

Food handlers' hygiene knowledge in small food businesses

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Abstract

Four hundred and forty-four food handlers, employed in 104 small food businesses, were personally interviewed with regard to their knowledge of food hygiene. Fifty-seven percent of food handlers thought that they could tell if food was contaminated with food poisoning bacteria by sight, smell and taste and 25% thought bacteria readily multiplied at -10 , 75 or 120 °C. Sixteen percent thought the correct temperature of a refrigerator was -18 °C or below. The study demonstrated that the basic lack of hygiene knowledge and understanding could prove to be a major barrier to the effective implementation of hazard analysis critical control point in small food businesses.

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1. Introduction

Food handlers have a major role in the prevention of food poisoning during food production and distribution. Food handlers may cross-contaminate raw and processed foodstuffs as well as inadequately cook and store foods. They can also be asymptomatic carriers of food poisoning organisms (Cruickshank, 1990). The staff at the butcher's shop that caused the Lanarkshire outbreak of *E. coli* 0157 thought biodegradable cleaners were bactericidal (Cox, 1998). Foodborne illness has been associated with improper storage or reheating (50%), food stored inappropriately (45%) and cross-contamination (39%) (Bean & Griffin, 1990). These contributory factors are due to a lack of food hygiene awareness or implementation. The UK Audit Commission found a strong link between those premises with poor practices and low levels of training (Audit Commission, 1990). Additionally, a correlation between management attitude towards training, levels of food

hygiene knowledge and standards of food handling practice has been identified (Tebbutt, 1992; Kitcher, 1994). Food hygiene training is therefore crucial in food safety and is an essential part of the hazard analysis critical control point (HACCP) concept (Bryan, 1991).

Nevertheless it is not only the ignorance of food hygiene that causes food poisoning, but also the lack of applying the acquired knowledge (Bryan, 1988; Ehiri & Morris, 1994). A number of studies have demonstrated a lack of correlation between food hygiene training and improvements in food hygiene behaviour (Laverack, 1989; Luby, Jones, & Horan, 1993; Taylor, 1996; Howes, McEwen, Griffiths, & Harris, 1996). A previous study in Italy of 411 food handlers interviewed on a face-to-face basis determined that whilst they had a positive attitude towards food safety this was not supported by observed practices (Angelillo, Viggiani, Rizzo, & Bianco, 2000). This confirmed that knowledge alone does not lead to changes in food handling practices. There are many proposed reasons for the lack of impact of training initiatives. These reasons include recruitment from lower socio-economic classes with low educational levels (Clingman, 1977; Oteri & Ekanem, 1992), rapid staff turnover (Burch & Sawyer, 1991), high level of seasonal staff (Travis, 1986), literacy and language problems (Taylor, 1996) and poor motivation due to low pay and job status (Rennie, 1995).

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HACCP implementation in a food business requires the recognition of hazards and their control. Therefore a major challenge in the food industry is to motivate food handlers to apply what they have learnt regarding food hygiene (Ehiri & Morris, 1994). However small businesses may lack the in-house knowledge and resources to identify foodborne microbial hazards and therefore correctly implement HACCP (Panisello & Quantick, 2001).

This paper presents data on a survey that assessed the hygiene knowledge of food handlers from small businesses. The study was conducted as face-to-face interviews and used a questionnaire with a series of open and closed questions.

2. Materials and methods

2.1. Food handler questionnaire design

The questions were designed to obtain information about food handler's knowledge of food poisoning, personal hygiene, high-risk food groups, temperature control, cross-contamination and cleaning. On the front of the questionnaire were simple completing instructions, along with an explanation of the purpose of the survey and that confidentiality would be assured.

The knowledge assessment part of questionnaire consisted of 27 multiple-choice questions each with four or five possible answers and a series of open questions. To reduce the possibility of food handlers selecting the correct answer by chance, the multiple choice answers included 'Do not know'. After the open questions food handlers had to write their responses. Questions related to temperature were asked in both units of Celsius and Fahrenheit. However for presentation purposes this paper only refers to Celsius values.

2.2. Delivery of food handler questionnaire

Each business was visited by personnel trained in conducting face-to-face interviews and administering questionnaires. Food handlers were encouraged to answer honestly and assured that no information would be given to their manager or enforcement officers. Food handlers were asked individually about their background details; job description, length of time in the food industry and formal food hygiene training. The remaining food hygiene knowledge questionnaire (as described above) was completed individually without discussion with other personnel. After food handlers had completed the questionnaire, the researcher reviewed the answers individually and explained incorrect answers. This enabled the researcher to determine if a

question had been misinterpreted and also served as a hygiene training opportunity.

2.3. Range of participating businesses

One hundred and fifty-nine small food businesses producing a variety of foodstuffs were invited to participate in this study. The businesses were all within the East Midlands region of the UK. The researchers had no legal right of entry and hence the co-operation with business managers was essential.

2.4. Pilot study

The pilot study was used to assess the clarity of the questions, candidate instructions, layout and time requirements. It was important that the time required for completing the questionnaire, was not perceived by the food business managers' as disruptive to the normal work pattern. The questionnaire was piloted on six food businesses (similar in size and products to those used in the final study) and involved a total of 30 food handlers. The results of these pilot studies were not included any further assessment.

3. Results

3.1. Participating businesses

One hundred and four independent food businesses, out of 159 contacted, participated in the study. These comprised of sandwich bars (8), fish and chip shops (11), cafés (16), ethnic takeaways (5 Chinese takeaways, 2 kebab houses and 1 Indian takeaway), butchers (14), bakeries (5), bed and breakfast (1), restaurants (10), manufacturers (6), nurseries (13), residential nursing homes (6) and public houses (6). The food businesses were typically small, with the average number of employees being less than 10. A total of 444 food handlers completed the hygiene knowledge questionnaire and took an average of 35 min (range 20–91 min) to complete. Forty-six percent of food handlers were involved in more than one job (i.e. cooking, serving, preparation and cleaning) within the business. Twenty-six percent of food handlers had been in the catering industry for between 1 and 5 years.

3.2. Formal food hygiene training

Fifty-five percent of the 444 food handlers surveyed had undertaken formal food hygiene training. A higher percentage (63%) of managers had undertaken formal food hygiene training. Thirty-six percent of managers reported that they had a mechanism for updating hygiene knowledge, including weekly staff meetings (49%),

periodic updates (13%) and on the job training (38%). The remainder of the businesses (64%) had no mechanism of updating hygiene knowledge of the staff.

3.3. Knowledge of food poisoning

Over half of the food handlers surveyed (57%) believed one could tell if food was contaminated with food poisoning bacteria, resulting in it being unsafe to eat, by visual, olfactory or taste checks (Fig. 1). Seventy-six percent correctly identified that food poisoning bacteria grew at 37 °C, but 4% answered 'Die', 6.5% 'Grow slowly' and 11% 'Did not know'. Fourteen percent thought bacteria grew best at 75 °C and 6% at 120 °C and 5 at –10 °C. The majority (93%) knew that diarrhoea was a symptom associated with food poisoning. The majority (82.5%) were aware that insects, other food handlers and raw food were sources of bacteria being brought into the kitchen. However 'flu' and measles were considered causes of food poisoning by 9 and 2% of the food handlers, respectively.

3.4. High risk food groups

Three quarters of the food handlers recognised that mayonnaise was a potential source of food poisoning bacteria. However, fewer (58%) knew that cooked rice could be a vehicle for food poisoning (Table 2). Nineteen percent thought pasteurised milk was sterile (Table 2).

3.5. Personal hygiene awareness

Food handlers were able to correctly identify aspects of good personal hygiene practice such as avoiding wearing jewellery (97%), the need for protective clothing (94%) and covering cuts with easily identifiable plasters (97%). The open question 'Name three occasions when you wash your hands?' elicited seven main response areas. All responses included 'after going to the toilet'

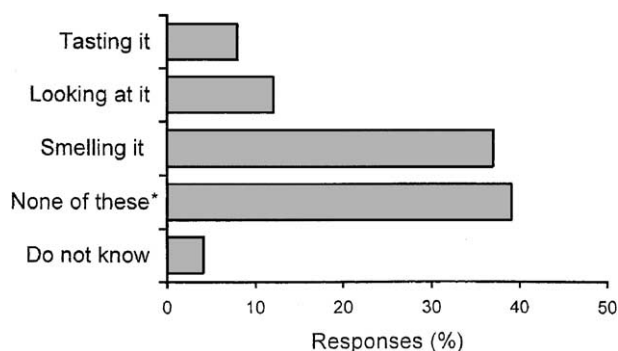


Fig. 1. Answers to the question 'If food is contaminated with food poisoning bacteria you can normally tell by?'. Asterisk indicates the expected correct answer. Number of food handlers = 444.

and 75% 'after handling raw food'. When asked to name foods associated with *Salmonella* contamination, the responses were chicken and meat (65%), eggs (12%), fish (10%), dairy products (5%) and 'Do not know' (8%).

3.6. Cross-contamination and cleaning

Ninety-seven percent of food handlers knew that raw and cooked foods should be separated in order to prevent bacterial transfer. However cleaning practice knowledge indicated that 17% thought that detergents, scrubbing brushes and cold water were best at killing bacteria and a further 3% answered 'Do not know' (Table 2).

3.7. Temperature control

Many food handlers were not aware of the basic temperature control requirements for the control of microbial hazards. Twenty-one percent thought that freezing killed all bacteria. Sixty-three percent correctly answered according to UK regulations, (Food Safety (Temperature control) Regulations, 1995) that the temperature of the food in a refrigerator should be at or below 8 °C (Fig. 2). In relation to hot food, 20% thought bacteria grew at temperatures above 75 °C (Table 1) and only 47% were able to specify the correct temperature according to UK regulations, for holding hot food (Fig. 3).

4. Discussion

Although the researchers had no legal right of entry, a high proportion (65%) of small businesses voluntarily allowed the hygiene knowledge of their staff to be evaluated. The small food businesses surveyed on average had less than 10 employees, who were involved in all aspects of food production (i.e. cooking, preparation and cleaning) and half of the food handlers surveyed had worked in the food industry for over six years.

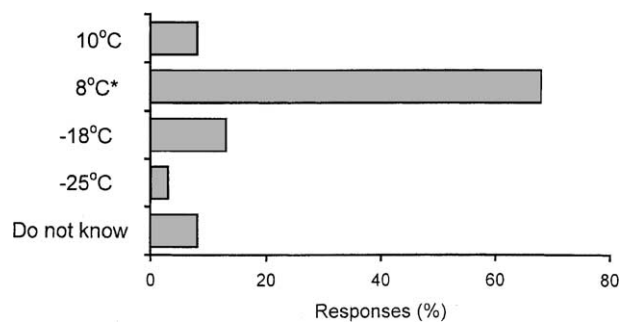


Fig. 2. Answers to the question 'The temperature inside a refrigerator should be at or below which temperature?'. Asterisk indicates the expected correct answer. Number of food handlers = 444.

Table 1
Food poisoning knowledge of 444 food handlers

Questions	Answers	%
At body heat (37 °C) what will food poisoning bacteria do?	Die	4
	Do not grow	2.5
	Grow quickly*	76
	Grow slowly	6.5
	Do not know	11
Which of the following temperatures do bacteria readily multiply at?	–10 °C	5
	25 °C*	63
	75 °C	14
	120 °C	6
	Do not know	12
Which is a common symptom of food poisoning?	Headache	1
	Diarrhoea*	93
	Rash	3
	Constipation	1
	Do not know	2
How may food poisoning bacteria be brought into the kitchen?	Insects	5
	Food handlers	3
	Raw food	9
	All of the above*	82.5
	Do not know	0.5

Asterisk indicates expected correct answer.

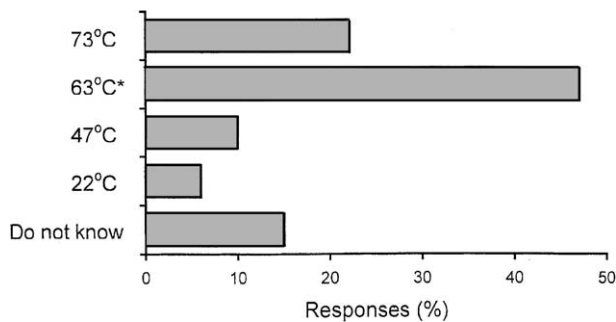


Fig. 3. Answers to the question 'Hot food must be kept above which temperature?'. Asterisk indicates the expected correct answer. Number of food handlers = 444.

Fifty-five percent of handlers had undertaken formal food hygiene training, however only 36% of outlets had mechanisms for updating hygiene knowledge. It is plausible that the lack of continuous training and reinforcement contributed to the lack of food hygiene knowledge concerning a number of key aspects in safe food production.

Sixty percent of food handlers did not know that food poisoning was caused by food that looked, smelt and tasted normal (Fig. 1). These results clearly revealed that the majority of food handlers did not understand that organoleptic assessment of food was insufficient to identify food contaminated by pathogenic bacteria. Therefore they were relying on incorrect physical attributes for food safety control. Almost all food handlers (93%) identified diarrhoea as a common symptom of food poisoning (Table 1). However the remaining 7% of

Table 2
Food poisoning knowledge of 444 food handlers

Questions	Answers	%
Which of the following is most likely to cause food poisoning?	Prawn crackers	11
	Cooked rice*	58
	Plain naan bread	2
	Cheese and tomato pizza	17
	Do not know	12
Which of the following is sterile?	UHT milk*	72
	Yoghurt	4
	Pasteurised milk	19
	Do not know	5
Why should raw and cooked foods be separated?	Food will go off quicker	1.4
	The flavour will be affected	1.1
	To stop bacteria transfer*	97
	Do not know	0.5
Which of the following is best at killing bacteria?	Disinfectant*	80
	Cold water	1.5
	Detergent	12.5
	Scrubbing brush	3
	Do not know	3

Asterisk indicates expected correct answer.

personnel could be a risk due to failure to report their illness to their manager and subsequently continue to work in a high-risk area. Basic knowledge on personal hygiene was good. The majority (94–97%) of food handlers identified the need to wash their hands after going to the toilet, wearing protective clothing, covering cuts with easily detectable plasters and that jewellery should not be worn in the kitchen as it can carry dirt and bacteria. However knowledge of hygienic practice was poor. Although the majority (97%) knew that reason for separating cooked and raw foods (Table 2), their knowledge of keeping work-surfaces hygienically clean to avoid cross-contamination was poor. Of the 444 food handlers surveyed 4.5% thought a scrubbing brush and cold water were best at killing bacteria and 12.5% thought detergents killed bacteria and 3% answered 'Do not know' (Table 2). Hence 20% of the food handlers did not know how to effectively clean a work-surface. In a previous study (Tebbutt, 1992) 29% of 75 food handlers did not know that disinfectants were used for reducing bacteria to a safe level and similarly the staff at the butchers that caused the *E. coli* O157 outbreak in Lanarkshire, Scotland thought biodegradable cleaners were bactericidal (Cox, 1998).

Food handlers need to be able to identify high-risk foods that support the survival and multiplication of pathogens and are intended for consumption without further treatment. Three quarters of the participants recognised that mayonnaise was a high-risk food, possibly due to a high awareness of 'salmonella in eggs' due to well publicised food scares in the late 1980s. However 42% of handlers did not recognise the microbial risk associated with cooked rice (Table 2) and 19% considered pasteurised milk to be sterile (Table 2). Sixty-five

percent associated *Salmonella* with chicken and meat, demonstrating an awareness of the food vehicle of the pathogen. This was greater than the 50.4% recognition of a *Salmonella* transmission vehicle in a previous study of 411 food handlers (Angelillo et al., 2000).

There was considerable confusion concerning the affect of temperature upon bacterial growth. Only 75% believed that food poisoning bacteria grew quickly at body temperature (Table 1). The remaining 25% thought the organisms answered 'grew slowly', 'died' or 'Do not know'. Only 68% of food handlers knew the correct temperature for refrigerators, with 13% replying $-18\text{ }^{\circ}\text{C}$ and 3% answering $-25\text{ }^{\circ}\text{C}$ (Fig. 2). Incorrect answers to a related question, querying which temperature bacteria readily multiplied at, were $-10\text{ }^{\circ}\text{C}$ (5%), $75\text{ }^{\circ}\text{C}$ (14%) and $120\text{ }^{\circ}\text{C}$ (6%) (Table 1). Less than half the food handlers knew the correct (UK) temperature for holding hot food ($63\text{ }^{\circ}\text{C}$, Fig. 3). Twenty-two percent answered $73\text{ }^{\circ}\text{C}$, $47\text{ }^{\circ}\text{C}$ was chosen by 10% and 6% thought the correct answer was $22\text{ }^{\circ}\text{C}$. Since these questions were asked in both Celsius and Fahrenheit, and the researcher ensured the food handlers recognised the minus sign in the questions, these results reflect a serious lack of temperature understanding amongst food handlers. There is therefore poor comprehension of temperature values and the practice of freezing food for long-term storage and even cooking food to kill micro-organisms. Since temperature treatment is frequently the critical control point a production process, the issue of poor temperature understanding could be a major hindrance to effective HACCP implementation.

The study demonstrates that although food handlers may be aware of the need for personal hygiene, they do not comprehend crucial aspects of hygiene such as cleaning of work-surfaces and cannot link temperature values with the role cooking and low temperature storage for the control of microbiological hazards.

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