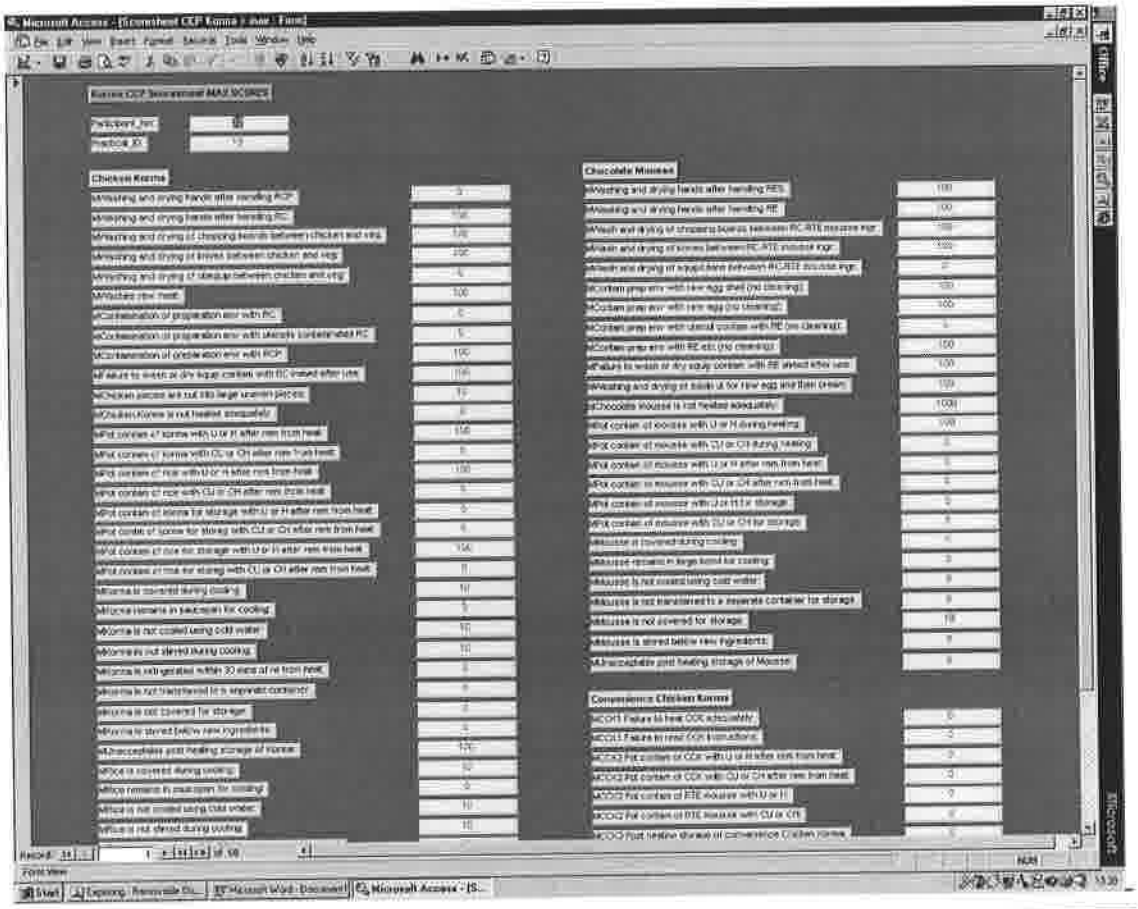
After initial preparation time of 15-20 minutes I will check the participant has no problems and all is going well.

APPENDIX 5.14

(a) Front page of Access Database.



(b) Example of form used for Access database.



APPENDIX 6.0

OBSERVATIONAL CHECKLIST: UWIC AND HOME MEAL PREPARATIONS (REPRODUCIBILITY STUDY).

HOME-MADE CHICKEN KORMA AND TURMERIC RICE

✓ per malpractice

Hand-washing and hand drying.

- Inadequate or no washing and drying of hands after handling RCP. ❑
- Inadequate or no washing and drying of hands after handling RC. ❑

Use of chopping boards and knives.

- Inadequate or no washing and drying of chopping boards after raw chicken and before ready-to-eat (RTE) foods / fruit / vegetables. ❑
- Inadequate or no washing and drying of knives after raw chicken and before ready-to-eat (RTE) foods / fruit / vegetables. ❑

Handling and preparation.

- Failure to wash / dry utensils / equipment contaminated with raw chicken immediately after use. ❑
- Washes raw meat prior to cooking. ❑
- Potential contamination of preparation environment with **raw chicken***. ❑
- Potential contamination of prep environment with **utensils** contaminated with raw chicken*. ❑
- Potential contamination of preparation environment with **raw chicken packaging***. ❑
- Chicken pieces are cut into large uneven pieces. ❑

Heating.

- Failure to heat chicken korma efficiently. ❑

Post-heating handling.

- Potential contamination of korma and / or rice with unclean utensils or hands after removal from heat. ❑
- Potential contamination of korma and / or rice with potentially contaminated utensils / potentially contaminated hands after removal from heat. ❑

Cooling.

- Use of large container for cooling (exceeding 7-8cm in depth). ❑
- Chicken Korma and / or rice is covered during cooling. ❑
- Rice is not cooled using cold water. ❑

Post-heating storage.

- Chicken Korma is left at room temperature ❑
- Rice is left at room temperature. ❑
- Korma is not covered. ❑
- Rice is not covered. ❑
- Korma is not transferred to a small separate container for storage. ❑
- Rice is not transferred to a small separate container for storage. ❑
- Refrigerated Korma or rice is stored below raw ingredients. ❑

*Failure to implement adequate cleaning of preparation environment (see Griffith *et al.* 1999)

HOME-MADE CHOCOLATE MOUSSE

✓ per malpractice

Hand-washing and hand drying.

- Inadequate or no washing and drying of hands after handling RES. ❑
- Inadequate or no washing and drying of hands after handling RE. ❑

Use of chopping boards, knives and equipment / utensils.

- Inadequate or no washing and drying of chopping boards after raw egg and before ready-to-eat (RTE) foods / fruit / vegetables. ❑
- Inadequate or no washing and drying of knives after raw egg and before ready-to-eat (RTE) foods / fruit / vegetables. ❑

Handling and preparation.

- Inadequate or no washing and drying of equipment / utensils used after raw egg and before cream. ❑
- Failure to wash / dry utensils / equipment potentially contaminated with raw egg immediately after use. ❑
- Potential contamination of preparation environment with **raw egg shell***. ❑
- Potential contamination of preparation environment with **raw egg***. ❑
- Potential contamination of preparation environment with **utensils** contaminated with raw egg*. ❑
- Potential contamination of preparation environment with **raw egg mixture***. ❑

Heating.

- Failure to heat chocolate mousse efficiently. ❑

Post-heating handling.

- Potential contamination of mousse with unclean utensils or hands after removal from heat. ❑
- Potential contamination of mousse with potentially contaminated utensils / potentially contaminated hands after removal from heat. ❑

Cooling.

- Use of large container for cooling (exceeding 7-8cm in depth). ❑
- Chocolate mousse is covered during cooling. ❑

Post-heating storage

- Mousse is left at room temperature ❑
- Mousse is not covered ❑
- Mousse is not transferred to a small separate container for storage ❑
- Refrigerated Mousse is stored below raw ingredients ❑

*Failure to implement adequate cleaning of preparation environment (see Griffith *et al.* 1999)
For definitions of terms used in this checklist, see 'definitions' in the main thesis.

APPENDIX 6.2

SCORESHEET: HOME MEAL PREPARATIONS (REPRODUCIBILITY STUDY).

Home-made Chicken Korma and Turmeric Rice with Chocolate Mousse.

Home-made Chicken Korma and Turmeric Rice

INADEQUATE PRACTICE	RISK SCORE AWARDED	TOTAL RISK SCORE AWARDABLE
Handling and Preparation.		
• Inadequate or no washing and drying of hands after handling RCP.		*100*
• Inadequate or no washing and drying of hands after handling RC.		*100*
• Inadequate or no washing and drying of chopping boards after raw chicken and before ready to eat (RTE) foods / fruit / vegetables.		*100*
• Inadequate or no washing and drying of knives after raw chicken and before ready to eat (RTE) foods / fruit / vegetables.		*100*
• Failure to wash / dry utensils / equipment contaminated with raw chicken immediately after use.		*100*
• Washes raw meat prior to cooking.		*100*
• Potential contamination of preparation environment with **raw chicken***.		*100*
• Potential contamination of prep environment with **utensils** contaminated with raw chicken*.		*100*
• Potential contamination of preparation environment with **raw chicken packaging*.**		*100*
• Chicken pieces are cut into large uneven pieces.		*10*
Heating.		
• Failure to heat chicken korma efficiently.		*1000*
Post-Heating Handling.		
• Potential contamination of korma and / or rice with unclean utensils or hands after removal from heat.		*100*
• Potential contamination of korma and / or rice with potentially contaminated utensils / potentially contaminated hands after removal from heat.		*1000*
Cooling.		
• Use of large container for cooling (exceeding 7-8cm in depth).		*10*
• Chicken Korma and / or rice is covered during cooling.		*10*
• Rice is not cooled using cold water.		*10*
Post-Heating Storage.		
• Chicken Korma is left at room temperature.		*100*
• Rice is left at room temperature.		*100*
• Korma is not covered.		*10*
• Rice is not covered.		*10*
• Korma is not transferred to a small separate container for storage.		*10*
• Rice is not transferred to a small separate container for storage.		*10*
• Refrigerated Korma or rice is stored below raw ingredients.		*10*

*Failure to implement adequate cleaning of preparation environment (see Griffith *et al.* 1999)

Home-made Chocolate Mousse

INADEQUATE PRACTICE	RISK SCORE AWARDED	TOTAL RISK SCORE AWARDABLE
Handling and Preparation		
• Inadequate or no washing and drying of hands after handling RES.		*100*
• Inadequate or no washing and drying of hands after handling RE.		*100*
• Inadequate or no washing and drying of chopping boards after raw egg and before ready to eat (RTE) foods / fruit / vegetables.		*100*
• Inadequate or no washing and drying of knives after raw egg and before ready to eat (RTE) foods / fruit / vegetables.		*100*
• Inadequate or no washing and drying of equipment / utensils used after raw egg and before cream.		*100*
• Failure to wash / dry utensils / equipment potentially contaminated with raw egg immediately after use.		*100*
• Potential contamination of preparation environment with **raw egg shell***.		*100*
• Potential contamination of preparation environment with **raw egg***.		*100*
• Potential contamination of preparation environment with **utensils** contaminated with raw egg*.		*100*
• Potential contamination of preparation environment with **raw egg mixture***.		*100*
Heating		
• Failure to heat chocolate mousse efficiently.		*1000*
Post-Heating Handling		
• Potential contamination of mousse with unclean utensils or hands after removal from heat.		*100*
• Potential contamination of mousse with potentially contaminated utensils / potentially contaminated hands after removal from heat.		*1000*
Cooling		
• Use of large container for cooling (exceeding 7-8cm in depth).		*10*
• Chocolate mousse is covered during cooling.		*10*
Post-Heating Storage		
• Mousse is left at room temperature		*100*
• Mousse is not covered		*10*
• Mousse is not transferred to a small separate container for storage		*10*
• Refrigerated Mousse is stored below raw ingredients		*10*

*Failure to implement adequate cleaning of preparation environment (see Griffith *et al.* 1999)
For definitions of terms used in this scoresheet, see 'definitions' in the main thesis.

APPENDIX 6.3

SPECIFIC OBSERVED ACTIONS OF COMPOSITE FOOD SAFETY MALPRACTICES

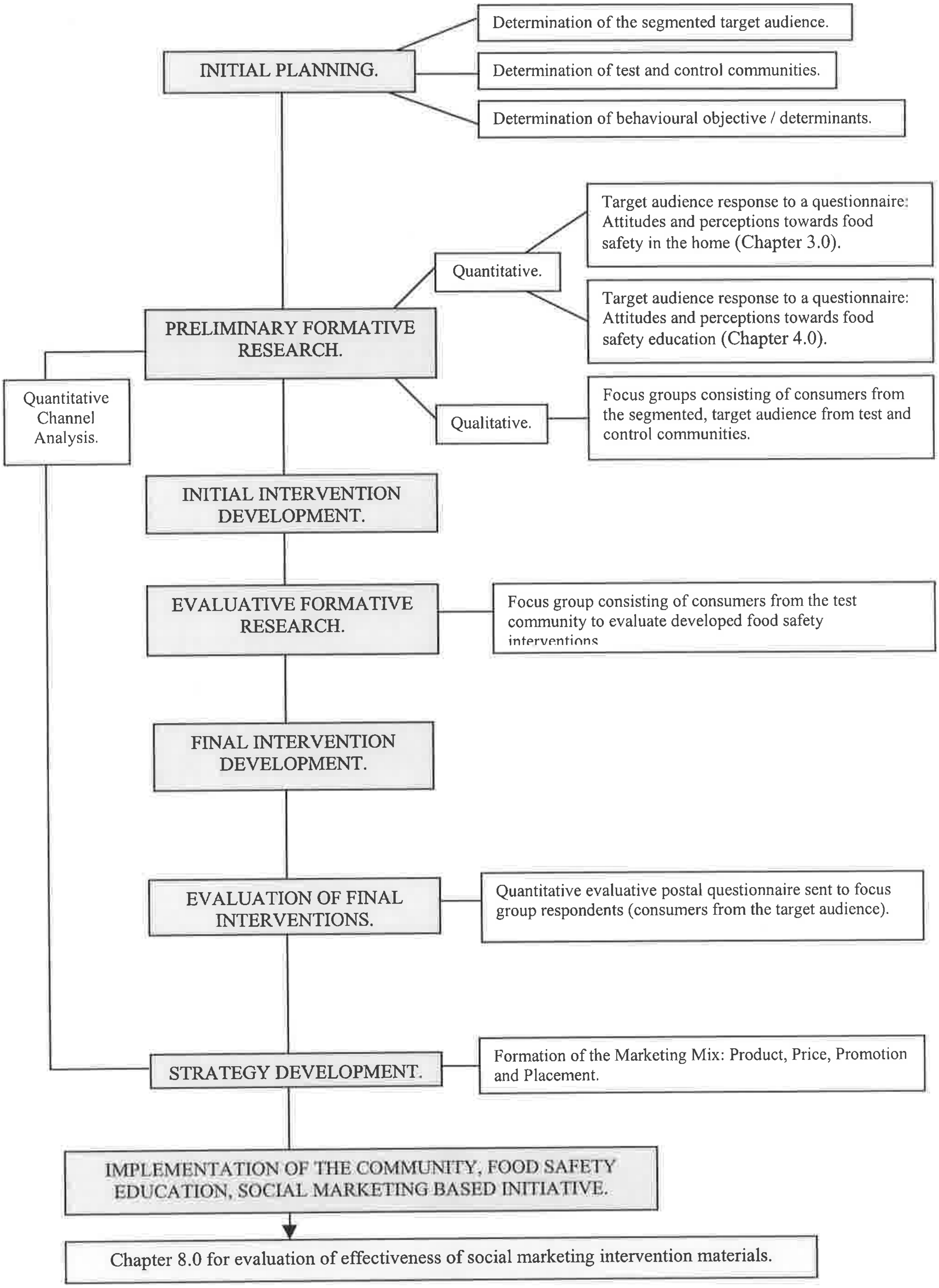
	Composite food safety malpractice.	Specific observed actions of the composite food safety malpractice.
I	Failure to wash and dry hands immediately and adequately after …..	……… after handling RCP.
		……… after handling RC.
		……… after handling RES.
		……… after handling RE.
II	Failure to implement safe use of chopping boards, knives and utensils.	Failure to use separate / inadequately washed and dried chopping boards between chicken and onion / tomato.
		Failure to use separate / inadequately washed and dried knives between chicken and onion / tomato.
		Failure to use separate / inadequately washed and dried equipment / utensils between chicken and onion / tomato.
		Failure to use separate / inadequately washed and dried chopping boards between RC and mousse ingredients.
		Failure to use separate / inadequately washed and dried knives between RC and mousse ingredients.
		Failure to use separate / inadequately washed and dried equipment / utensils between RC and mousse ingredients.
III	Potential contamination of preparation environment.	Potential contamination preparation environment with RC *.
		Potential contamination preparation environment with utensil contaminated with RC *.
		Potential contamination preparation environment with RCP *.
		Potential contamination preparation environment with RES *.
		Potential contamination preparation environment with RE *.
		Potential contamination preparation environment with utensil contaminated with RE *.
		Potential contamination preparation environment with RE mix *.
IV	Potential contamination of end products: H,U.	Potential contamination of korma with U or H after removal from the heat.
		Potential contamination of rice with U or H after removal from the heat.
		Potential contamination of korma with U or H for storage.
		Potential contamination of rice with U or H for storage.
		Potential contamination of mousse with U or H after removal from the heat.
		Potential contamination of mousse with U or H for storage.
V	Potential contamination of end products: CH,CU.	Potential contamination of korma with CU or CH after removal from the heat.
		Potential contamination of rice with CU or CH after removal from the heat.
		Potential contamination of korma with CU or CH for storage.
		Potential contamination of rice with CU or CH for storage.
		Potential contamination of mousse with CU or CH after removal from the heat.
		Potential contamination of mousse with CU or CH for storage.
VI	Inadequate cooking efficacy.	Chicken Korma is not heated adequately.
		Chocolate Mousse is not heated adequately.
VII	Inadequate cooling practices.	Korma is covered during cooling.
		Rice is covered during cooling.
		Mousse is covered during cooling.
		Korma remains in saucepan for cooling.
		Rice remains in saucepan for cooling.
		Mousse remains in large bowl for cooling.
		Korma is not stirred during cooling.
		Rice is not stirred during cooling.
		Korma is not transferred to a separate container.
		Rice is not transferred to a separate container.
		Mousse is not transferred to a separate container for storage.
		Rice is not cooled using cold water.
VIII	Inadequate storage practices.	Korma is stored below raw ingredients.
		Rice is stored below raw ingredients.
		Mousse is stored below raw ingredients.
		Korma is not covered for storage.
		Rice is not covered for storage.
		Mousse is not covered for storage.
		Chicken korma is left at room temperature for storage.
		Rice is left at room temperature for storage.
		Mousse is left at room temperature for storage.

Key: RC=raw chicken; RCP=raw chicken packaging; RM=raw meat; RMP=raw meat packaging; RE=raw egg; RES=raw egg shells; CU=contaminated utensil; H=hands; U=utensils; CH=contaminated hands; * = *followed by no cleaning*

APPENDIX 7.0

APPENDIX 7.1

SOCIAL MARKETING PLAN FOR CHAPTER 7.0.



APPENDIX 7.2

SOCIAL MARKETING RECRUITMENT QUESTIONNAIRE.

BEAUFORT RESEARCH	**FOOD PREPARATION RECRUITMENT FORM** **B2066**	**FOR OFFICE USE ONLY**

APPROACH WOMEN AGED 60-74 YEARS, WHO ARE ON THE PHONE

INTRODUCTION: My name is ________ of Beaufort Research. We are conducting some research in conjunction with UWIC – the University of Wales Institute Cardiff – into different aspects of food preparation, such as food safety. Can I just ask you a few questions please?

SHOW CARD RQ.1

Q.1	Have you or any member of your family ever been involved with or worked in the following areas		
	Marketing Market Research Journalism Broadcasting Professional food preparation or cooking UWIC food research		IF ANY CLOSE
Q.2	Do you know anyone else that has already participated / is participating in any food preparation research?		
	Yes	1	→ CLOSE
	No	2	→ CONTINUE
Q.3	Have you previously had any dealings or know anyone who works with Beaufort Research?		
	Yes	1	→ CLOSE
	No	2	→ CONTINUE
Q.4	How often do you prepare your own or your family/household meals?		
	Once or twice a day or more	1	CONTINUE
	Once or twice a week	2	CONTINUE
	Less than once a week	3	CLOSE
	Very Rarely	4	CLOSE

Q.5	Do you ever handle raw meat or poultry in your food preparation at home?	
	Yes	1 → CONTINUE
	No	2 → CLOSE
Q.6	And are you vegetarian?	
	Yes	1 → CLOSE
	No	2 → CONTINUE
Q.7	To which age group do you belong?	
	Under 18	1 } CLOSE
	18-59	2 } CLOSE
	60 -74	5 → CONTINUE
	Over 74	6 → CLOSE
Q.8	OCCUPATION OF THE CHIEF WAGE EARNER IN THE RESPONDENT'S HOUSEHOLD	
	Job Title:________________ AB	1 } CLOSE
	C1	2 } CLOSE
	Position/ C2	3 } CONTINUE
	Rank/Grade:________________ DE	4 } CONTINUE
	(Please give last position if unemployed/retired)	
SHOW CARD A		
Q.11	Using this card please tell me how much you know about nutritional aspects of food preparation?	
	Everything	1
	A Lot	2
	Something	3
	A little	4
	Nothing at all	5
SHOW CARD A (AGAIN)		
Q.12	Using this card please tell me how much you know about food safety practices when preparing food at home?	
	Everything	1 → CLOSE
	A Lot	2 } CONTINUE
	Something	3 } CONTINUE
	A little	4 } CONTINUE
	Nothing at all	5 → CLOSE
SHOW CARD B		
Q.13	Which of the following is a serious nutritional problem caused by the lack of calcium?	
	Osteoporosis	1
	Anaemia	2
	Dermatitis	3
	Don't Know	4
SHOW CARD C		
Q.14	Using the definitions on this card how bad do you think food poisoning could be?	
	Severe	1 } CONTINUE
	Moderate	2 } CONTINUE
	Minor	3 → CLOSE
Q.15	Do you think that using a low sodium salt in your cooking reduces the risk of high blood pressure?	
	Yes	1
	No	2
Q.16	Do you think that things you do when preparing food can reduce the risk of getting food poisoning?	
	Yes	1 → CONTINUE
	No	2 → CLOSE

For recruitment of participants for focus groups:

IF SUCCESSFULLY SCREENED NOW RECRUIT YOUR RESPONDENT TO TAKE PART IN A GROUP DISCUSSION:

As we said at the start of the interview; we are conducting this research in combination with UWIC. They will be holding some group discussions and would like to invite you personally to attend.

IF RESPONDENT WILLING TO ATTEND GROUP HANDOUT INVITATION WITH RELEVANT DATE AND TIME OF GROUP

For recruitment of participants for cooking sessions:

IF SUCCESSFULLY SCREENED NOW RECRUIT YOUR RESPONDENT TO TAKE PART IN 3 COOKING SESSIONS.

As we said at the start of the interview; we are conducting this research in combination with UWIC. They will be holding some cooking sessions and would like to invite you personally to attend. This will mean coming to UWIC on three separate occasions to cook a simple meal. (Explain incentivisation and show plan if necessary).

IF RESPONDENT WILLING TO ATTEND HANDOUT INVITATION.

RESPONDENT DETAILS:

Name: ______________________________

Address: ______________________________

____

____

Postcode: ______________________________

Telephone Number: ______________________________

THANK RESPONDENT, LEAVE INVITATION & CLOSE INTERVIEW.

INTERVIEWER DECLARATION

I declare that I have conducted this interview in accordance with your instructions.

Signature: ______________________________

Date: ______________________________

APPENDIX 7.3

SCALED SHOW CARDS USED TO RECRUIT PARTICIPANTS FOR SOCIAL MARKETING PROJECT.

CARD A	CARD B
EVERYTHING A LOT SOME A LITTLE NOTHING AT ALL	Severe: Acute illness, resulting in hospitalisation and possible complications such as rheumatoid arthritis or even death. Moderate: Illness involving fever, abdominal pain, diarrhoea, vomiting and nausea lasting for less than one week. Minor: Mild illness involving vomiting and / or diarrhoea causing discomfort for less than 24 hours.
CARD C	**CARD RQ1**
Handwashing and hand drying: Use of hot water and soap, lather hands and then rinse with hot water and dry hands using a hand towel or paper towel to dry. Chopping boards and knives: Use unused chopping board / knife OR Washing chopping board / knife in clean hot water and detergent, rinse, spray with sanitiser, rinse and dry using an unused T Towel or paper towel.	MARKETING MARKET RESEARCH JOURNALISM BROADCASTING PROFESSIONAL FOOD PREPARATION OR COOKING UWIC FOOD RESEARCH

APPENDIX 7.4

INVITATION GIVEN TO PARTICIPANTS TO CONFIRM FOCUS GROUP RECRUITMENT.

An Invitation from.........

Dear Madam

Thank you for agreeing to attend *UWIC discussion groups*.
This invitation is for you personally – please do not pass it on to anyone else.

You have been asked to come along because we are interested in your opinion as a member of the public. We look forward to meeting you and may we assure you that you will **not** be asked to purchase anything. All information you supply is confidential.

The discussion will be held at:

12 St. Mary's Road
Whitchurch
Cardiff

On ....

If for any reason you subsequently cannot attend please contact
Rebecca Thomas on *029 20 378565* as soon as possible.

PLEASE BRING THIS INVITATION WITH YOU TO THE DISCUSSION GROUP

APPENDIX 7.5

FOCUS GROUP DISCUSSION ROUTE.

UWIC

Preliminary Focus Group Discussion Route

Section 1.	Introduction.	
Section 2.	Frequently prepared / consumed foods and meals.	*Re:* most common method for preparation and cooking of chicken.
Section 3.	Food poisoning.	*Re:* experience of food poisoning; risk perceptions; vulnerability; severity; location of getting food poisoning and personal risk / risk of others.
Section 4.	Food handling practices.	*Re:* behavioural determinants (PRODUCT); self efficacy; barriers (PRICE) and benefits; outcome expectancies; action plans / control.
Section 5.	Intervention placement.	*Re:* PLACE.
Section 6.	Intervention promotion.	*Re:* PROMOTION.

Section 1: Introduction.

(Introductory paragraphs 1-5 are based on a suggested format by Kruegar, (1998).

1. Good morning and welcome to our session. Thank-you for taking time to join our discussion about various issues about food poisoning and food hygiene.
Introduction of Moderator (Rebecca Thomas from Beaufort Research) and co-moderator (Elizabeth Redmond from UWIC).
This morning we are attempting to gain information from you about your perceptions of food poisoning and food safety / food hygiene and ideas about future interventions.

2. You were selected because you have certain things in common that are of particular interest to us.
Confirm that no one knows each other etc
Remind participants what they answered in the recruitment questionnaire: all people in the group have said that they feel that they know something about food safety (not everything or nothing), all think food poisoning can cause a severe or moderate illness, and all recognize that certain food safety practices can reduce the risk of food poisoning.
In addition all prepare meals at least once or twice a week and are used to handling raw chicken.

3. There are no right or wrong answers, rather differing points of view. Please feel free to share your point of view, even if it differs from what others have said.

4. Before we begin, let me remind you that you will be assured of complete confidentiality. Please speak up - only one person should talk at a time. We are tape recording the session because we do not want to miss any of your comments. If several people are talking at the same time, comments will be missed. We will be on a first name basis tonight, and in our later reports there will not be any names attached to comments. Keep in mind that we are just as interested in negative comments as positive comments, and at times the negative comments are the most helpful. As mentioned already, all information collected during the course of study will be treated with complete confidentiality.

5. Our session will last about an hour and a half and we will not be taking a formal break.

Section 2: Frequently prepared / consumed foods and meals.

Question.	*Comment.*
• To start with briefly talk about the foods that each person in the group most frequently prepares.	*Relate back to these types of meals later in the discussion.*
• Who is food prepared for?	*Themselves; husband; children; grandchildren; friends??*
• Find out what are the most common meals prepared using chicken and poultry.	*All in the group have stated in the recruitment questionnaire that they handle raw meat or poultry. e.g. roasts, stir-fry, casseroles, pies, etc ???*
• Particularly find out whether group members prepare chicken salad.	*i.e. chop raw chicken fillets, fry, then chop u salad veg, and mix all the ingredients up together and serve.*
• Find out the most common methods for cooking chicken?	*Roasting, grilling, frying, casserole, microwave, BBQ, stir fry etc.*
• What are the most frequently bought chicken pieces?	*Whole chicken, fillets, legs, wings etc.*
• What is cooked chicken typically served with?	*Salad, cooked vegetables etc?*
• How safe is chicken thought to be?	*In comparison with other foods eg bread, minced beef, eggs (raw or cooked). If not perceived to be safe then why?*

Section 3: Food poisoning.

Question	*Comment*
Has anyone here experienced food poisoning? (ever). Any family / friends experienced food poisoning?	*If yes, when?, what bacteria caused it? was the doctor visited? how bad was the illness, how long did the illness last? any complications? any implicated food or preparation practices?* *Did having food poisoning alter your food preparation practices at all (if yes / no why??)*
Risk perception of illness.	
How vulnerable do you think that you are to getting food poisoning?	*How likely do the respondents think that they are to getting food poisoning?* *Do they think that they are more vulnerable compared to younger people? Or to when they were younger themselves?* *Why do they think they are or are not vulnerable?*
What do you think that the consequences of food poisoning are?	*What do they think happens when a person (like themselves) is ill due to food poisoning?*
What do you think is a more of a threat to your health than food poisoning?	*Get ideas from respondents.*
What do you think is less of a threat to your health than food poisoning?	*E.g. getting run over by a bus; catching a cold/ flu; compared to other form of illness*
How would you rate / describe the risk of you getting food poisoning?	*In terms of what? as a %, or compared to being in a car accident or getting another illness (such as what?).*
Where do you think the MOST and LEAST common locations for getting food poisoning are? WHY?	*Take-away van or Fast food establishment (e.g. McDonalds), Own home, Pub, Supermarket restaurant, Parents / friends house, , 5 star / 2 star hotel / restaurant, Ethnic style restaurant (e.g. Chinese, Thai), University / school / work canteen, Hospital / Old persons home*
Find out what risk (chance) is thought to be associated with preparing food in the home compared to outside establishments.	*Outside establishments = restaurants, cafes, takeaways etc* *Very high > Very low WHY?*
What do you consider the risk (chance) of illness to be after eating food that you have prepared yourself?	*Very high-risk > very low risk. WHY?*
What do you consider the risk (chance) of other people experiencing food poisoning to be after eating food that other people have prepared themselves?	*More chance or less chance or other people getting food poisoning compared to yourself. Why?*
Are you more careful with your food preparation for yourself, rather than friends or family?	*Who are you more careful for? Children? Husband? Grandchildren?*

Section 4: Food-handling practices.

Question.	*Comment.*
Do you think about food hygiene when preparing meals?	*If yes, what do you think about and WHY?*
How would you describe a 'safe' food?	*What do respondents think that a safe food is? (if no answers at all suggest absence or presence of bacteria)*
What do you think that you have to do to prepare safe food?	*What actions help to make food safe during food preparation eg, handwashing, separate raw and cooked foods, proper cool storage*
What practices do you currently do to ensure that food is safe?	*What actions do respondents carry out to prepare safe food*
Do you think that you know enough to provide safe food?	*Gauge how much the respondents think that they do know about food hygiene and food safety*
Do you think that you are capable of preparing safe food?	*In terms of having sufficient skills, equipment, utensils*
Do you think that it costs more money to prepare safe food and be hygienic? If so how?	*~ buying cleaning liquids etc? cloths etc? salmonella free eggs or chicken*
What do you expect to achieve by carrying out safe food preparation practices?	*Outcome expectations; what respondents expect to from safe food preparation? E.g. food that will not cause food poisoning*
Has anyone head of cross contamination?	*If yes, ask them what it is and examples of cross contamination in the home food preparation*
Do you think that it is possible to get food poisoning from cross contamination?	*If yes, WHY? How? How do they know that?*
Hand-washing	
Do you wash and dry hands every single time after touching raw meat / poultry?	*Truth??*
Get participants to describe how they wash their hands after touching raw meat / raw egg or before food preparation....	
Description has been given for best handwashing practice SHOW CARD A.	*What are you opinion on this? over the top, acceptable, what you do already*
Do you think that you are capable of doing this every time after touching raw meat?	*Yes / No WHY?. Which part makes it difficult?*
(Barriers) What things stop you from doing this every time?	*See* ✳

Section 4 continued: Food-handling practices.

Question.	*Comment.*
Chopping boards / knives.	
Do you use a washed and dried chopping board / knife every single time after touching raw meat / poultry?	*Truth??*
Chopping boards… Get participants to describe how they wash their chopping boards or knives after chopping raw chicken	
Description has been given for best practice for washing chopping boards / knives after raw chicken SHOW CARD B	*What are you opinion on this? over the top, acceptable, what you do already*
Do you think that you are capable of doing this every time after preparing raw meat?	
What things stop you from doing this every time?	*See ✳ (page 6)*

✳ Lack of time, lack of knowledge (don't actually realize that harmful bacteria may be being transferred from the raw meat to e.g. tap handle etc. around the kitchen), lack of facilities (re. cleaning), costs too much, general feeling that it doesn't matter if (e.g.) hands aren't washed <u>every</u> time after touching raw meat- bit over the top etc., 'a bit of dirt will not hurt', unnecessary etc., can't be bothered, not relevant to me - 'I have never had food poisoning before from food that I have prepared', 'I don't like washing hands too often as it makes the skin go too dry'.

Do you think that you are able to overcome these barriers? How?	*Do the respondents have the skill? Have the knowledge? Money? Time?*
What are the benefits of carrying out the behaviours on show cards A and B?	*Eg Satisfaction in the knowledge that the food that has been prepared is safe, implementing the good behaviour will help prevent illness to myself and family, prefer a clean kitchen, confidence in the food that is prepared.*
How much control do you feel that you have over your own food safety when preparing meals?	*Full control > no control at all.*
How much control do you think that other people have over food safety during their own food preparation?	*Full control > no control at all.*
Do you think that you have any responsibility for food safety?	*If yes, how much and why.*
Who do you think is responsible for your own / your familys' food safety?	*Government, school, you, other members of your family, retailers supplying food, health education authorities (internal / external control).*
Under what circumstances could you carry out the desired behaviours on show cards A and B?	
What thought process might you think when deciding to carry out the behaviours or not?	*E.g. what is in the respondents mind when just touching raw meat and what might make them think of food safety?*

Section 5: Interventions – placement of information / interventions.

Question.	*Comment.*
In the past, is there any information that has had a big impact upon you / actually affected you and made you then see the need to change?	*Find out what the info. was, and why it had an impact, what made you change, what did you change*
Have you ever picked up information on food safety before now? If yes, where from?	*Doctors surgery / clinic; dentist; supermarket; schools / colleges; magazines; newspapers; library; environmental health dept*
From which location are you likely to pick up information about food safety / hygiene? Why? Where is preferable?	*Clinic, at doctors surgery or dentist, community centre, OAP club, local shop notice board, notice boards anywhere else, on bus stop, from health visitor, school, supermarket, food packaging, back of a cereal box* **find out exact locations in Llanrumney**
What part of the day would you most likely take information about food safety / hygiene in? Why?	*Morning / afternoon / evening WHY? Relate to eg tea time, after breakfast etc*
What television programmes most often watch / like? What radio programmes? Where most often go in the week? Shopping? < which shops? How do they get to the shops? Bus? Ever go to an OAP club? Doctors surgery, which one? Community centre? WI? Post office?	*Aim is to find out where this group of people from particularly Llanrumney go (so I can position intervention material in the community)*

From what kinds of promotional material do you gain most of your information on food safety / hygiene? WHY? What is preferable?.

1. From a person (family, friend, doctor verbally delivering information).
2. From television (documentary, TV cooking programme).
3. From radio.
4. From written information (poster, leaflet, recipes) include shock tactics.
5. From gimmick (magnet, Ttowel etc).

What sort of person are you most likely to believe as a source of food safety information? (who do respondents think will provide credible / reliable information) WHY?	*Scientist; nurse; chief medical officer; environmental health officer; school teacher / college lecturer; medical person; politician; TV chef; newsreader; farmer; health educator; familiar TV personality; normal person like yourself; younger adult, or older adult???* *Identify a specific person??*
What information channels do you most trust? WHY?	*FSA; EHOs; Health ed Authority; Medical council; government authorities; supermarkets; FDA; Hygiene advisory services e.g. Domestos; Health promotion units* *Identify most and least trustworthy information channels*

Section 5 continued: Interventions – placement of information / interventions.

Question.	*Comment.*
Do any respondents watch any of the television cooking programmes?	*If yes, which ones?* *Do they watch the programmes for pleasure or to pick up information?*
Do you think that TV Chefs practice good hygiene behaviour?	*Yes / No WHY?*
Have any respondents watch documentaries on food safety / informative programmes?	*Yes / No WHY?* *Remember ones watched in the past, good and bad points* *What is preferred television documentaries or cooking programmes?*
Gain attitudes and opinions of respondents about television as an effective method of delivering food safety information.	*Is it useful / beneficial or not? WHY?* *Other television programmes about food safety ?? e.g. the news? Any benefit?*
Any respondents heard information on the radio about food safety?	*How preferable source, when information is just listened to.*
Written information: Leaflets	*Distribute leaflet examples amongst group. Identify most and least preferred formats. Find out why. Difference between those made by supermarkets, advisory units etc*
Do you ever read leaflets? Do you ever throw leaflets away?	*Truth!! Do you ever refer back to what may have been read?*
How have you obtained leaflets in the past?	*Picked them up.. from where?? Received through the letter box? In magazines??*
What do you think would be the best way of you obtaining leaflets?	*Picked up.. from where?? Receive through the letter box? In magazines??*
Poster (MAFF '10 food safety tips').	*Would you ever take any notice of anything like this? Where would you most likely read this?*
Recipes	*Do you ever use recipes? Do you follow instructions?* *How useful would you find it if detailed food safety information was written within the recipe?* *Would you prefer food safety information to be at the beginning of the recipe rather than within?*
Read shock tactics extract.	*Determine impact / response to what is read*
Information from 'gimmicks' e.g. Information on T-towel? or on magnet?	*Do respondents think these would be any use as sources of food safety information? Or a waste of time?*
Do you think that you need to be constantly reminded about food safety / hygiene or have you heard enough about it already.	*Yes / No WHY?*
Overall, where are you most likely to pick up information on food safety?	*General open ended question*

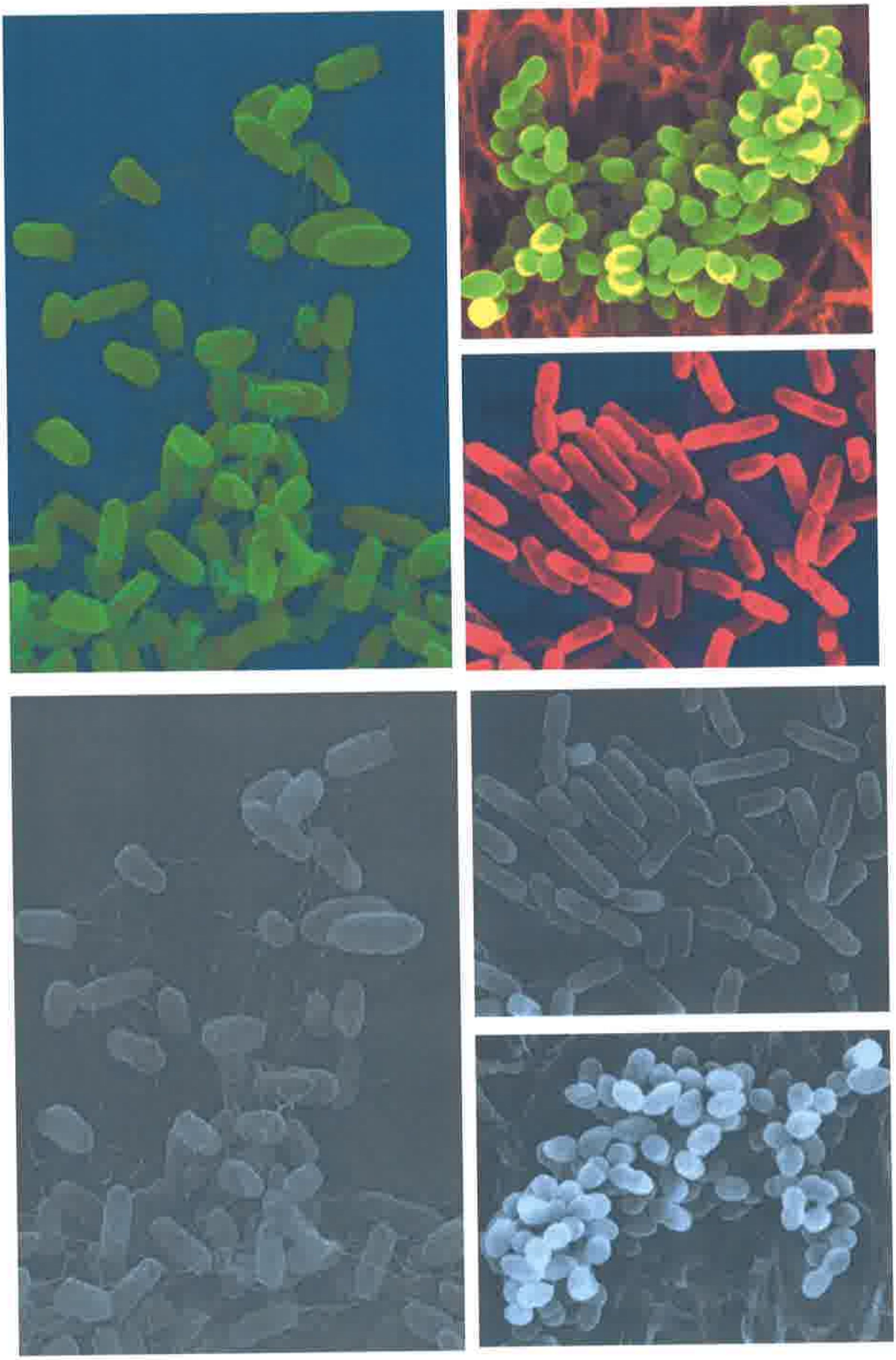
APPENDIX 7.6

FOOD SAFETY LEAFLETS PUBLISHED BY A VARIETY OF ORGANISATIONS.

Leaflet.	Title of leaflet / written by.
A.	'Food safety and the consumer'. Meat and Livestock and Meat Commission.
B.	'Food safety and temperature control.' Foodlink.
C.	'Follow Franks Fingertips for Clean Hands.' Foodlink.
D.	'Danger in your kitchen.' Milton.
E.	'Food safety information for our consumers.' Meat and Livestock Commission.
F.	'Food safety tips in your kitchen.' Microban – Sainsburys.
G.	'Sainsburys- first in food safety.' Sainsburys.
H.	'The good food safety guide.' Food Safety Advisory Centre.
I.	'Pack cool for school – what you need to know.' Domestos.
J.	'Food hygiene – what you need to know' Domestos.
K.	'Chicken rules.' British Chicken Information Service.
L.	'Wise Up to Food Hygiene.' Domestos.
M.	'Care with Frozen Foods' Anon.
N.	'Food sense – Food safety' MAFF (1997).
O.	'You can avoid poisoning this Christmas.' City of Cardiff, Environmental Services.
P.	'Fight Bac – Keep food safe from bacteria' FSIS / FDA / USDA.

APPENDIX 7.7

COLOUR AND BLACK / WHITE IMAGES OF BACTERIA.



APPENDIX 7.8

SHOWCARDS USED IN PRELIMINARY FOCUS GROUPS.

Showcard 1	**After cutting raw chicken on a chopping board…..** Rinse under running water and wipe with cloth
Showcard 2	**After cutting raw chicken on a chopping board…..** Wash with hot water and washing up liquid and scrub using cloth / scourer or brush.
Showcard 3	**After cutting raw chicken on a chopping board…..** Wash with hot water and washing up liquid, scrub with scourer / brush / unused cloth, rinse, spray with sanitiser then rinse for a second time
Showcard 4	**Drying of chopping board…..** Wipe using used T-towel / Hand towel Wipe using unused T-towel / Hand towel Wipe using paper towel Air dry
Showcard 5	**After touching raw chicken…….** Rinse hands under running water
Showcard 6	**After touching raw chicken…….** Wash hands under hot running water with soap
Showcard 7	**After touching raw chicken…….** Wash hands in a bowl of hot water (without touching the tap) and lather with soap and then rinse.
Showcard 8	**Drying of hands…..** Wipe on apron Wipe on used T-towel / Hand towel Wipe on unused T-towel / Hand towel Wipe on to paper towel

APPENDIX 7.9

RECIPE WITH ADDITIONAL FOOD SAFETY INFORMATION.

Recipe
Home-made chicken salad

Additional Guidance Notes:

- Before beginning to prepare the meals, hands should be washed using hot water and cleanser, and then dried using a clean hand towel or paper towel.
- An apron should be worn and long hair tied back.
- It is suggested that the washing up bowl is filled with hot water and detergent before beginning to prepare the food to allow immediate washing of hands and utensils. The water should be changed regularly.
- To clean contaminated equipment and utensils effectively, use clean, hot water and detergent and either dry using a paper towel or clean t-towel.
- To clean a contaminated chopping board effectively, clean, hot water and detergent should be used followed by rinsing of excess soap. Sanitiser should then be sprayed onto the chopping board and rinsed off after 4 to 5 minutes. Drying should involve use of a paper towel or clean t-towel.
- To clean the preparation area, a clean J cloth should be used to wipe hand hot water and detergent over the work surfaces. This should be rinsed and excess soap removed. Sanitiser should then be sprayed onto the work surface and wiped off using a disposable paper towel.

Home-made Chicken Salad.

Ingredients

- 1 chicken breast
- 50g / 2oz Fusilli pasta shapes
- ¼ Iceberg lettuce, chopped
- ¼ cucumber, diced
- 1 tomato, chopped
- 1 carrot, grated
- 2 tbsp. chopped parsley
- 60 ml / 4 tbsp. mayonnaise
- 15 ml / 1 tbsp. vegetable oil

Method

1. Place Fusilli pasta in a saucepan of boiling water and add salt to taste if desired.
2. Boil Fusilli pasta for 9 - 11 minutes (10 - 12 minutes for whole-wheat Fusilli). Drain and cool pasta in a colander under a tap of running cold water.
3. Remove chicken from the refrigerator and take a plastic or glass chopping board and sharp knife out of the cupboard ready for chopping chicken pieces.
4. Remove packaging and chicken skin and dispose into the bin immediately (do not place onto work surface).
5. Chop chicken into small, consistently sized pieces, no larger than $2cm^3$ (do not place contaminated knife onto work surface after use).
6. Immediately after handling or chopping the raw chicken wash hands in a bowl of clean, hot water and detergent or cleanser provided. Dry hands using a paper towel or clean hand towel.
7. Preheat frying pan with 1 tbsp. vegetable oil for a few minutes and then scrape chopped chicken from chopping board into the frying pan using a utensil (not hands).
8. Wash utensils and equipment contaminated with raw chicken immediately after use (do not place onto work surface).
9. Shallow fry chicken at medium heat (3-4) for at least 10 minutes, then cool chicken pieces on a plate at room temperature for no longer than 30 minutes.
10. Wash all salad vegetables (tomatoes, lettuce, cucumber, parsley and carrots) in cold water and dry -if necessary- with a paper towel.
11. Use a clean chopping board and knife to chop vegetables.
12. Toss all salad ingredients together with cooled chicken pieces and drained pasta.
13. Remove mayonnaise from jar using a clean spoon, and mix into salad. Place lid back onto mayonnaise jar and put into the refrigerator immediately.
14. Serve one portion of the salad using clean utensils and do not allow to stand at room temperature for more than 30 minutes.
15. Keep the remaining salad for a meal 'the following day'- place into a clean bowl and cover.
16. Store onto the top shelf of the refrigerator before use the following day.

APPENDIX 7.10

SHOCK TACTICS ARTICLE.

'The tragic death of Helen Bodnar, USA, 1998'

''I'm going to read an extract from a magazine about a 76-year old lady called Helen who tragically died as a result of a food poisoning illness.

Following are extracts from a diary kept by her husband:

The diary mainly recounted the ordinary, slow paced life of the retired couple, who enjoyed their garden, four children and their grandchildren and each other.

Everything seemed to be going well until it all changed on 3rd October 1998. That's when Helen who had seemed perfectly healthy, crumpled into a pile on the kitchen floor.

Her husband wrote ' Helen was as white as a sheet and didn't say anything for about 30 seconds' he managed to get her into bed, but in the middle of the night Helen woke up wracked by pain. Her husband took her to the emergency room at the local Hospital, where she was admitted. For 3 days doctors rang lots of tests, but they could find nothing wrong and sent her home.

Within 24 hours Helen was back in the emergency room and placed in intensive care. Her fever had reached 40°C and her stomach was grotesquely bloated. Her condition progressively worsened. Over the next few days the family kept a vigil, but Helens blood pressure plummeted and her heart finally failed.

The cause of Helen's illness was *Listeria monocyogenes*.

She got the infection from a pack of hot dogs.''

Source: Anon, (1999i)

APPENDIX 7.11

QUANTITATIVE CHANNEL ANALYSIS QUESTIONNAIRE.

Frequency of visiting shops and community amenities in Llanrumney

Please tick whether you go to each shop / amenity (in Column A) once a week or more, at least once a month, less than once a month or never in the boxes below (see example)

	Once a week or more	At least once a month	Less than once a month	Never	Leaflet, poster or both
Example of ticking		✓			
Llanrumney stores *(Llanrumney Avenue)*					
Butchers					
Newsagents					
Long row of shops on Countisbury Avenue *(starting at the far end and working down the hill)*					
Post office					
Home and Garden					
Dental Surgery					
Pharmacy					
Ferrans the Savoury Specialists					
Gary Anthony Butchers					
Greggs the Bakers					
Newsagents					
Boots					
Co-op					
Fresh fruit					
Newsagent					
Mikes Fruit Market					
Fords the Bakers					
Danish bacon shop					
Fruit shop					

	Once a week or more	At least once a month	Less than once a month	Never	Leaflet, poster or both
Row of shops *(Burnham Avenue)*					
Al's Foodstore					
Pharmacy					
Newsagents					
Mikes food store					
John Renolyds Centre					
Leisure Centre					
Doctors Surgery (*on Ball Road)*					
Library *(on Countisbury Av)*					
Countisbury Surgery					
Garage *(Mount Pleasant Avenue)*					
St. Illtyds Church (eg for Bingo)					
Old St Mellons Village Hall events					
Llanrumney clinic					
Community Centre (what events?)					

APPENDIX 7.12

INITIAL DESIGNS FOR SOCIAL MARKETING INTERVENTION DEVELOPMENT.

Appendix 7.12 (a): A5, 8 page leaflet.

CONSUMER ADVICE FOR OVER 60's

SAFE PREPARATION OF RAW CHICKEN

'You're never too old to learn'

Page 1

This is a description of the symptoms experienced by a local lady who had suffered from food poisoning after eating food that had been contaminated from raw chicken:

"I had it so badly that I couldn't keep anything down. The vomiting was terrible, the doctor came out a few times and I was grey, I couldn't walk around, it was terrible. I was bad … really, really ill."

Gwyneth, aged 64 from Cardiff

If Salmonella hits you at the age of 78 … you wouldn't be able to fight it as much … you'd be lucky to survive it at that age …. it could kill you"

5 Reminder Tips

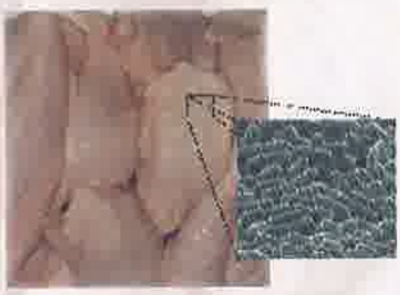
- ✓ Do not wash raw chicken
- ✓ Place raw chicken packaging into the bin immediately after removal of chicken pieces.
- ✓ Prepare all salad vegetables and cooked meat before touching raw chicken.
- ✓ Do not use unwashed or rinsed chopping boards / knives for preparing salad vegetables or cooked meat.
- ✓ Wash hands using soap and hot water immediately after touching raw chicken, dry hands using paper towel.

FRCU © 2001

Page 8

Raw chicken facts

- 9 out of 10 raw chickens are naturally contaminated with harmful germs.
- It is easy to control these harmful germs by following adequate hygiene practices in your kitchen.
- The picture below (A) shows harmful germs such as Salmonella that are often on raw chicken.



- Its your own responsibility to prepare raw chicken safely at home.
- People aged 60 years and over are more likely to get food poisoning and have to be especially careful when preparing foods such as raw chicken.
- Make sure you help to teach the younger generations to prepare chicken safely by following descriptions in this leaflet.

Page 2

- ✗ The harmful germs from raw chicken transfer onto the plastic packaging.
- ✓ Place packaging into the bin immediately after removing chicken pieces to avoid potential spreading of harmful germs.

- ✗ Washing chicken helps spread harmful germs around the sink.
- ✓ All germs that may be on the chicken should be killed during the cooking process.
- ✓ There is <u>no need</u> to wash the chicken during food preparation.

Page 3

Step by step effective handwashing after handling raw chicken

✗ Do not touch the tap with contaminated fingers (B), because harmful germs will be spread onto the tap handle.

✓ To avoid transferring germs to the tap handle fill a washing up bowl of hot soapy water before opening the raw chicken packaging.

Page 4

- ✓ After touching raw chicken (A) immerse hands immediately into a bowl of hot soapy water (B).
- ✓ Rub hands together when in the soapy water (C).
- ✓ Use soap or washing up liquid to wash hands (D).
- ✓ Lather hands on both sides with soap or washing up liquid for several seconds (E).
- ✓ Rinse hands using the washing up water.
- ✓ Dry hands using a disposable paper towel (F).

Page 5

Step by step effective chopping board and knife hygiene

- ✓ Keep raw chicken away from salad vegetables / cooked meat.
- ✓ If possible use separate chopping boards and separate knives for raw chicken and salad vegetables / cooked meat

- ✓ If you only have one chopping board and one knife it is best to prepare salad vegetables / cooked meat before touching raw chicken.
- ✓ After cutting raw chicken steps A to D need to be followed to ensure that all harmful germs that have been spread from the raw chicken are removed.

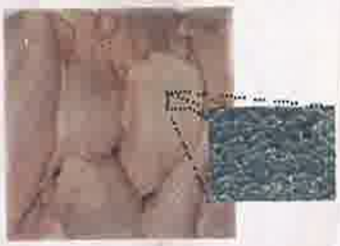
Page 6

- ✓ Immediately after chopping raw chicken immerse chopping board and knife into washing up bowl of hot soapy water. Scrub using a scourer or brush (A).
- ✓ Rinse soap from chopping board and knife (B).
- ✓ Spray bleach onto the chopping board and knife (C).
- ✓ Remove bleach and dry using a disposable paper towel (E).

Page 7

RAW CHICKEN AND RISK

- 9 out of 10 raw chickens are naturally contaminated with harmful germs
- It is easy to control these harmful germs by following adequate hygiene practices in your kitchen.
- The picture below (A) shows harmful germs such as Salmonella that are often on raw chicken.



This is a description of the symptoms experienced by a local lady who had suffered from food poisoning after eating food that had been contaminated from raw chicken:

"I had it so badly that I couldn't keep anything down. The vomiting was terrible, the doctor came out a few times and I was grey. I couldn't walk around, it was terrible. I was bad.... really, really ill."

Gwyneth, aged 64 from Cardiff

Simple steps for use of chopping boards and knives when preparing raw chicken at home

- Always prepare salad vegetables and cooked meat before touching raw chicken.
- Keep raw chicken away for salad vegetables and cooked meat.
- Wash chopping boards and knives immediately after use.
- Wash contaminated chopping board and knife using hot water and washing up liquid and scrub using a scourer / brush.
- Spray bleach onto the washed chopping board and knife, followed by rinsing with hot water.
- Dry using a disposable paper towel.

FRCU ©2001

CONSUMER ADVICE FOR OVER 60's

Safe use of chopping boards and knives when preparing raw chicken at home.

'You're never too old to learn'

Step by step effective chopping board and knife hygiene

- ✓ Immediately after chopping raw chicken immerse chopping board and knife into washing up bowl of hot soapy water. Scrub using a scourer or brush (A).
- ✓ Rinse soap from chopping board and knife (B).
- ✓ Spray bleach onto the chopping board and knife(C).
- ✓ Remove bleach and dry using a disposable paper towel (D).
- ✓ Chop salad vegetables and / or cooked meat.

Appendix 7.12(c): Three-fold A4 leaflet: Effective hand-washing and drying after handling raw chicken at home.

RAW CHICKEN AND RISK

- 9 out of 10 raw chickens are naturally contaminated with harmful germs
- It is easy to control these harmful germs by following adequate hygiene practices in your kitchen.
- The picture below (A) shows harmful germs such as Salmonella that are often on raw chicken.

This is a description of the symptoms experienced by a local lady who had suffered from food poisoning after eating food that had been contaminated from raw chicken:

"I had it so badly that I couldn't keep anything down. The vomiting was terrible, the doctor came out a few times and I was grey. I couldn't walk around, it was terrible. I was bad… really, really ill."

Gwyneth, aged 64 from Cardiff

Simple steps for effective hand washing after touching raw chicken

- Before opening raw chicken packaging fill a washing up bowl of hot soapy water.
- To stop the spreading to germs do not touch the tap handle with contaminated hands.
- Wash hands using soap or washing up liquid immediately after touching raw chicken.
- Make sure soap is lathered all over both hands.
- Rinse hands with clean water.
- Dry hands using a disposable paper towel

Make sure you get it right.

'If Salmonella hits you at the age of 78 … you wouldn't be able to fight it as much … you'd be lucky to survive it at that age… it can kill you"

FPDU © 2001

CONSUMER ADVICE FOR OVER 60's

Effective hand washing after handling raw chicken at home.

'You're never too old to learn'

Step by step effective hand-washing after handling raw chicken

✗ Do not touch the tap with contaminated fingers, because harmful germs will be spread onto the tap handle.

✓ After touching raw chicken (B) immerse hands immediately into a bowl of hot soapy water (C).

✓ Rub hands together when in the soapy water.

✓ Use soap or washing up liquid to wash hands (D).

✓ Lather hands on both sides with soap or washing up liquid for several seconds (E).

✓ Rinse hands using the washing up water.

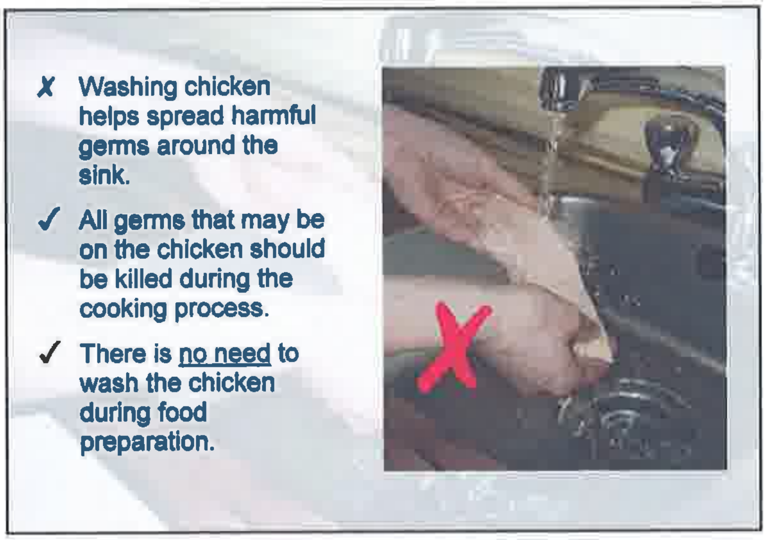
✓ Dry hands using a disposable paper towel (F).

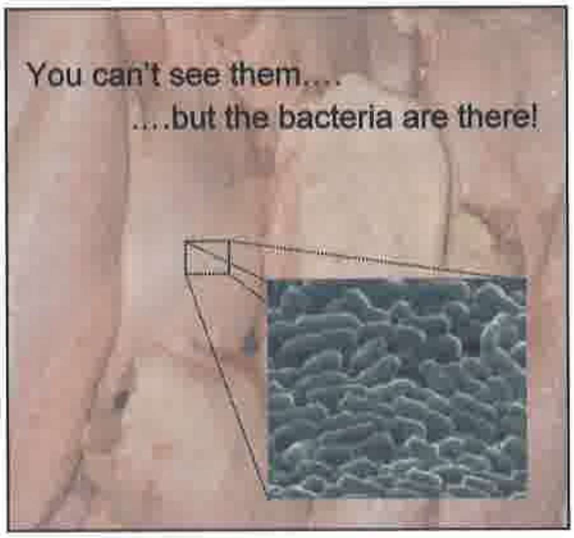
Helpful hint!

✓ To avoid transferring germs to the tap handle, fill a washing-up bowl with hot soapy water (A) before opening raw chicken packaging.

APPENDIX 7.13

PRELIMINARY MAGNETS.





APPENDIX 7.14

EVALUATION FOCUS GROUP PLAN.

Evaluation of intervention development and placement
Topic Guide.

Thank respondents for attending. Introduce self and invite participants to do so.

Explain that the purpose of the discussion is to allow respondents to express their own views in an informal group setting. This is not a test of knowledge – there are no right or wrong answers. The information will be regarded as confidential.

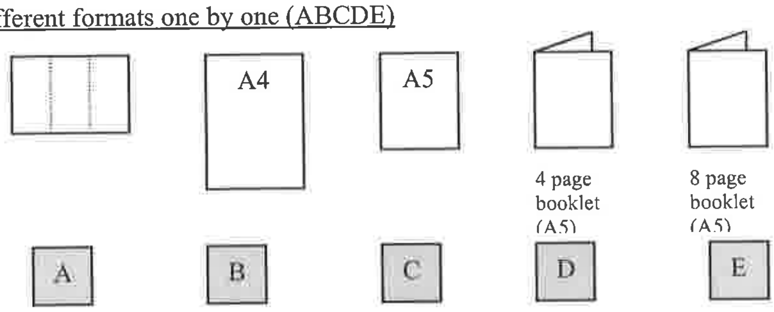
Purpose of the mini disc player / audio tape recorder is to make it easier to report what people say and think. Individual comments will not be attributed.

(Certain things need to cover - need their help in making an effective source of information)

FORMAT

- What is the best size and shape of a leaflet/poster? Why?

<u>Show different formats one by one (ABCDE)</u>



- What do they think of each one? Which is the best one? Why?

SIZE OF WORDS / WORDING

- How big do the words need to be on the leaflet/poster?

<u>Show different examples (FGH)</u>

- Which is best? Why? Ask to rank, Which ones like?, most effective, Why?
- Content – simple through to complex (show examples IJK) point is the same, but what is they best way of saying it? Best words, germs, bacteria, name of bacteria or soap, washing up liquid, detergent)
- What kind of caption/title/cover would grab <u>their</u> attention? (Unprompted) For people like themselves?
- (show pictures) What about (Prompted) pictures of person like themselves/young family/pictures of food/ref to consumer/titles – attention over 60s/survived the war, can you survive germs in chicken/scare tactic?/percentage suffer from food poisoning a year??
- Pictures of bacteria (tell them its *Salmonella*) is it effective, would they take notice/ realise it could be on chicken?

PICTURES / DESCRIPTIONS

- What kind of pictures would you need to see?

Show examples of pictures / photos for hand washing

- What do they think? Best one/ones to use?
- What about the type of picture? What would be best? Probe on different examples (NOP)
- What about picture of chicken with bacteria on it? (Example??)
- What about descriptions of how to wash hands etc? What would they need to say? How would it be said?

Show examples of descriptions?

- Which is best? Simpler or more detailed?
- Is it better to have descriptions or pictures?

POSTER

- How big should the words be? What would it need to look like?

Show example of poster.

- What do they think? Which size of word is most effective / do they prefer? Why?

PLACEMENT

- How likely are they to pick up a leaflet on chicken?
- Best way to provide leaflets? Through the door? Pick up when out?
- Different types of leaflet better for putting through the door/others to pick up? Why?
- Where would be the best place to put info? Where do they go?

MAGNETS

Show examples of magnets

- Which do they prefer? Why? Would they use them? Where put them?

APPENDIX 7.15

Covering letter sent to participants with the Evaluation Questionnaire and 'Evaluation Pack'.

00th xxxx, 0000

Dear

On behalf of the UWIC Food Research Group, I would like to thank-you for attending the discussion group(s) in Whitchurch regarding food safety at the end of last year. Your participation and help so far in the research project has been extremely useful and gratefully appreciated.

As a follow up to the discussion group(s), a selection of health promotion interventions have been designed for people like you. These can be found in the enclosed folder labelled 'Evaluation pack'. I would like to find out your honest opinion of the 3 posters, 2 leaflets, selection of magnets and newspaper article in enclosed folder. Please read all of the instructions on the form while looking at items in the 'Evaluation pack' and then complete *all* of the questions. Please return the completed form and 'Evaluation pack' in the prepaid and addressed envelope as soon as possible (before 00th xxxx, 0000).

Your opinion of the enclosed leaflets, posters, magnets and newspaper article is important because it will help further development of health educational materials. This development may help other people improve their food preparation practices and reduce the chance of illness.

As a token of thanks for your time and co-operation of completing and returning the form, I will send you a **£5 voucher** for Sainsburys, Tescos or Marks and Spencers in return of the <u>fully completed</u> form. Please state your name and address on the final sheet of this form and indicate which voucher type you would like to be sent.

As with the information gained from the food preparation sessions, all data collected during the course of the study will be treated with **complete confidentiality**. If you have any problems with the form, please do not hesitate to contact me at UWIC on Cardiff 20416452. I am <u>extremely grateful</u> for your participation and help with my research.

I look forward to receiving your form. Thank-you again for your helpful co-operation, without your help the majority of my practical research would not be possible.

Yours Sincerely,

Elizabeth Redmond (Research Assistant)

APPENDIX 7.16

EVALUATION PACK QUESTIONNAIRE.

Evaluation Questionnaire

The aim of the following questions is to find out what you think of the leaflets, posters, newspaper article and fridge magnets in the 'Evaluation Pack' (enclosed folder).

Please read and follow all of the instructions for each question.

When you have filled in all of the questions, please return the completed questionnaire to Elizabeth at UWIC in the enclosed SAE.

Section I : Leaflets

Please look at and read Leaflet A.

A1. Do you think the content of Leaflet A is any of the following? (✓ *as many as necessary*)

Helpful	❑	Unhelpful	❑
Insulting	❑	Common sense	❑
Interesting	❑	Un-interesting	❑
Confusing	❑	Clear	❑
Useful	❑	Informative	❑

A2. Do you think the descriptions for use of chopping boards / knives in Leaflet A are any of the following? (✓ *one only*)

Too simple for people like me ❑

Appropriate for people like me ❑

Too complicated for people like me ❑

A3. How relevant do you think the information about chopping boards / knives in Leaflet A is to you and people like you? (✓ *one only*)

Relevant ❑

Neither relevant / irrelevant ❑

Irrelevant ❑

A4. Do you think that the word size in Leaflet A is any of the following? (✓ *one only*)

Too small for me to easily read ❑

Appropriate for my sight ❑

Too large ❑

A5. Which of the following best describes Leaflet A? (*as many as necessary*)

Eye catching	❑	Dull	❑
Indistinctive	❑	Colourful	❑

A6. Does the front cover of Leaflet A give a clear indication of the what the leaflet is about? (✓ *one only*) Yes ❑ No ❑

A7. How much information do you think that there is in the leaflet? (✓ *one only*)

Not enough information ❑

Enough information ❑

Too much information ❑

A8. How useful do you think Leaflet A is is as a source of food safety information?

Please circle a number on the line below to indicate usefulness.

Extremely Useful	1	2	3	4	5	6	7	8	9	10	Not at all useful

Please look at and read Leaflet B.

B1. Do you think the content of Leaflet B is any of the following? (✓ *as many as necessary*)

Helpful	❑	Unhelpful	❑
Insulting	❑	Common sense	❑
Interesting	❑	Un-interesting	❑
Confusing	❑	Clear	❑
Useful	❑	Informative	❑

B2. Do you think the descriptions used for hand washing / drying in Leaflet B are any of the following? (✓ *one only*)

Too simple for people like me ❑

Appropriate for people like me ❑

Too complicated for people like me ❑

B3. How relevant do you think the information about handwashing / drying in Leaflet B is to you and people like you?

(✓ *one only*)

Relevant ❑

Neither relevant / irrelevant ❑

Irrelevant ❑

B4. Do you think that the word size in Leaflet B is any of the following? (✓ *one only*)

Too small for me to easily read ❑

Appropriate for my sight ❑

Too large ❑

B5. Which of the following best describe Leaflet B? (*as many as necessary*)

Eye catching	❑	Dull	❑
Indistinctive	❑	Colourful	❑

B6. Does the front cover of Leaflet B give a clear indication of the what the leaflet is about?

(✓ *one only*) Yes ❑ No ❑

B7. How much information do you think that there is in the Leaflet B? (✓ *one only*)

Not enough information ❑

Enough information ❑

Too much information ❑

B8. How useful do you think Leaflet B is is as a source of food safety information?

Please circle a number on the line below to indicate usefulness.

Extremely Useful	1	2	3	4	5	6	7	8	9	10	Not at all useful

Section II : Posters

Important: The enclosed examples of posters are 4 times smaller than actual sized posters that have been put on the walls / windows of shops, chemists etc.
Please consider this when answering the following questions.

Please look at and read Poster C.

C1. Do you think the content of Leaflet B is any of the following? (✓ *as many as necessary*)

Helpful	❑	Unhelpful	❑
Insulting	❑	Common sense	❑
Interesting	❑	Un-interesting	❑
Confusing	❑	Clear	❑
Useful	❑	Informative	❑

C2. Which of the following best describe Poster C? (*as many as necessary*)

Eye catching	❑	Dull	❑
Indistinctive	❑	Colourful	❑

C3. How much information do you think that there is in the Poster C? (✓ *one only*)

Not enough information	❑
Enough information	❑
Too much information	❑

C4. How useful do you think Poster C is as a source of food safety information?
Please circle a number on the line below to indicate usefulness.

Extremely Useful	1	2	3	4	5	6	7	8	9	10	Not at all useful

Please look at and read Poster D.

D1. Do you think the content of Poster D is any of the following? (✓ *as many as necessary*)

Helpful	❑	Unhelpful	❑
Insulting	❑	Common sense	❑
Interesting	❑	Un-interesting	❑
Confusing	❑	Clear	❑
Useful	❑	Informative	❑

D2. Which of the following best describe Poster D? (*as many as necessary*)

Eye catching	❑	Dull	❑
Indistinctive	❑	Colourful	❑

D3. How much information do you think that there is in the Poster D? (✓ *one only*)

Not enough information	❑
Enough information	❑
Too much information	❑

D4. How useful do you think Poster D is as a source of food safety information?

Please circle a number on the line below to indicate usefulness.

Extremely Useful	1	2	3	4	5	6	7	8	9	10	Not at all useful

Please look at and read Poster E.

E1. Do you think the content of Leaflet E is any of the following? (✓ *as many as necessary*)

Helpful	❑	Unhelpful	❑
Insulting	❑	Common sense	❑
Interesting	❑	Un-interesting	❑
Confusing	❑	Clear	❑
Useful	❑	Informative	❑

E2. Which of the following best describe Poster E? (*as many as necessary*)

Eye catching	❑	Dull	❑
Indistinctive	❑	Colourful	❑

E3. How much information do you think that there is in the Poster E? (✓ *one only*)

Not enough information	❑
Enough information	❑
Too much information	❑

E4. How useful do you think Poster E is as a source of food safety information?

Please circle a number on the line below to indicate usefulness.

Extremely Useful	1	2	3	4	5	6	7	8	9	10	Not at all useful

E5: Which poster do you think you would MOST take notice of? (✓ *one only*)

Poster C	❑
Poster D	❑
Poster E	❑

E6: Which poster do you think you would LEAST take notice of? (✓ *one only*)

Poster C	❑
Poster D	❑
Poster E	❑

Section III : Newspaper advert.

Please look at and read Newspaper advert F.

This newspaper article entitled 'Kitchen Food Safety Advice for the over 60's' was printed in South Wales Echo on 3rd April, 2001.

F1. Do you think the content of newspaper advert is any of the following? (✓ *as many as necessary*)

Helpful	❑	Unhelpful	❑
Insulting	❑	Common sense	❑
Interesting	❑	Un-interesting	❑
Confusing	❑	Clear	❑
Useful	❑	Informative	❑

F2. Which of the following best describe the newspaper advert? (✓ *as many as necessary*)

Eye catching	❑	Dull	❑
Indistinctive	❑	Colourful	❑

F4. How useful do you think newspaper advertisments are as a source of food safety information?

Please circle a number on the line below to indicate usefulness.

Extremely Useful	1	2	3	4	5	6	7	8	9	10	Not at all useful

F5. How frequently do you read the South Wales Echo? (✓ *one only)*

Daily	❑
At least once a week	❑
Fortnightly	❑
Monthly	❑
Never	❑

Section VI : Magnets.

Please open the envelope entitled '5 x magnets',
Look at each of the magnets and look at page 'G' in the Evaluation Pack.

1. How useful do you think fridge magnets are as a source of food safety information?

   Please circle a number on the line below to indicate usefulness.

Extremely Useful	1	2	3	4	5	6	7	8	9	10	Not at all useful

2. Do you think that you would use fridge magnets such as these? (✓ *one only)* Yes ❑ No ❑

3. Which is your MOST favourite magnet? (✓ *one only)*
   - Magnet 1 ❑
   - Magnet 2 ❑
   - Magnet 3 ❑
   - Magnet 4 ❑
   - Magnet 5 ❑

4. Which is your LEAST favourite magnet? (✓ *one only)*
   - Magnet 1 ❑
   - Magnet 2 ❑
   - Magnet 3 ❑
   - Magnet 4 ❑
   - Magnet 5 ❑

5. Please look at each of the magnets and indicate your level of preference for each magnet by circling one number on each of the 5 lines below.

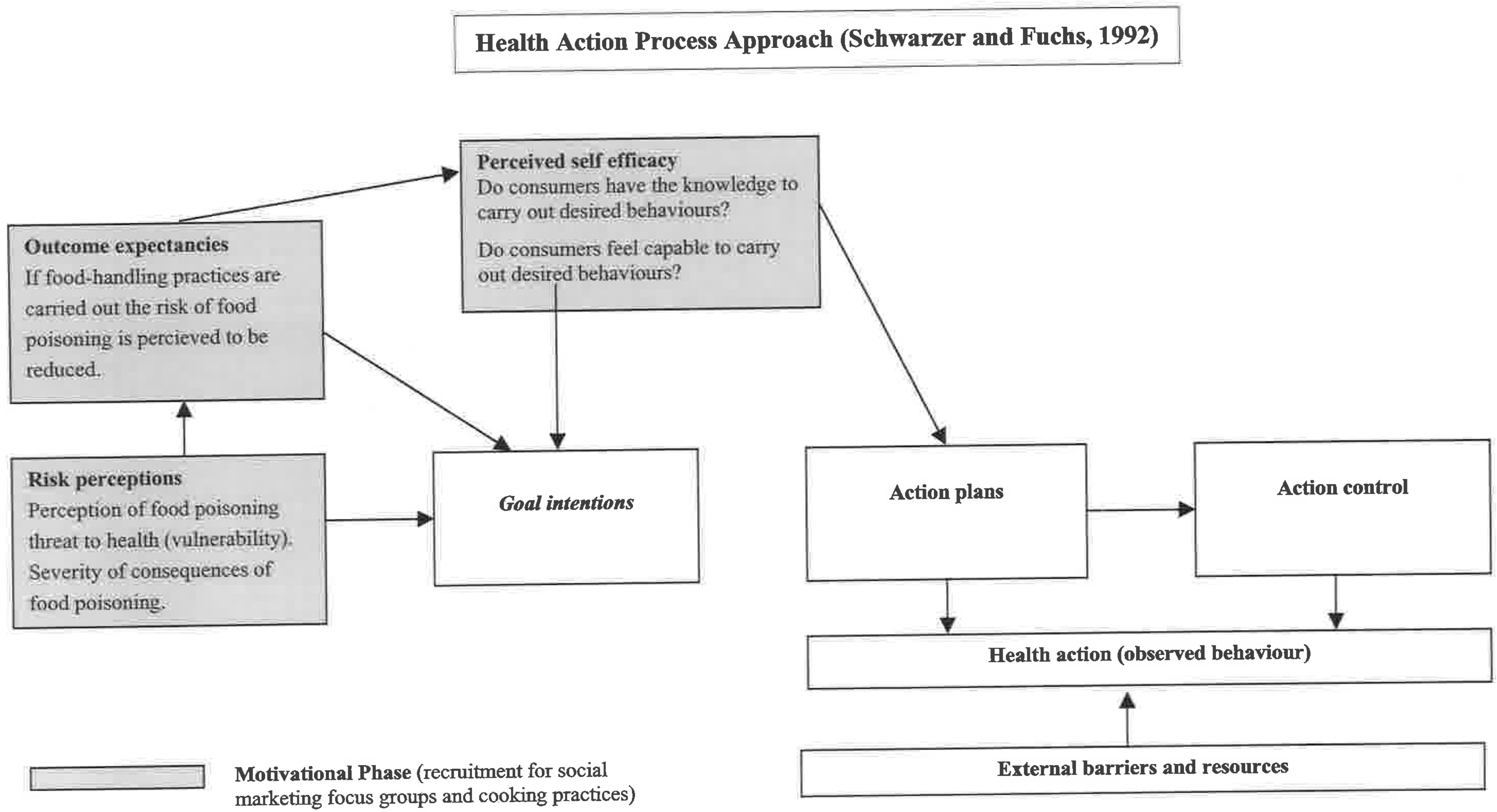
MAGNET 1	Most preferred	1	2	3	4	5	6	7	8	9	10	Least preferred
MAGNET 2	Most preferred	1	2	3	4	5	6	7	8	9	10	Least preferred
MAGNET 3	Most preferred	1	2	3	4	5	6	7	8	9	10	Least preferred
MAGNET 4	Most preferred	1	2	3	4	5	6	7	8	9	10	Least preferred
MAGNET 5	Most preferred	1	2	3	4	5	6	7	8	9	10	Least preferred

APPENDIX 7.17

EVALUATION PACK CONTENTS

Intervention.	Title of intervention.	Appendix
Leaflet A.	Consumer advice for the over 60's. Use of chopping boards and knives when preparing raw chicken at home.	Appendix 7.20 (b)
Leaflet B.	Consumer Advice for the over 60's. Effective hand-washing and hand drying after handling raw chicken at home.	Appendix 7.20 (a)
Poster C.	Consumer Advice for the over 60's. Simple steps for effective hand-washing after handling raw chicken at home.	Appendix 7.20 (d)
Poster D.	Consumer Advice for the over 60's. Step by step use of chopping boards and knives when preparing raw chicken at home.	Appendix 7.20 (e)
Poster E.	Consumer Advice for the over 60's. Raw chicken – facts and risks.	Appendix 7.20 (f)
Newspaper Advert F.	Kitchen food safety Advice for the over 60's.	Appendix 7.20 (g)
Magnets.	Remember! Wash hands with soap immediately after handling raw chicken. Four reminder tips. You can't see them .... But harmful germs are on raw chicken! Keep raw chicken and vegetables / cooked meat separate! Think before you handle!	Appendix 7.20 (c)

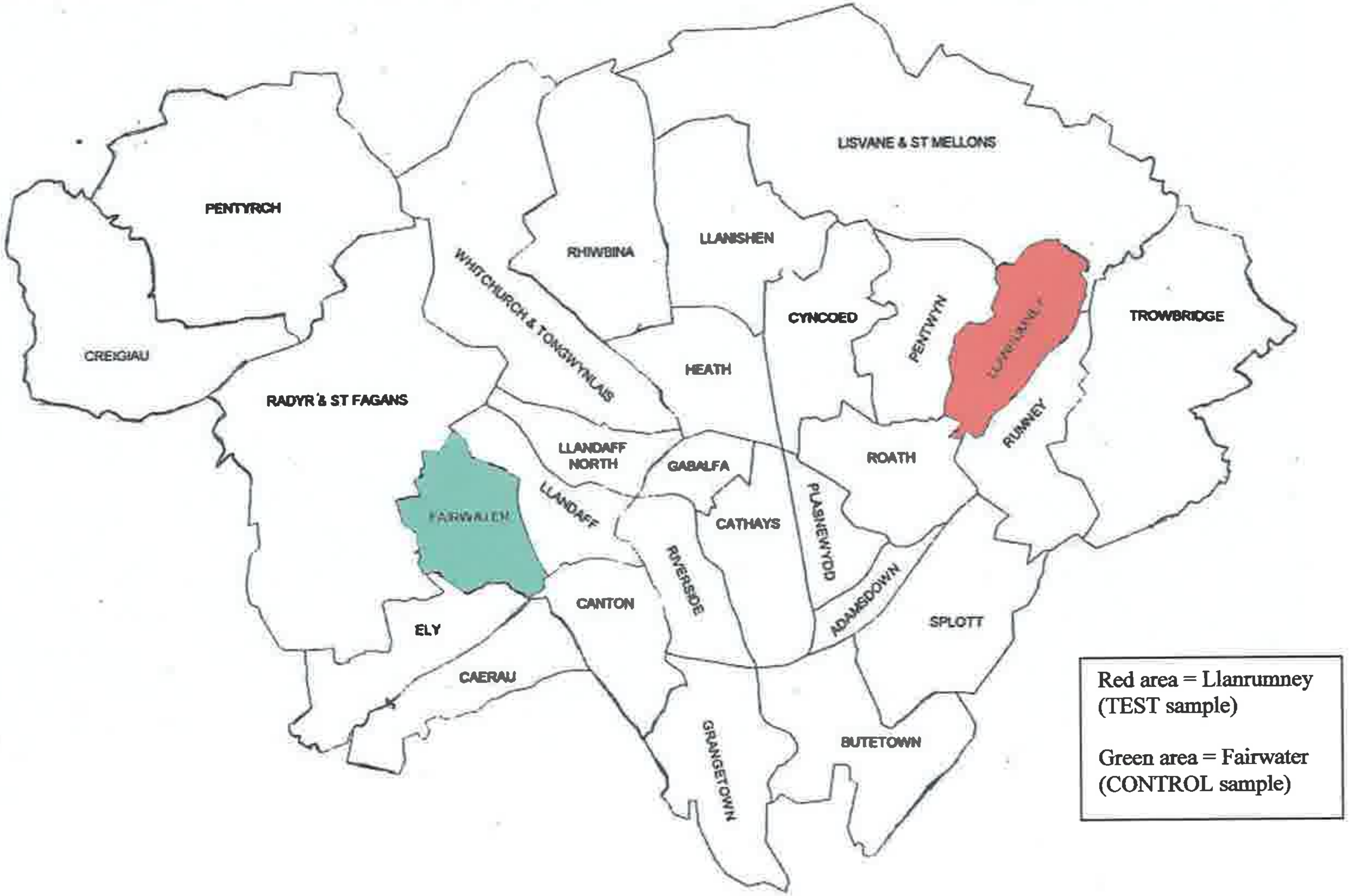
APPENDIX 7.18 HEALTH ACTION PROCESS APPROACH.



APPENDIX 7.19

TEST AND CONTROL COMMUNITIES.

Map of location of geographical test (red) and control (green) communities in Cardiff for the social marketing food safety education initiative.



APPENDIX 7.20

FINAL INTERVENTIONS.

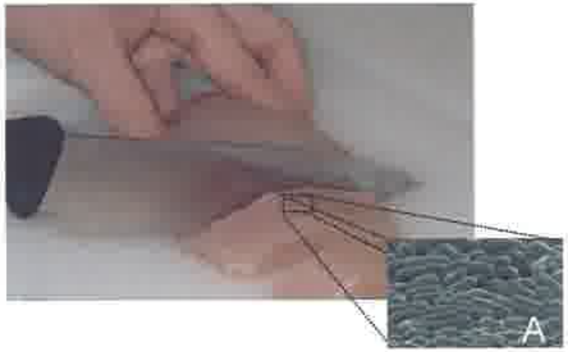
Appendix 7.20 (a).	Hand-washing (3 folded) leaflet: 'Consumer Advice for the over 60's: Effective hand-washing and hand drying after handling raw chicken at home.'
Appendix 7.20 (b).	Chopping boards (3 folded) leaflet: 'Consumer Advice for the over 60's: Use of chopping boards and knives when preparing raw chicken at home.'
Appendix 7.20 (c).	Five different magnets 1. 'Think before you handle' 2. 'Remember! Wash hands with soap immediately after handling raw chicken' 3. Keep raw chicken and vegetables / cooked meat separate! 4. 'You can't see them ....but harmful germs are on raw chicken!' 5. Four reminder tips.
Appendix 7.20 (d).	A3 poster : 'Consumer Advice for the over 60's: Simple steps for effective hand-washing and hand drying after handling raw chicken at home.'
Appendix 7.20 (e).	A3 poster : 'Consumer Advice for the over 60's: step by step safe use of chopping boards and knives when preparing raw chicken at home'
Appendix 7.20 (f).	A3 poster : 'Consumer Advice for the over 60's: Raw chicken – facts and risks.'
Appendix 7.20 (g).	A quarter page newspaper advertorial: 'Food Safety Advice for the over 60's' in South Wales Echo.

999 Lifesavers: Presented by

Presented by Michael Burke and Donna Bernard.

One 30 minute TV documentary illustrating the severity of food poisoning illness and the illuminous glow of cross contamination around a domestic kitchen during preparation of raw chicken (for transcription of 30 minute documentary, see Redmond *et al* 2001).

Hand-washing and raw chicken risks.



- Picture (A) shows harmful germs such as *Salmonella*, which are often on raw chicken.
- After touching raw chicken 100% hands have been found to be contaminated with harmful germs.
- Rinsing hands with water alone does not remove harmful germs.

- It is easy to control harmful germs by following proper hand-washing practices in your kitchen at home.

'If *Salmonella* hits you after the age of 60
… you wouldn't be able to fight it as much
… you'd be lucky to survive it at that age
… it can kill you'

Glenys, aged 61 from Cardiff

Simple steps for effective hand-washing and drying after touching raw chicken.

✓ Before opening raw chicken packaging fill a washing up bowl of hand hot, soapy water.

✓ Wash hands using soap or washing-up liquid immediately after touching raw chicken.

✓ To stop the spreading of germs from raw chicken do not touch the tap handle with contaminated hands.

✓ Make sure soap is lathered all over both hands.

✓ Rinse hands with clean water.

✓ Dry hands thoroughly using a disposable paper towel.

Make sure you get it right!

Prepared by FRCU© Health Educators 2001

CONSUMER ADVICE FOR THE OVER 60's

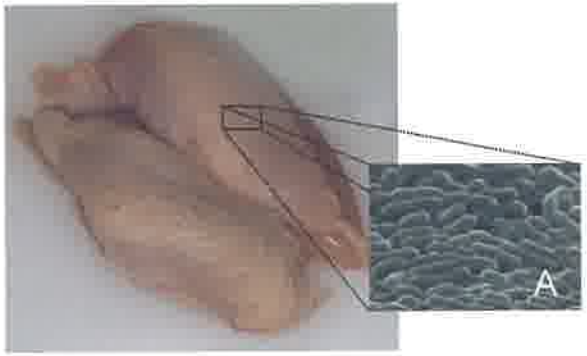
Effective hand-washing and drying after handling raw chicken at home.

Step by step effective hand-washing and drying after handling raw chicken

- ✓ To avoid transferring germs to the tap handle, fill a washing-up bowl with hand, hot soapy water (A) before opening raw chicken packaging.
- ✓ After touching raw chicken (B) immerse hands <u>immediately</u> into a bowl of hand hot soapy water (C).
- ✗ Do <u>not</u> touch the tap with contaminated fingers (X), because harmful germs may be transferred onto the tap handle.

- ✓ Rub hands together when immersed in the clean soapy water.
- ✓ Use soap or washing-up liquid to wash hands (D).
- ✓ Lather hands on both sides with soap or washing-up liquid for several seconds (E).
- ✓ Rinse hands using clean washing-up water.
- ✓ Dry hands thoroughly using a disposable paper towel (F).

Raw chicken risks and facts.



- Picture (A) shows harmful germs such as *Salmonella*, which are often on raw chicken.
- Up to 80% raw chickens are naturally contaminated with harmful germs.
- It is easy to control harmful germs by following proper hygiene practices in your kitchen at home.

Food poisoning illness.

This is a description of the symptoms experienced by a local lady who suffered food poisoning after eating food that had been contaminated from raw chicken:

'I had it so badly that I couldn't keep anything down. The vomiting was terrible, the doctor came out a few times and I was grey. I couldn't walk around, it was terrible. I was bad ..... really, really ill.'

Gwyneth, aged 64 from Cardiff

Simple steps for use of chopping boards and knives when preparing raw chicken at home.

✓ Always use clean equipment when starting food preparation.

✓ Always prepare salad vegetables and cooked meat before touching raw chicken.

✓ Keep raw chicken away from salad vegetables and cooked meat.

✓ Wash chopping boards and knives immediately after use.

✓ Wash contaminated chopping board and knife using hand hot water and washing-up liquid and scrub using a scourer / brush.

✓ Spray bleach (or other cleaner) onto the washed chopping board / knife, then rinse using hand hot water.

✓ Dry chopping board and knife using a disposable paper towel.

It's down to you!

Prepared by FRCU© Health Educators 2001

CONSUMER ADVICE FOR THE OVER 60's

Safe use of chopping boards and knives when preparing raw chicken at home.

Step by step effective chopping board and knife hygiene.

✓ Keep raw chicken away from salad vegetables / cooked meat.

✓ If possible, use separate chopping boards and knives for raw chicken and salad vegetables / cooked meat.

✓ If you only have one chopping board and one knife it is best to prepare salad vegetables / cooked meat before touching raw chicken.

✓ After cutting raw chicken, steps A to D need to be followed to ensure that all harmful germs that could have come from the raw chicken are removed.

✓ Immediately after chopping raw chicken put chopping board / knife into washing up bowl of hot water with washing-up liquid and scrub clean (A).

✓ Rinse soap from chopping board and knife (B).

✓ Spray bleach (or other cleaner) onto the washed chopping board and knife (C), then rinse using hot water.

✓ Dry using a disposable paper towel (E).

APPENDIX 7.20 (c)

FOOD SAFETY MAGNETS.

Magnet no.	Topic
1.	'Think before you handle'.
2.	Remember! Wash hands with soap immediately after handling raw chicken.
3.	Keep raw chicken and vegetables / cooked meat separate.
4.	You can't see them… but harmful germs are on raw chicken.
5.	Four reminder tips.

Magnet 1

Magnet 2

Magnet 3

Magnet 4

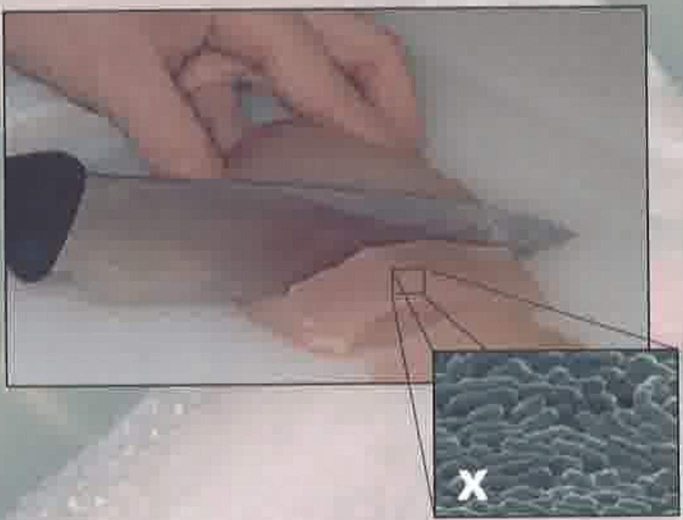
Magnet 5

Four Reminder Tips.

- ✓ Place raw chicken packaging into the bin immediately after removal of chicken pieces.
- ✓ Prepare all salad vegetables and cooked meat before touching raw chicken.
- ✓ Do not use unwashed or rinsed chopping boards / knives for preparing salad vegetables or cooked meat.
- ✓ Wash hands using soap and hot water immediately after touching raw chicken, dry hands using paper towel.

CONSUMER ADVICE for the over 60's

Simple steps for effective hand-washing and hand drying after handling raw chicken at home.



- **After touching raw chicken, 100% hands have been found to be contaminated with harmful germs.**
- **Rinsing hands with water alone does not remove harmful germs.**
- **Harmful germs (such as *Salmonella*) (picture X) are on 80% of raw chickens.**

✓ To avoid transferring germs to the tap handle, fill a washing-up bowl with hot soapy water (A) before opening raw chicken packaging.

✓ After touching raw chicken (B) immerse hands <u>immediately</u> into a bowl of clean hot soapy water (C).

✗ Do <u>not</u> touch the tap with contaminated fingers, because harmful germs will be spread onto the tap handle.

✗

✓

✓ Rub hands together when in the clean soapy water.

✓ Use soap or washing -up liquid to wash hands (D).

✓ Lather hands on both sides with soap or washing up liquid for several seconds (E).

✓ Rinse hands using clean washing-up water.

✓ Dry hands thoroughly using a disposable paper towel (F).

REMEMBER!

'If *Salmonella* hits you after the age of 60 … you wouldn't be able to fight it as much … … you'd be lucky to survive it at that age … it can kill you'

Prepared by FRCU© Health Educators 2001

CONSUMER ADVICE for the over 60's

Step by step safe use of chopping boards and knives when preparing raw chicken at home.

Harmful germs such as *Salmonella* (picture X) are on up to 80% of raw chickens.

✓ Use separate chopping boards and knives for raw chicken and salad vegetables / cooked meat.

✓ If you only have one chopping board / knife prepare salad vegetables / cooked meat BEFORE touching raw chicken.

✓ After cutting raw chicken, steps A to D need to be followed to ensure that harmful germs spread from the raw chicken are removed.

✓ Immediately after chopping raw chicken, put chopping board / knife into a bowl of hot water with washing-up liquid and scrub clean (A).

✓ Rinse soap from chopping board and knife (B).

✓ Spray bleach (or other cleaner) onto the chopping board / knife (C), then rinse using hot water.

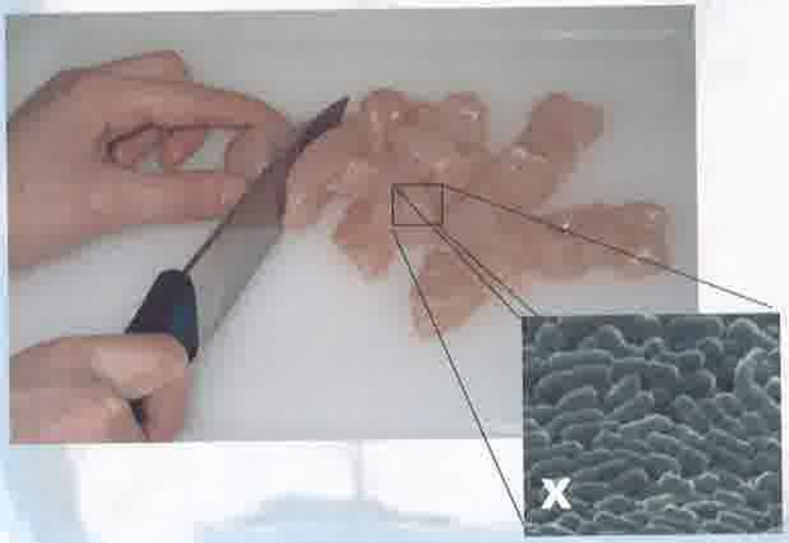
✓ Dry using a disposable paper towel (E).

REMEMBER!

'If *Salmonella* hits you after the age of 60 … you wouldn't be able to fight it as much … you'd be lucky to survive it at that age … it can kill you''

Prepared by FRCU© Health Educators 2001

CONSUMER ADVICE for the over 60's
RAW CHICKEN - FACTS AND RISKS

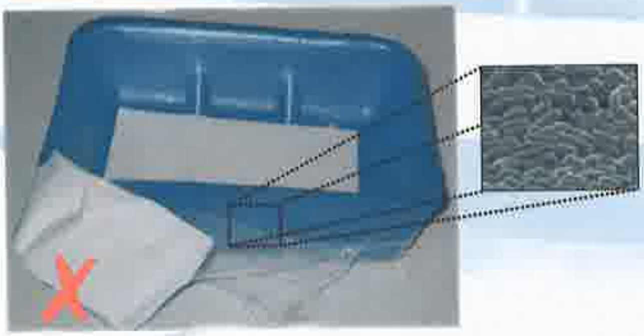


- It's your responsibility to prepare raw chicken safely at home.
- Up to 80% raw chickens are naturally contaminated with harmful germs.
- It is easy to control these harmful germs by following good hygiene practices in your kitchen.
- Picture **X** shows harmful germs (such as *Salmonella*) that are often on raw chicken.

Helpful Hints to stop spreading the harmful germs around your kitchen

✗ The harmful germs from raw chicken transfer onto the plastic packaging.

✓ Place packaging into the bin immediately after removing chicken pieces to avoid potential spreading of harmful germs.



FOOD POISONING ILLNESS FROM RAW CHICKEN

Older adults, young children and those who are unwell are more likely to get food poisoning and have to be especially careful when preparing foods such as raw chicken.

Description of a food poisoning illness from raw chicken.

'I had it so badly that I couldn't keep anything down. The vomiting was terrible, the doctor came out a few times and I was grey. I couldn't walk around, it was terrible. I was bad..... really, really ill.'

Gwyneth, aged 64 from Cardiff

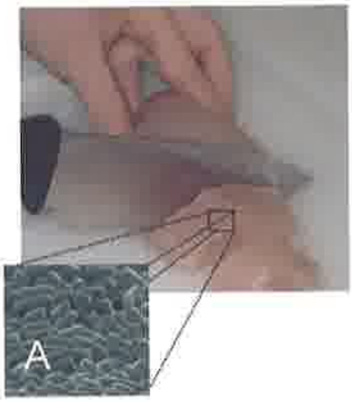
Prepared by FRCU© Health Educators 2001

APPENDIX 7.20 (g)

NEWSPAPER ARTICLE APPEARED IN SOUTH WALES ECHO (AS AN ADVERTORIAL) AS PART OF SOCIAL MARKETING INTERVENTIONS.

Kitchen Food Safety Advice for the over 60's.

Food poisoning frequently occurs from food preparation mistakes in the home.
Older people can be more seriously ill from food poisoning and need to be extra careful when preparing raw chicken in their kitchen at home.
A large number of these food poisoning illnesses are caused by harmful germs (A) such as *Salmonella* and *Campylobacter* from raw chicken.



How to control the harmful germs and protect yourself and your family against food poisoning illness:

Simple steps for effective hand - washing after touching raw chicken

- ✓ Before opening raw chicken packaging fill a washing up bowl of hand hot, soapy water.
- ✓ Wash hands using soap or washing-up liquid immediately after touching raw chicken.
- ✓ To **stop the spread of germs** from raw chicken, do not touch the tap handle with contaminated hands.
- ✓ Make sure soap is lathered all over both hands, then rinse hands with clean water.
- ✓ **Dry** hands thoroughly using disposable paper towels.

Simple steps for use of chopping boards and knives after preparing raw chicken

- ✓ Always prepare salad vegetables and cooked meat before touching raw chicken.
- ✓ Keep raw chicken away from salad vegetables and cooked meat.
- ✓ Wash contaminated chopping board and knife using hand hot water and washing-up liquid and scrub clean.
- ✓ Spray bleach (or other cleaner) onto the washed chopping board / knife, then rinse using hand hot water.
- ✓ **Dry** chopping board and knife using disposable paper towels.

APPENDIX 8.0

APPENDIX 8.1

INVITATION GIVEN TO PARTICIPANTS TO CONFIRM MEAL PREPARATION RECRUITMENT.

An Invitation from.........

BEAUFORT RESEARCH

british market research association
bmra
BS 7911

Dear Sir/Madam

Thank you for agreeing to attend *UWIC cooking sessions.*
This invitation is for you personally – please do not pass it on to anyone else.

The 3 cooking sessions will be held at:

UWIC – University of Wales, Institute, Cardiff
Colchester Avenue
Cardiff

You will be telephoned by UWIC's researcher, Liz Redmond, who will agree convenient dates and times with yourself before each cooking session. Please will you enter the dates and times you agree with Liz below so that it can act as your "aide memoire".

	Date	Time
Cooking Session 1		
Cooking Session 2		
Cooking Session 3		

Liz will also ask you whether you require your "gifts" for attending to be in the form of vouchers from either Marks & Spencers, Tescos or Sainsburys.

If for any reason you subsequently cannot attend please contact *Liz Redmond* on *029 20 416452* as soon as possible.

PLEASE BRING THIS INVITATION WITH YOU TO YOUR COOKING SESSION

APPENDIX 8.2

Letter sent to participants prior to attending the first meal preparation session.

xxxxxxxxxxxx,
xxxxx xxxx xxxxx,
xxxxxx,
Cardiff, CFxx xxx

Xx xxxx xxxx

Dear

On behalf of the UWIC Food Research Group, I would like to thank-you for agreeing to participate in the three food preparation practical sessions of my research project. As you will recall from our recent telephone conversation, we have made the following arrangements for the first cooking session:

Date: ***xx, xxxx, xxxx***
Time: ***xx:xx am / pm***
Location: Reception Desk, Colchester Avenue Campus of UWIC
Inform porter of your arrival and wait in UWIC entrance foyer

Dates and times for the second and third cooking sessions will be arranged after you have prepared the salad for the first time.

You will be preparing and serving the following meal: **Home-made Chicken Salad**

I have taken this opportunity to enclose the relevant recipe, so that you can familiarise yourself with the preparation method. I will confirm taxi arrangements with you during the day before you will be attending the cooking session.

I am extremely grateful for your participation with the research, and as a token of my thanks for your help you will receive vouchers totaling £50 from Sainsburys, Marks and Spencers or Tescos. You will receive £10 voucher after completion of the first cooking session, a £10 voucher after completion of the second cooking session and a £30 voucher after completion of the third cooking session.

Data collected during the course of the study will be treated with complete confidentiality. If I can be of any further assistance or for any reason you will be unable to attend the cooking session, please do not hesitate to contact me at UWIC on Cardiff 2041 6452.

I look forward to meeting you.

Yours Sincerely,

Elizabeth Redmond (Research Assistant)

APPENDIX 8.3

Letter sent to participants prior to attending the second / third meal preparation session.

xxxxxxxxxxxx,
xxxxx xxxx xxxxx,
xxxxxx,
Cardiff, CFxx xxx

Xx xxxx xxxx

Dear

On behalf of the UWIC Food Research Group, I would like to thank-you for attending the first cooking session of my research project. As you will recall we have made the following arrangement for the second cooking session:

Date: ***xx, xxxx, xxxx***
Time: ***xx:xx am / pm***
Location: Reception Desk, Colchester Avenue Campus of UWIC
Inform porter of your arrival and wait in UWIC entrance foyer

Dates and times for the second / third and final cooking session will be arranged after you have prepared the salad for the second / third time.

Data collected during the course of the study will be treated with complete confidentiality. If I can be of any further assistance or for any reason you will be unable to attend the cooking session, please do not hesitate to contact me at UWIC on Cardiff 2041 6452.

I look forward to meeting you again.

Yours Sincerely,

Elizabeth Redmond
(Research Assistant)

APPENDIX 8.4

RECIPE: HOME-MADE CHICKEN SALAD

Ingredients

- 2 chicken breasts (with skin)
- 10 ml / ½ tbsp vegetable oil
- 50g / 2oz Fusilli pasta shapes
- salt and pepper
- ¼ Iceberg lettuce, chopped
- 2 tomatoes, chopped
- 2 spring onions, sliced
- 2-3 slices of cooked ham
- 10ml / ½ tbsp olive oil
- 10ml / ½ tbsp pesto
- chopped mixed herbs

Method

1. Cook the pasta in boiling salted water for 8 to 10 minutes.
2. Remove skin from chicken breasts.
3. Chop chicken into suitably sized pieces and shallow fry using 1 tbsp vegetable oil.
4. Drain the pasta, cool and place into a mixing bowl.
5. Cut the slices of ham into small pieces.
6. Prepare all salad vegetables.
7. Gently heat the olive oil and pesto in a small pan
8. Add cooked chicken, pieces of ham and salad vegetables to the pasta and mix well
9. Remove the pesto mixture from the heat and pour over the salad ingredients, chicken ham and pasta and season to taste using chopped mixed herbs and any additional salt and pepper.

Serve one portion of the salad on the table and keep the remaining salad to be eaten 'the following day'.

APPENDIX 8.5

SEMI-STRUCTURED INTERVIEW: RECALL OF INTERVENTIONS.

Nutritional / food safety education information

	Nutritional information ✓ or ✗	Food safety information ✓ or ✗
Leaflets		
Posters		
Magnets		
Television		
Newspaper articles		
Other		

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