

Hazard analysis critical control point and prerequisite programme implementation in small and medium size food businesses

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Abstract

One hundred and two small and medium sized food businesses in the UK were quantitatively assessed for hazard analysis critical control point (HACCP) and prerequisite programme (PRP) implementation. The assessment was conducted in person using a generic HACCP-PRP questionnaire from the point of ingredient purchase through to consumer service. Since the questionnaire was completed on the business premises, managers' claims regarding food safety issues could be verified. Scores were awarded for the implementation of time, temperature and cross contamination controls. These parameters were considered as essential for the control of microbial hazards. Temperature control was the activity least likely to be implemented due to 60% of businesses using domestic refrigerators for commercial purposes and only 40% having temperature probes. The survey revealed that only 65% of businesses kept any form of records. These were primarily temperature logs and delivery notes which were kept for up to 10 years with no apparent reason. The study showed that the proposed European Union legal requirement of full (seven stage) HACCP in all businesses may present problems for small and medium sized multi-product businesses lacking in-house knowledge and access to experts.

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1. Introduction

It is estimated that in the UK up to 9.4 million people a year suffer from intestinal illness and there are consequently 100–200 deaths (Wheeler et al., 1999). Although this incidence is small when compared with the several billion meals served annually, the economic and social costs are considerable (Buzby & Roberts, 1997). When food poisoning outbreaks are investigated it has been established that small and medium sized businesses are often important locations in the transmission of foodborne illness (Border & Norton, 1997). In the UK

small companies account for 99% of all food operations (DTI, 1999).

End-product testing alone is unable to assure safe food production and hence the hazard analysis critical control point (HACCP) approach has been adopted for the elimination or reduction the identified hazard(s) to an acceptable level. HACCP is a systematic means in identifying the hazards at any stage of the food operation, assessing the related risks and determining the areas where control is needed (Codex, 1997; NACMCF, 1997). Monitoring and verification procedures form an integral part of the system in the maintenance of safe food. In the UK there is a legal requirement for the application of a HACCP-type approach (Anon, 1995) that omits the need for documentation and the requirement for verification. These were omitted due to perceived difficulties of their application by small and medium sized businesses. However, partially due to the Pennington Report into the Lanarkshire outbreak of *E. coli* O157, the European Union are now proposing the implementation of full HACCP in all food businesses

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which will include the requirements of documentation and verification (Pennington Group, 1997). Prior to effectively implementing HACCP, food business should already have in place various practices including ingredient and product specifications, staff training, cleaning and disinfectant regimes, hygienically designed facilities and be engaged in good hygienic practices (GHP). These collectively may be termed 'prerequisite programmes' (PRP) (NACMCF, 1997; WHO, 1999).

A number of hindrances to the effective implementation of HACCP in small businesses have been identified such as lack of expertise and perception of benefits, absence of legal requirements, as well as various attitude barriers and financial constraints (Ehiri, Morris, & McEwen, 1995; WHO, 1999; Taylor, 2001). In addition, many small businesses believe that they must abandon existing control systems prior to implementing HACCP (Ackerley, 1997). These difficulties may be due to HACCP being developed from the perspective of large, as opposed to small, food companies (WHO, 1999). Panisello, Quantick and Knowles (1999) reported that HACCP implementation decreased proportionately as the the number of employees decreased. Evidently the effective application of HACCP to small businesses is a considerable challenge to both the food industry and enforcement agencies.

This paper presents data on the implementation of HACCP and PRP by small businesses, assessed in person on the premises. The study used a quantitative generic HACCP (WHO, 1999) and PRP approach that focussed on the control of microbial hazards through time, temperature and cross contamination related activities. In order to determine the level of commitment towards HACCP implementation, managers were interviewed four months after the assessment. If full HACCP implementation becomes a legal requirement in the future, then this study could be used as a comparative baseline.

2. Materials and methods

2.1. Businesses

One hundred and fifty nine businesses were initially contacted for their agreement to participate in the study. These businesses were selected on the basis of being independent and small scale (<250 employees). A total of 102 businesses participated and comprised of sandwich bars (8), fish & chip shops (11), cafés (16), ethnic takeaways (8), butchers (14), bakeries (5), bed and breakfast (1), restaurants (10), manufacturers (6), nurseries (13), residential nursing homes (6) and public houses (6). Each business was visited by personnel trained in HACCP, conducting face to face interviews and administering questionnaires.

2.2. Generic HACCP and PRP questionnaire

Due to the diversity of foods produced by the businesses a generic (as opposed to product-specific) HACCP related questionnaire was designed and included PRP. This was based on the principles of time, temperature and cross contamination as the three main activities for controlling microbial hazards. The questionnaire was designed to obtain information, in a systematic manner, from purchase of ingredients through to receipt by the consumer. Hence the questionnaire assessed each food businesses' controls, monitoring and corrective actions in relation to purchase, storage, preparation, cooking, chilling, reheating and any record keeping associated with this process. Hence control points as well as critical control points were included (Mortimore, 2001). As part of the PRP assessment, details regarding menus and business layout (to identify potential points of cross contamination) were collected and an assessment of the facilities including the equipment, structure of premise, waste, cleaning, personal hygiene and pest control. Managers were interviewed to ascertain their general level of HACCP understanding. The completed questionnaire was returned to the business manager to assist in their subsequent HACCP and PRP of related activities.

2.3. Quantification of generic HACCP and PRP compliance

A scoring system for the questionnaire, described above, was devised to quantify the businesses' HACCP and PRP compliance. During the visit, each step of the process was evaluated to establish if control measures existed and separately if they were being implemented. Where hazards were uncontrolled a score of one was assigned. A score of two was given if controls were only partially implemented or no evidence was available to support the answer received during the visit. Full compliance was given a score of three. The final food safety score was therefore calculated based on the total points achieved against the maximum possible. An arbitrary 'satisfactory' criteria was set at >60% compliance. The generic HACCP questionnaire was initially piloted with two businesses and took approximately 100 min to complete.

2.4. Temperature monitoring

A temperature logger (-40–70 °C, ±0.2 °C; Mono-Log, Whatman UK) was used to record the temperature profile of refrigerators in commercial use over 24 h periods.

2.5. Telephone semi-structured interview

Business managers were contacted by telephone four months after the survey. They were asked a series of both open and closed questions related to their subsequent application of HACCP.

3. Results

3.1. Range of businesses participating in generic HACCP-PRP study

A total of 102 businesses, out of 159 contacted, agreed to participate in the study. The highest response rate (100%) was from 13 nurseries in contrast to the lowest (8/17) from ethnic takeaways. The most common reason (13/57) given for non-participation was a lack of time. Eleven claimed they had or were in the process of HACCP implementation, seven claimed that their English was too poor and six were closing down in the near future.

The food businesses included in the survey were typically small, with the average number of employees being less than 10 in 84 of the businesses and only three had more than 30 employees. The majority of food handlers surveyed (444 in total) were predominately involved in more than one job with 46% being involved in cooking, service, preparation and cleaning.

3.2. HACCP and food legislation knowledge of managers

The managers of the small businesses were asked questions on HACCP and relevant food legislation. Although 70% of managers were aware of the Food Safety (General Food Hygiene) Regulations 1995, less than half (40%) could explain what the requirements were. Only 42% of managers had heard of HACCP and 65% could not explain what it involved. Of those managers that were aware of HACCP the majority (68%) had acquired information from their local environmental health officer. Other sources of information included trade associations (16%), press (4%), other companies (4%) and college courses (8%).

3.3. HACCP prerequisites

All businesses scored satisfactory (>60%) in relation to facilities that were considered prerequisites for HACCP, i.e. equipment, premise structure, waste and pest control. Where lower scores were obtained, it was primarily for having insufficient preparation and dish-washing sinks (with reference to the requirements of the Food Safety (General Food Hygiene) Regulations 1995). High scores were achieved in relation to waste control (>87%) for all businesses. Pest control tended to

conflict with the need for ventilation in the hot summer months. The worse scores were for the bed & breakfast (33%), day nurseries (mean 50%, SD = 25) and manufacturers (mean 50%, SD = 28) that were using doors and windows for additional ventilation and hence did not control flies entering their businesses.

Many businesses, such as the bed & breakfast business (score 40%) and ethnic takeaways (mean score 52%, SD = 11), had a poor knowledge of cleaning and disinfection procedures. This included being unaware of the importance of temperature probe disinfection prior to use. All businesses were aware of the good personal hygiene practice requirements for food handlers.

3.4. Receipt of ingredients and storage

In relation to control at the point of purchase or receipt, all businesses consistently scored satisfactory (>60%). Lower scores were recorded in those businesses that were unable to monitor the temperature of goods on arrival due to lack of time and appropriate equipment. Storage of goods demonstrated a range of problems. The ethnic takeaways had a mean score of only 54% (SD = 20) primarily due to the risks of contamination of raw ingredients during storage prior to use. Two kebab houses, within this category, had a mean score of only 44% due to inadequate stock control and cross contamination which warranted immediate attention.

3.5. Refrigeration

Domestic-type refrigerators were used in 60% of small businesses. The temperature variation in one domestic and one commercial catering refrigerator was recorded using a data-logger. Both were monitored during commercial use and neither units were overloaded (Fig. 1). The data were subsequently used as examples to demonstrate to managers the difference in

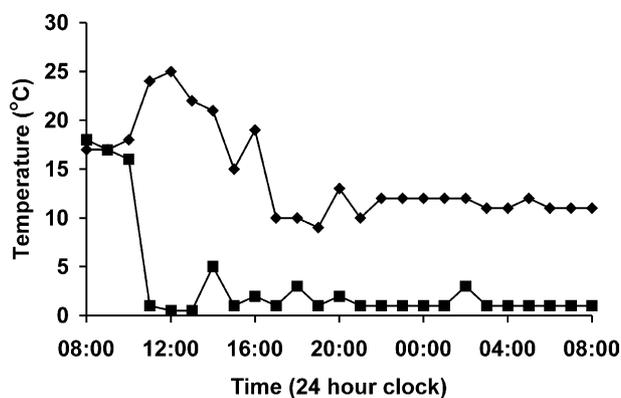


Fig. 1. Data-logger temperature recordings for a domestic (◆) and a commercial catering (■) refrigerator. Data logger in transit at ambient temperature from 8 to 10 am.

temperature control between the two types of refrigerators.

3.6. Food preparation practices

Food preparation was satisfactory (>60%) in most businesses. Lower scores were mainly due to risks of cross-contamination with businesses such as ethnic takeaways only using a detergent on surfaces and not a disinfectant.

3.7. Cooking and cooling practices

Temperature during cooking was poorly monitored with only 40% of businesses possessing temperature probes. The other businesses were relying on experience and visual observation. Additionally, businesses did not have sufficient control of the cooling procedure for cooked foods. There was often no timing of how long foods were cooling at room temperature, with foods being left for over 6 h and even overnight in two instances. The main mechanism for reheating in all businesses was the use of a microwave oven. Only the food manufacturers (6/102 participants) reheated the food to a 'piping hot' (i.e., just below boiling) description.

3.8. Record keeping

Of the 102 food businesses surveyed 65% kept some form of records. The most common records were temperature logs and delivery notes (Fig. 2). In some instances records were being kept for up to 10 years. The majority of businesses did not understand why they were keeping records, only that their environmental health officer had requested it.

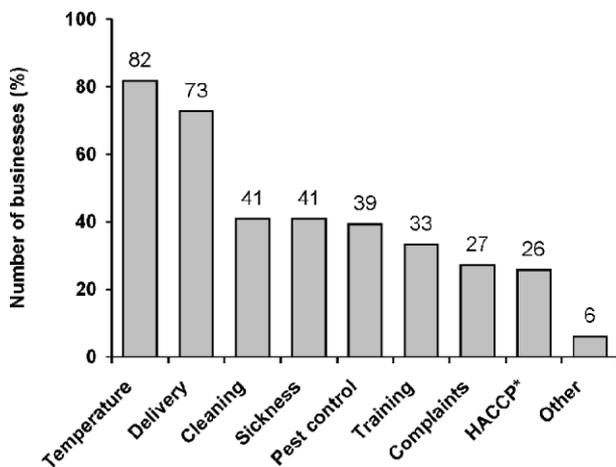


Fig. 2. Types of records being kept by 66 small food businesses. See Materials and Methods for number of businesses in each category. *Number of businesses with a formal HACCP system already in place.

3.9. Time, temperature and cross contamination control

The scores for the HACCP questionnaire of all businesses were re-analysed for activities related to the control of time, temperature and cross contamination. These categories were regarded as key activities related to the control of microbial hazards. Temperature was the weakest area of control (Fig. 3). This was evident from the lack control during cooking (only 40% possessing temperature probes), cooling and subsequent storage before distribution. Better control of cross contamination and total production time (from receipt to distribution) compared with temperature was evident (Fig. 4).

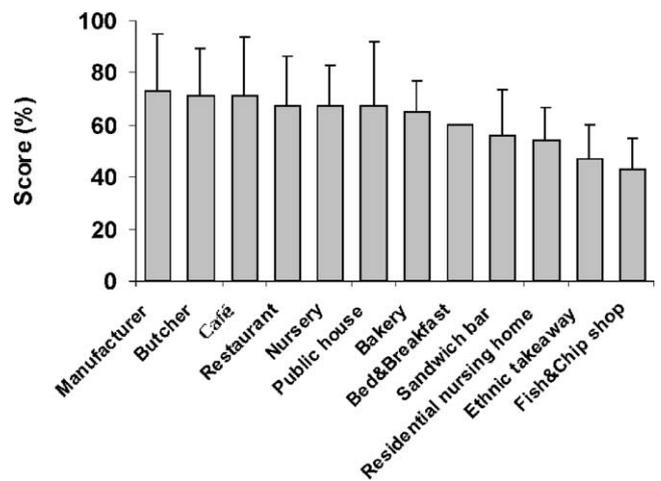


Fig. 3. Temperature control of microbial hazards from ingredient receipt to product distribution in 102 small food businesses. Error bars indicate standard deviation values. See Materials and Methods for number of businesses in each category.

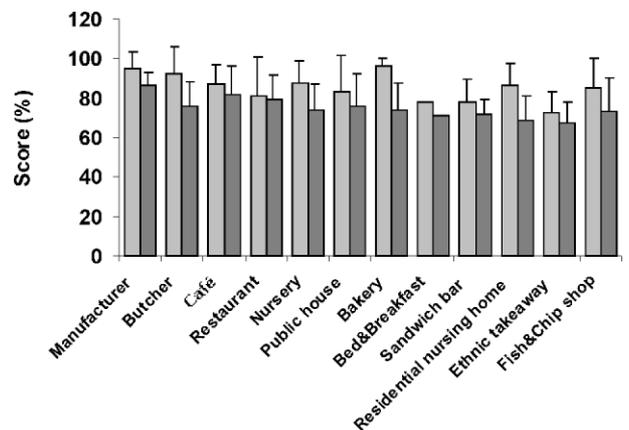


Fig. 4. Cross contamination (■) and time control (□) from ingredient receipt through to product distribution in 102 small food businesses. Error bars indicate standard deviation values. See Materials and Methods for number of businesses in each category.

Table 1
Food business managers perceived benefits of the HACCP survey

Manager responses to generic HACCP questionnaire	Number of responses
Survey reference document very useful	25
Simplification of principles in an understandable manner	23
Beneficial informal guidance given	11
Useful auditing of processing operations	11
Provided motivation to start work on HACCP	9

3.10. Follow-up telephone questionnaire

Four months after the completion of the generic HACCP survey, 95 of the original 102 businesses participated in a semi-structured interview. The remaining seven businesses could not be contacted. Seven managers who could be contacted had not read the completed HACCP questionnaire on their business and were subsequently excluded from the following results.

The main constraints to HACCP implementation perceived by the remaining 88 managers were a lack of time (44) and expertise (26). Seventy-nine of the 88 businesses participating said that the survey had been beneficial (Table 1). Nine businesses that did not think that the survey had been beneficial. Their reasons included business closing down (6), very low risk food product (2) and one believed the HACCP concept was common sense and that they were doing it already. Sixty (out of 88) of the managers had not furthered their work on HACCP implementation due to lack of time (40), did not see any benefit (12), business in financial difficulty (6) or believed their operations did not warrant HACCP control (2). This left 28 managers who had further worked on HACCP related issues. Eight of these had implemented the 'assured safe catering' scheme of the Department of Health (1993), six had constructed flow charts of their production process, six had developed their own HACCP-like scheme, four had identified hazards associated with their foods and two had carried out necessary alterations to their premises. In total, twenty-three out of 102 businesses had documented schemes related to HACCP in place after the study compared to seventeen before.

4. Discussion

Although the researchers had no legal right of entry, a high proportion (64%) of small businesses voluntarily participated by allowing personnel into the premises for a HACCP and PRP overview. This

enabled an on site review of current practices related to the control of microbial hazards in small food businesses. This survey was probably a more accurate representation of business practices than data obtained from postal surveys since managers' claims could be verified on site. The generic HACCP approach was necessary due to the variety of foods produced by the participants and was subsequently usable by the businesses as a framework for future assistance in HACCP implementation.

The survey was conducted after September 1995 when the HACCP-like implementation became a legal obligation in the UK (Anon, 1995). Nevertheless, only 42% of managers from the 102 food businesses claimed to have heard of HACCP. Prerequisite activities scored satisfactory with the exception of cleaning and disinfection. Although many businesses were not controlling potential points of cross contamination in their premise design or workflow patterns. Therefore we concur with Wallace and Williams (2001) on the essential need of PRP in food businesses.

The application of HACCP in all businesses for the control of microbial hazards was found to be similar in that purchase and storage stages were satisfactorily executed. However, less control was evident for the important stages of cooking, chilling and reheating. Cooking and cooling regimes are major CCPs for the control of pathogenic bacteria, yet many businesses had no accurate method of checking cooking temperatures. Businesses did not have sufficient control over the cooling procedures of foods as evident from the lack of monitoring the cooling period and left cooked food at room temperature for over 6 h. Therefore any vegetative cells or spores surviving the cooking process could proliferate to levels sufficient to cause illness and inadequate reheating would not reduce their number to a safe level. Domestic refrigerators were in significant use (60%) and therefore, as evident from temperature profiles (Fig. 1), contributed to poor temperature control during food production (Fig. 3). Poor control of temperature was also evident during cooking and reheating due to the lack of instrumentation.

By reducing controlling factors to the three critical areas of time, temperature and cross contamination a survey of food safety practices was achievable using a generic HACCP plan. A generic approach, as opposed to product-specific, HACCP (WHO, 1999) could assist small businesses in the future with a diverse product range should there be a legal requirement for full HACCP implementation. Despite the current legal requirement for a HACCP-like approach to food safety, 88 of the food business managers claimed that their lack of HACCP progress was due to a lack of time and expertise. Therefore, there needs to be proactive enforcement and education about PRP and HACCP for these small businesses.

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