Application of HACCP to food preparation practices in domestic kitchens

C.J. Griffith and D. Worsfold

To ensure food safety, all links in the food chain, except the home, have been urged to adopt the HACCP approach. Surveys have shown that domestic knowledge and practices relating to the prevention of foodborne disease may be inadequate and that family outbreaks of food poisoning are numerically very important. There are potential benefits in applying the HACCP approach to domestic food preparation but little has been published. HACCP can be used to obtain information on domestic hazards and risks and this can be used to formulate realistic control measures. The data produced can be used for health education campaigns as well as an auditing technique. Differences between the home and commercial operations, that affect the application of HACCP, are discussed.

Keywords: HACCP; domestic food preparation; food safety

INTRODUCTION

Although requiring careful interpretation, surveillance statistics indicate that many food poisoning cases occur in the home. Between 1973 and 1976 in North America, it was estimated that 26.8% of outbreaks were of domestic origin (Bryan, 1978). Figures for the UK suggest an even higher incidence with 62% of outbreaks between 1986–1988 being regarded as family outbreaks (Richmond, 1991). The Richmond report further suggested that family outbreaks were likely to be substantially under-reported.

Raw food sold to the public may or may not be contaminated with pathogens, although some foods, e.g. poultry and poultry products are more likely to be contaminated than others. Food manufacturers have quality assurance systems and cooked foods, bought by the public, should be free of pathogens. Once purchased, the consumer must store and handle foods correctly to minimize the risk of any further contamination and to retard the growth of any microorganisms already present. This stage is of particular importance in dealing with high risk foods, i.e. those which are ready to eat and can support the growth of bacteria, as there will be no subsequent step to destroy any pathogens present. Additionally, with raw foods, the consumer must cook the food correctly and ensure that it does not act as a focus for cross-contamination.

Foodborne disease can result from a single error by one individual or a series of errors by anyone in the food chain. Therefore, preventing foodborne disease should be a partnership between food manufacturers, food retailers and the consumer.

INFORMATION ON DOMESTIC FOOD-HANDLING PRACTICES

Information relating to domestic food-handling practices comes from two main sources, surveys of consumer knowledge and retrospective analysis of incidents of foodborne disease.

A number of surveys of the UK consumer's food-handling knowledge have been conducted (MAFF,

Faculty of Tourism, Hospitality and Food, Cardiff Institute of Higher Education, Colchester Avenue, Cardiff, CF3 7XR, UK

0956-7135/94/03/0200–05

1988; Spriegel, 1991; FDF–IEHO, 1993). The problem with this approach is that, at best, it assesses what people know or even understand but not what they actually do.

The second approach, of analysing outbreaks, attempts to identify factors that have contributed to known incidents of foodborne disease. Information on factors important in general outbreaks in the UK is available (Hobbs and Roberts, 1993) but this may not truly reflect incidents in the home. More specifically Bryan (1988) reviewed the factors that contributed to outbreaks in North American homes from 1973–1982. Nevertheless, how typical these factors are of the general public's food handling practices remains uncertain.

There is therefore an identified lack of information concerning the microbiology of the kitchen and domestic food-handling practices (Richmond, 1991).

APPLICATION OF HACCP TO DOMESTIC FOOD PREPARATION

All links in the food chain, except the consumer, have been urged to adopt the HACCP approach. This inevitably raises the question of whether it is possible or even desirable to try to apply HACCP to domestic food preparations.

HACCP was developing in the late 1960s for use in food manufacturing but it was not until the early 1980s that the technique was first applied to the domestic environment. In 1981, Zottola and Wolf, attempted to apply a systematic approach, based on the HACCP concept, to analysing potential hazards in recipes for home use. The technique known as recipe hazard analysis (RHAS) analysed recipes for ingredient and preparation hazards with the aim of alerting consumers to possible dangers and discouraging the use of some recipes. The rationale for this approach was their belief that food-handling techniques necessary to prevent outbreaks of foodborne disease were unknown, misunderstood or not followed by people preparing food in the home.

Beddows (1983), using a questionnaire HACCP approach, tried to identify the extent of potentially hazardous practices which could contribute to the contamination survival or growth of foodborne bacteria when chicken was prepared in the home. The results indicated a lack of awareness relating to food safety procedures. Michanie *et al.* (1987, 1988) used the technique to identify critical control points in households where food-related illness had occurred. These studies, on a relatively small number of households, identified cooking, cooling and holding as critical control points. This work, on HACCP in the domestic environment, followed recommendations (FAO/WHO, 1984) that the technique should be employed in homes in developing countries because they had the highest incidence of food transmitted diseases.

More recently, Beard (1991) in North America claimed to have identified eight critical control points after interviewing 50 consumers. Peri (1993) produced a model for identifying hazard points in domestic food preparation based on a matrix relating hazard modes and conditions to a process flow-chart. Other suggestions concerning the applicability of HACCP to domestic kitchens have been made including ICMSF (1988), Mitchell (1992) and Bryan (1992).

In reviewing the literature, it is worthwhile to summarize the potential benefits and uses that applying HACCP to the home could bring. HACCP can be used:

- as a technique in analysing cases of domestic foodborne disease;
- as an auditing tool of domestic procedures to identify errors in everyday domestic food preparation. Such information would provide feedback on consumer practices and could be incorporated into health education programmes;
- as an approach or basis for teaching hygiene;
- as the basis for an improved method of writing recipes.

To date no attempt has been made to apply observational HACCP auditing to ordinary domestic food preparation practices. Considering the useful information that could be obtained, the social and financial cost of foodborne disease (Gritikis, 1991) and the importance of the home in the food chain, it may be that all countries could benefit from applying HACCP to domestic environments.

CONSIDERATIONS IN APPLYING HACCP TO DOMESTIC FOOD PREPARATION

HACCP has been described (Mitchell, 1992) as being, in principle, a philosophy and, in practice, a tool. Furthermore that it should not be surprising to find there are different opinions as to how it should be applied.

The HACCP approach advocated for the catering industry (Department of Health, 1993) employs some of the principles of the system used in food manufacturing. The approach must be further modified for the domestic environment. Some of the factors to be considered when applying HACCP to the home are summarized in *Table 1*.

Unlike the commercial kitchen or food factory, the domestic equivalent is not normally subject to food safety legislation. The domestic food handler, unlike their commercial equivalent is unlikely to have been trained in food hygiene and may have very limited knowledge and skills relating to food preparation. Young people may be expected to prepare food for themselves with no training whatsoever. It is not therefore surprising that some surveys (MAFF, 1988; FDF–IEHO, 1993) have found lack of knowledge and understanding concerning the mechanisms of food

Table 1 Summary of differences between the home and commercial premises that may affect the application of HACCP

	Commercial food preparation	Domestic food preparation
1.	Likely to be a trained workforce and some degree of management in the form of a quality assurance or food hygiene programme. HACCP is likely to be incorporated into existing good manufacturing practice (GMP) or good catering practice (GCP).	Food handler may have little or no knowledge of food and its associated hazards and the risks. Levels of good domestic kitchen practice (GDKP) are very variable.
2.	Levels of equipment, design and construction of premises and cleaning programmes are likely to be appropriate.	Hygiene is often given little thought in the design of domestic premises and appliances. Levels of organic soil on surfaces are likely to be higher than commercial premises.
3.	To support or enforce 1 and 2 there is likely to be some degree of legislation requiring implementation of HACCP principles with regulatory enforcement.	The domestic kitchen unless preparing food for commercial reasons, is exempt from legislation.
4.	For people concerned with carrying out the HACCP (buyers, environmental health officers etc.) access is usually easily gained.	Access can be difficult.
5.	A team can be used to construct and if necessary implement or audit a HACCP programme.	A team can be used to construct a strategy and method but implementation and evaluation will often be by individuals.
6.	Intended use of the product is often unknown or very variable.	Often precise statements can be made about the product end use.
7.	Specific flow diagrams can be constructed and validated by on-site confirmation.	Only general flow diagrams can be constructed. Work flow is often extremely variable.
8.	Easier to apply a 'decision tree' approach to critical control points.	Application of the decision tree is not so easy. It is more difficult to have confidence in future steps eliminating or reducing a hazard. This is due to the variable nature of the environment, equipment and the critical limits and target values.
9.	Easier to establish critical limits for each critical control point and monitoring equipment is sophisticted and available.	More difficult to monitor critical limits and monitoring equipment is generally unavailable.
10.	HACCP plans should contain detailed record keeping and documentation.	Only possible to use simpler documentation if at all.
11.	Product lines tend to be more limited. Continuous and batch production.	Wide variety of end products. Batch production only.

poisoning and the means to prevent it. Attention has been drawn to the risk of direct contamination and cross-contamination of foods in the domestic environment. The fact that cross-contamination can easily occur in domestic kitchens has been demonstrated (de Wit *et al.*, 1978).

Unlike the commercial kitchen or food plant, the domestic kitchen is not a dedicated food production environment. It can serve as a laundry, work room and even living quarters for family pets. These activities may contribute to contamination, restrict working space making it difficult to separate clean and dirty food processes and to clean effectively. Hygiene is often given a low priority in the design of domestic kitchens and equipment. The materials used in construction are often less durable and more difficult to clean than their commercial equivalent.

There is little information available on the maintenance and cleanliness of domestic kitchens. The efficiency of domestic cleaning techniques appears to be very variable with recent research (Worsfold and Griffith, unpublished results) indicating organic soil levels on domestic surfaces being substantially higher than those encountered in commercial premises. This is likely to be a reflection of the standards of construction, cleaning programmes and cleaning equipment available to commercial food producers.

The range of sophisticated and automated equipment available is much greater for food manufacturers and caterers. This ranges from automated cleaning equip-

Table 2 Common hazards and critical control points of home produced foods

Food	Hazard	Critical control point(s)
Scrambled egg	Enteric pathogens	Cooking
Chilli con carne, spaghetti bolognese, chicken curry, shepherds pie for:		
Immediate consumption	Enteric pathogens	Cooking
Later consumption	Enteric pathogens Spores of potential pathogens	Cooking Cooling Storage Handling Reheating } or Hot Holding
Sausages/burgers	Enteric pathogens	Cooking
Roast chicken for:		
Immediate consumption	Enteric pathogens	Cooking
Later consumption	Enteric pathogens Spores of potential pathogens	Cooking Cooling Storage Handling
Meat sandwiches	Enteric pathogens	Purchase Storage Preparation Storage after preparation

ment to chillers and advanced computer-controlled heat processors.

In the domestic kitchen, a wide range of food products is handled using a variety of production techniques. Food service systems including cook-serve, cook-chill and cook-freeze can be used separately or combined on an *ad hoc* basis. Unlike commercial operations which use standardized recipes, continuous production and production schedules, domestic food operations are often individual to that unique meal.

The individual and variable nature of production plus a different type of environment require the application of HACCP, as a quality assurance technique, to be more flexible than the very specific product, process and plant application found in food manufacturing. This is particularly true in the realistic setting of control measures and limits which can be much more difficult to monitor in the domestic kitchen.

In spite of these differences, knowledge from commercial food service operations combined with factors commonly involved in contributing to domestic food poisoning can be integrated into the HACCP philosophy. *Table 2* provides examples of some typical UK meals indicating their critical control points. *Table 3* provides examples of hazards, control measures and monitoring which can be employed. The control measures are based on the hygiene principles of preventing microbial contamination of foods and preventing growth and survival of pathogens which may be present.

Cooking will be a critical control point for cook-serve meals. The control measure will be to cook thoroughly although how best to describe this in terms of critical limits and target levels is more difficult in the domestic environment. The widely used term 'piping hot' meaning so hot as to sizzle or hiss is not clearly understood and there are widely different interpretations.

It is unrealistic to expect the domestic kitchen to have sophisticated temperature-monitoring equipment and the strategy to dsescribe and achieve correct cooking in the home is twofold.

Firstly, emphasis must be given to adhering to cooking instructions. These must be carefully constructed to ensure that a sufficiently high end-point temperature can be achieved. They should consider not just cooking times and temperature but also factors

Table 3 Control measures for domestic food preparation

Process Step	Importance	Hazard	Control Measure	Monitoring
Purchase	Critical if ready to eat	Growth or contamination with food poisoning bacteria or toxins	Buy from reputable supplier	Date code Storage temperature in shop Packaging integrity
Transport	Critical if ready to eat	Growth of food poisoning bacteria or toxin production	Correct storage	Use of cool bag Short transport time
Storage	Critical if ready to eat	Growth or contamination with food poisoning bacteria or toxin production	Correct refrigeration	Check refrigeration temperature Check storage position Check 'use by' date
Preparation	Critical if ready to eat	Contamination with food poisoning bacteria	Good personal and general hygiene – proper handwashing and cleaning of surfaces and utensils Separate raw from cooked	Handwashing facilities Visual inspection of surface and facilities for cleaning surfaces Visually assess work organization
Cooking	Critical if cook-serve	Survival of pathogens	Thorough cooking	Check time and temperature Indication of heat treatment – colour changes, bubbling etc.
Cooling	Critical if cook-chill or cook-freeze	Germination of spores, growth of pathogens	Rapid cooling (within 90 min)	Availability of cold water, ice Availability of clean utensils and vessels
Freezing/refrigerated storage	Critical if cool-chill	Growth of pathogens	Store covered under 5°C for less than 3 days	Check refrigeration temperature Identify day of production on container Limit time
Reheating	Critical if cook-chill or cook-freeze	Survival of pathogens	Reheat thoroughly	Actual temperature Length of reheating Indication of heat, e.g. bubbling
Service	Critical if high-risk food	Contamination or growth of pathogens	Cold service – serve as soon as possible after removal from refrigerator Hot foods – serve as soon as possible after reheating or heating	Check if cold foods cold and hot foods hot (above 60°C)

such as method of cooking, initial temperature of food, size of food and cooking utensil as well as surface area and depth. The cooking process, recommended by the food manufacturer or the recipe author, should not be arbitrary but should be verified and incorporate a safety margin to allow for equipment performance.

Secondly, the means of checking that an adequate temperature has been reached must be given. This might include the use of thermometers. Additionally other means of monitoring including colour changes in meat or juices, setting or coagulation of proteins in egg, bubbling of liquids for a minimum time, can be stated.

Cooking in advance is a common domestic practice and a factor which has been implicated in food-poisoning outbreaks; when this occurs, cooling becomes a critical control point. Whilst people may recognize the importance of cooking, the critical need for rapid cooling is less likely to be understood. Cooling control measures should specify how and where cooling is to be carried out, including the use of containers, cold or iced water, whether the dish should be covered or uncovered and the maximum time for leaving at ambient temperature.

Following cooling, correct storage of the dish is critical. With the advent of cheap refrigerator thermometers, monitoring of post-cooling storage temperatures is not difficult. The need and the mechanisms for preventing cross-contamination of the cooked product should be explicit.

The procedures for ensuring adequate reheating will be similar to those for primary cooking but should emphasize that reheating should be carried out once only.

Ready prepared foods, requiring no further cooking, have different critical control points. Greater emphasis is required on the correct purchase, transport, storage and handling of these foods. The need to prevent the growth of pathogens and cross-contamination determine the control measures that should be employed.

CONCLUSION

HACCP as a philosophy and a technique does have applications to domestic food preparation. These applications are in writing recipes, as the basis of health education programmes and as an auditing tool. In auditing it can be used to evaluate food-handling practices and procedures. This type of approach has recently been applied to 108 observations of domestic food preparation (unpublished) and it is hoped that the knowledge gained will provide information on which specific education programmes can be based.

Such knowledge in itself will enable people to change their behaviour, once they are motivated to do so. The problem of changing people's behaviour is more complicated and this is a health education challenge which is becoming increasingly important.

REFERENCES

Beddows, C.L. (1983) Chicken research. *Home Econ.* April, 28–30

Bryan, F.L. (1978) Factors that contribute to outbreaks of foodborne disease. *J. Food Prot.* **41**, 816–827

Bryan, F.L. (1988) Risks of practices, procedures and processes that lead to outbreaks of foodborne illness. *J. Food Prot.* **51**, 663–673

Bryan, F.L. (1992) *Hazard Analysis Critical Control Point Evaluations: a Guide on Identifying Hazards Associated with Food Preparation and Storage.* WHO, Geneva

Beard, T.D. (1991) HACCP and the home: the need for consumer education. *Food Technol.* June, 123–124

Department of Health (1993) *Assured Safe Catering: A Management System for Hazard Analysis* HMSO, London

de Wit, J.C., Broekhuizen, G. and Kampelmacher, E.H. (1978) Cross contamination during preparation of frozen broilers in the kitchen. *Voeding* **39**, 208–210

FDF–IEHO (Food and Drink Federation – Institution of Environmental Health Officers; (1993) *National Food Safety Report* Institute of Environmental Health Officers

FAO/WHO (1984) The role of food safety in health and development: report of a joint FAO/WHO Expert Committee on food safety. *WHO Tech. Rep.* No 705, WHO, Geneva

Grikitis, K. (1991) Proper protection. *Food Process.* May, 23–29

Hobbs, B.C. and Roberts, D. (1993) *Food Poisoning and Food Hygiene* 6th edn, Edward Arnold, London

ICMSF (International Commission on Microbiological Specification for Foods) (1988) Application of the hazard analysis critical control point (HACCP) system to ensure microbiological safety and quality. *Microorganisms in Foods 4* Blackwell Scientific, Oxford

MAFF (Ministry of Agricuilture, Fisheries and Food) (1988) *Food Hygiene: a Report on a Consumer Survey* HMSO, London

Michanie, S., Bryan, F.L., Alvarez, P. and Olivo, A.B. (1987) Critical control points for foods prepared in households in which babies had Salmonellosis. *Int. J. Food Microbiol.* **5**, 337–354

Michanie, S., Bryan, F.L., Alvarez, P., Olivo, A.B. and Paniagua, A. (1988) Critical control points for foods prepared in households whose members had either alleged typhoid fever or diarrhoea. *Int. J. Food Microbiol.* **7**, 123–134

Mitchell, B. (1992) How to HACCP. *Br. Food J.* **94**, 16–20

Peri, C. (1993) A hazard analysis model for food processes. *Food Sci. Technol. Today* **7**, 67–71

Richmond, M. (chairman) (1991) *The Microbiological Safety of Food*, Part II. *Report on the Committee on the Microbiological Safety of Food.* HMSO, London

Spriegel, G. (1991) Food Safety in the home. *Nutr. Food Sci.* November/December, 14–15

Zottola, E.A. and Wolf, I.D. (1981) Recipe hazard analysis RHAS–a systematic approach to analysing potential hazards in a recipe for food preparation/preservation. *J. Food Prot.* **44**, 560–564