Epidemiol. Infect. (1995), **114**, 143–151

A comparative study of food retail premises by means of visual inspection and microbiological quality of food

S. C. POWELL AND R. W. ATTWELL*

Department of Biological Sciences, The Manchester Metropolitan University, Chester Street, Manchester M1 5GD

(*Accepted 2 October 1994*)

SUMMARY

The relationship between visual inspection ratings given to ten food retail premises and the microbiological quality of food samples was examined. Viable counts of bacteria and of *Staphylococcus aureus* were determined for cooked meat samples from each of the premises. There was no correlation between potential risk of foodborne infection, as assessed by total inspection rating, and bacteriological counts in food ($P < 0{\cdot}05$). Neither was there a consistent relationship between scores given to any component of the total rating and the bacteriological quality of food.

The effectiveness of the current UK inspection scheme in assessing risk of foodborne infection is questioned. Inclusion of appropriately weighted criteria such as food temperature abuse is suggested to improve the scheme.

INTRODUCTION

One of the principal aims of recent EC legislation (Official Control of Foodstuffs Directive) [1] is to ensure that Member States have confidence in each others' food law enforcement systems. The Directive seeks to establish a consistent approach by requiring each Member State to draw up a programme of regular inspections of food premises. These inspections are undertaken by Environmental Health Officers (EHOs) in the UK, their frequency and nature being outlined in Government guidelines, Code of Practice Number 9, Food Hygiene Inspections (CP9) [2]. The EHO determines the potential risk of foodborne infection associated with all food premises by means of the risk assessment scheme contained in CP9. This scheme takes account of six individual components. Each component is assigned a numerical value by the inspecting officer and the inspection therefore generates a total numerical rating for each food premises (Fig. 1). This rating indicates the risk of infection associated with food from a particular premises and determines the frequency of subsequent visits. Premises which pose a greater risk i.e. with high rating scores, will be inspected more frequently than those judged to pose a lesser risk. It is therefore reasonable to assume that the inspection rating and microbiological quality of the food handled in a premises will correlate. Correlation between the results of risk assessments by microbiological sampling and those obtained by visual inspection of food premises has not been established.

* Correspondence to Dr R. W. Attwell.

Risk assessment scheme

(A) Premises: Name:
Address:_____

(B) Date of inspection:
Inspecting officer:_____

	Tick	Score
1. *Potential hazard*		
(*a*) *Type of food and method of handling*		
Handling low risk foods		5
Handling high risk		10
Preparation high risk		30
Production high risk		40
(*b*) *Method of processing*		
High risk activities e.g.		
Cooked and chilled foods		20
Aseptic packing low acid food		
Retail and small producers of cooked meats		
Thermal processing, low acid foods		
(*c*) *Consumers at risk*		
Very few		0
Few		5
Intermediate		10
Substantial		15
Vulnerable groups – catering (additional to score above)		20
2. *Compliance*		
(*a*) Food hygiene and safety		
Very good		0
Good		5
Fair		10
Poor		15
Bad		20
Very bad		25
(*b*) Structural		
Very good		0
Good		5
Fair		10
Poor		15
Bad		20
Very bad		25
3. *Confidence in management/control systems*		
Highly confidant		0
Moderate confidence		5
Some confidence		10
Little confidence		20
No confidence		30
Inspection rating total:		

Fig. 1. The Risk Assessment Scheme, Code of Practice Number 9, Food Hygiene Inspections.

[3–5]. The methods used in these previous studies have been devised specifically for the purposes of the investigation. In contrast, the work reported here employed standard methods introduced by the UK government in order to achieve consistent assessments nationwide.

The main aim of this investigation was to establish the relationship between the microbiological quality of food and the inspection rating given to food retail premises. The association between each of the six individual components of the rating and the microbiological quality of food was also considered.

METHODS

Premises studied

Ten food retail premises were investigated. Two of the premises belonged to national supermarket chains. The remaining eight were small to medium sized delicatessens with five employees on average.

Inspection

One EHO inspected all the premises included in the study to ensure consistency in approach. The inspection was carried out in accordance with CP9 using the standard risk assessment form (Fig. 1). This form is divided into three sections each dealing with a different aspect of risk.

Section 1. Potential Hazard

Three sources of potential hazard are specified in Section 1: (*a*) type of food; (*b*) method of processing; (*c*) consumers at risk. Each component would generate a high score where the potential risk was judged to be great. Some food types and processing methods present a greater risk of becoming sources of infection than others. Also certain groups of consumers e.g. the old, the young and the immunocompromised, have a higher chance of suffering from the effects of foodborne disease.

Section 2. Compliance

This section includes: (*a*) food hygiene and safety compliance (*b*) structural compliance. Food hygiene and safety compliance includes food handling practices, procedures and temperature control. Structural compliance includes cleanliness, lighting, ventilation and design and construction of a premises.

Section 3. Confidence in management/control systems

This section deals with the likelihood of a premises maintaining satisfactory standards of compliance with the law. It takes into account the history of a premises, attitude of the management and technical knowledge of the risks involved in food processing and retailing. A high score would be given where there was no confidence in the management control.

Food sampling

Samples (25 g) of cooked turkey and cooked ham sliced on the premises were taken for microbiological analysis. These foods were chosen since they were retained at all of the premises inspected and are food types which have been used

in previous studies [4, 5]. Food sampling was carried out on three occasions, the first being at the time of the inspection. The subsequent two samples were taken within 3 months and prior to the next inspection. Three replicate samples of each meat were taken on each occasion. Samples were transported as soon as possible in a refrigerated container for analysis by the regional Public Health Laboratory. Total viable counts (TVCs) of bacteria at 30 °C and numbers of *Staphylococcus aureus* were determined. All samples were processed by one laboratory using the same procedures for all samples.

RESULTS

Relationship between total inspection ratings and TVCs

Nested ANOVA demonstrated that the effect of sampling time did not affect the outcome of comparisons made between TVCs from different premises. Therefore, no distinction was made between counts obtained at different times in the following analyses. Figure 2 shows that there was no consistent trend in the relationship between TVCs for ham or turkey and inspection ratings. Premises with a low inspection rating, e.g. 55, had associated TVCs ranging from 1×10^1 to $2{\cdot}1 \times 10^8$/g for turkey. Premises with a high rating, e.g. 75, had associated TVCs ranging from $2{\cdot}2 \times 10^4$/g to $1{\cdot}10^6$/g for turkey. The corresponding figures for ham were for 55, TVCs of 1×10^1 to $5{\cdot}2 \times 10^5$/g and for a score of 75, TVCs of $1{\cdot}2 \times 10^3$ to $8{\cdot}6 \times 10^3$/g.

Relationship between individual components of the total inspection rating and TVCs

These data are shown in Table 1.

Component 1a, Type of food and method of handling

Premises visited achieved a rating of 30 or 40 for component 1a. There was no significant difference between TVCs associated with these two scores ($P = 0{\cdot}05$).

Component 1b, Methods of processing

The premises inspected were all retail outlets not involved in processing. Therefore, they were not assigned a score for this component.

Component 1c, Consumers at risk

Premises were assigned a score of five or ten for component 1c. Counts (Table 1) were shown to be significantly higher when associated with a score of ten than with a score of five for turkey. For ham, the situation was reversed ($P < 0{\cdot}05$).

Component 2a, Food hygiene and safety compliance

Premises were given scores of five, ten or 15 for component 2a. The ANOVA showed that there was no significant difference between TVCs for turkey associated with scores of five, ten and 15. There was a significant difference between inspection ratings and counts for ham ($P < 0{\cdot}05$). TVCs for ham did not follow a consistent trend i.e. high counts were associated with a score of ten whereas the low counts were associated with scores of either five or 15.

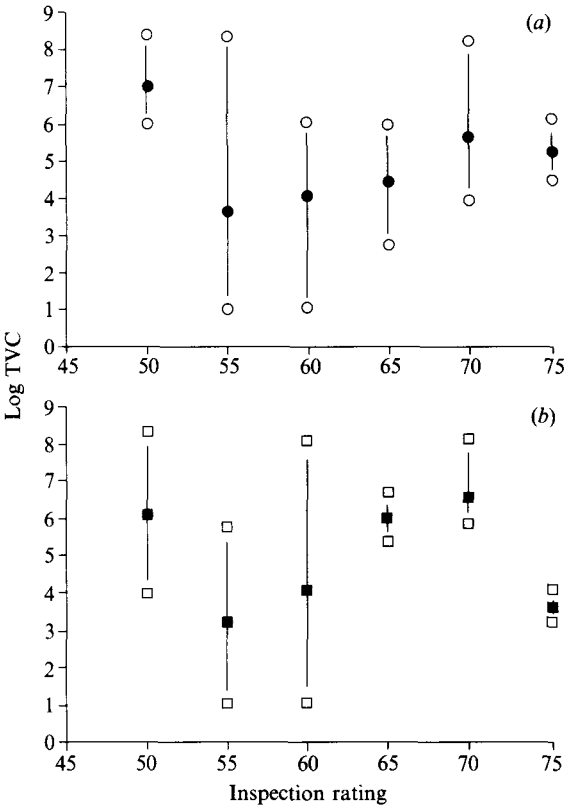

Fig. 2. TVCs of bacteria of (*a*) turkey and (*b*) ham with corresponding visual inspection ratings for premises sampled. Closed symbols indicate mean TVCs, open symbols indicate maximum and minimum TVCs associated with each inspection rating.

Table 1. *Minimum, maximum and mean TVCs of bacteria/g for turkey and ham associated with each component score of the inspection rating*

		Turkey TVCs			Ham TVCs		
Component	Score	Min	Max	Mean	Min	Max	Mean
1a	30	$1{\cdot}0 \pm 10^{2}$*	$2{\cdot}6 \pm 10^{8}$	$3{\cdot}6 \times 10^{4}$	$1{\cdot}0 \times 10^{2}$*	$1{\cdot}9 \times 10^{8}$	$2{\cdot}7 \times 10^{4}$
1a	40	$1{\cdot}0 \times 10^{2}$*	$1{\cdot}4 \times 10^{8}$	$5{\cdot}6 \times 10^{4}$	$1{\cdot}0 \times 10^{2}$*	$9{\cdot}9 \times 10^{7}$	$6{\cdot}6 \times 10^{4}$
1b	0	$1{\cdot}0 \times 10^{2}$*	$2{\cdot}6 \times 10^{8}$	$4{\cdot}1 \times 10^{4}$	$1{\cdot}0 \times 10^{2}$*	$1{\cdot}9 \times 10^{8}$	$3{\cdot}5 \times 10^{4}$
1c	5	$1{\cdot}0 \times 10^{2}$*	$2{\cdot}6 \times 10^{8}$	$3{\cdot}6 \times 10^{4}$	$1{\cdot}0 \times 10^{2}$*	$1{\cdot}9 \times 10^{8}$	$4{\cdot}8 \times 10^{4}$
1c	10	$2{\cdot}2 \times 10^{4}$	$1{\cdot}0 \times 10^{6}$	$1{\cdot}3 \times 10^{5}$	$1{\cdot}1 \times 10^{3}$	$8{\cdot}6 \times 10^{3}$	$2{\cdot}8 \times 10^{3}$
2a	5	$1{\cdot}0 \times 10^{2}$*	$2{\cdot}6 \times 10^{8}$	$1{\cdot}8 \times 10^{4}$	$1{\cdot}0 \times 10^{2}$*	$1{\cdot}9 \times 10^{8}$	$8{\cdot}5 \times 10^{3}$
2a	10	$4{\cdot}9 \times 10^{2}$	$1{\cdot}4 \times 10^{8}$	$1{\cdot}3 \times 10^{5}$	$3{\cdot}3 \times 10^{5}$	$1{\cdot}0 \times 10^{7}$	$1{\cdot}7 \times 10^{6}$
2a	15	$2{\cdot}2 \times 10^{4}$	$1{\cdot}0 \times 10^{6}$	$1{\cdot}3 \times 10^{5}$	$1{\cdot}1 \times 10^{3}$	$8{\cdot}6 \times 10^{3}$	$2{\cdot}8 \times 10^{3}$
2b	5	$1{\cdot}0 \times 10^{2}$*	$2{\cdot}6 \times 10^{8}$	$8{\cdot}0 \times 10^{4}$	$1{\cdot}0 \times 10^{2}$*	$1{\cdot}9 \times 10^{8}$	$3{\cdot}3 \times 10^{4}$
2b	10	$1{\cdot}0 \times 10^{2}$*	$1{\cdot}0 \times 10^{6}$	$9{\cdot}0 \times 10^{3}$	$3{\cdot}0 \times 10^{2}$	$3{\cdot}3 \times 10^{6}$	$1{\cdot}2 \times 10^{4}$
2b	15	$7{\cdot}6 \times 10^{3}$	$2{\cdot}4 \times 10^{6}$	$9{\cdot}5 \times 10^{4}$	$5{\cdot}4 \times 10^{5}$	$4{\cdot}8 \times 10^{6}$	$2{\cdot}8 \times 10^{6}$
3	5	$1{\cdot}0 \times 10^{2}$*	$2{\cdot}6 \times 10^{8}$	$2{\cdot}0 \times 10^{4}$	$1{\cdot}0 \times 10^{2}$*	$1{\cdot}9 \times 10^{8}$	$1{\cdot}8 \times 10^{4}$
3	10	$1{\cdot}0 \times 10^{2}$*	$2{\cdot}1 \times 10^{8}$	$6{\cdot}6 \times 10^{4}$	$1{\cdot}1 \times 10^{2}$*	$1{\cdot}0 \times 10^{8}$	$5{\cdot}8 \times 10^{4}$

* Indicates a TVC of 10^{2} or less.

https://doi.org/10.1017/S0950268800051992 Published online by Cambridge University Press

Component 2b, Structural compliance

Premises were given scores of five, ten or 15 for component 2b. The ANOVA showed that there was a significant difference in counts occurring in conjunction with scores of five, ten and 15 for turkey and ham ($P < 0{\cdot}05$).

In neither case did the counts follow a consistent trend, low counts occurring with a score of 10 for both turkey and ham, five or 15 being associated with higher counts.

Component 3, Confidence in management/control systems

Premises were assigned a score of five or ten for component 3. There was no significant difference between counts associated with a score of five or ten for either turkey or ham ($P = 0{\cdot}05$).

Staphylococcus aureus

Staphylococcus aureus was detected on only one occasion. This occurrence was associated with a TVC of $2{\cdot}6 \times 10^8$/g in turkey and with a total inspection rating of 50.

DISCUSSION

The risk of food infection and the general level of hygiene in each of the premises examined was expressed as a total inspection rating. This rating was generated by application of CP9 in the course of a routine inspection by an EHO. Each rating falls within a category designated in CP9 which determines the frequency of subsequent inspections (Table 2).

A rating of 50 leads to a minimum inspection frequency of once every 18 months. A rating of 75, which implies a greater risk and a lower standard of hygiene, results in an inspection frequency of at least once a year.

The microbiological quality of food sampled from the premises might be expected to reflect these inspection ratings. Such a correlation was not apparent in this investigation. There was no relationship between the total inspection rating for a premises and the microbiological quality of food sampled, as indicated by the TVC (Fig. 2). *Staph. aureus* was isolated only once from the samples taken. There was no correlation between inspection rating or TVCs and isolation of the pathogen. These observations confirm the findings of earlier studies [3–5] which also failed to show a link between visual assessment of hygiene standards and the microbiological quality of foods.

TVCs were used to measure the general bacterial load of the foods sampled. This is comparable to the approach adopted in studies of cleaning standards in food premises [6]. Aerobic plate counts were also employed to assess the microbiological acceptability of ready-to-eat foods, including cooked meats, in provisional guidelines produced by the Public Health Laboratory Service (PHLS) [7]. The occurrence of specific groups e.g. indicators and pathogens, apart from *Staph. aureus*, comprising the bacterial load was not determined. It could however provide useful information in more detailed studies of the broad picture reported here.

The previous studies [3–5] cited each employed experimental procedures

Table 2. *The range of total inspections ratings and the corresponding minimum frequency of inspection*

Points range	Minimum frequency of inspection
91–175	(At least) every 6 months
71–90	(At least) every year
41–70	(At least) every 18 months
31–40	(At least) every 2 years
21–30	(At least) every 3 years
Less than 20	(At least) every 5 years

designed specifically for the investigation. Results reported here are based on procedures for inspection as specified by the UK Government (CP9) and methods adopted by PHLS. They therefore have significance in a national context and are derived from the application of a standard approach.

The total inspection rating comprises six components (Fig. 1) and the possibility that one or more of these components might correlate with TVCs was considered. Analysis of the data showed that there was no consistent trend between scores for any one of the components and TVCs (Table 2).

Neither the total inspection rating for a premises nor any single component of the total showed a direct relationship to the microbiological quality of the food sampled. In the case of component 2a for example, the lowest TVCs from ham samples were associated with a score of 15 i.e. a poor level of compliance with food hygiene and safety. The highest TVCs, which suggest a greater risk, are associated with a score of 10 i.e. a fair level of compliance. The score of 5, i.e. a good level of compliance, resulted in TVCs intermediate between those of 10 and 15. Thus the counts do not conform to the pattern anticipated by the scheme.

The effect of some components was reinforced or counteracted by others. There was for example, positive correlation between consumers at risk (1c) and food hygiene and safety compliance (2a) suggesting that the two might have a similar impact on overall risk. These two factors are however entirely independent of one another. The rating given to consumers at risk is dependent upon the numbers and types of consumers whereas the rating given for food hygiene and safety compliance depends upon the extent to which a premises can maintain compliance in the future. The numbers and types of consumers would not be expected to have the same impact on risk and therefore on the total inspection rating as the hygiene and safety compliance.

There was a positive correlation between 2a food hygiene and safety compliance and 2b, structural compliance. This is to be expected because both 2a and 2b involve compliance with legislation. In the case of 2a in the hygiene and safety standards adopted and in 2b in the general structural condition of the premises.

A positive correlation also existed between 2a food hygiene and safety compliance and 3 confidence in management. This arose because component 3 assesses the effectiveness of management control which would in turn have a direct bearing on 2a compliance with hygiene and safety requirements.

The only negative correlation was between 1a potential hazard and 2b structural compliance. These two components counteracted one another in

https://doi.org/10.1017/S0950268800051992 Published online by Cambridge University Press

determining the total score. The former would be expected to indicate a greater level of risk than the latter although both should influence the total rating in the same way.

There were no other correlations between sets of components. These results call into question the ability of the visual inspection scheme specified in CP9 to assess the potential risk of foodborne infection. The scheme was originally designed to assess risk and to ensure that more frequent inspections took place in premises of higher risk.

The UK Government recognized shortcomings in the scheme and have made amendments to CP9 due to be implimented in 1995. The amendments relate to the guidance given to the inspector but do not change the scoring system. Despite the fact that the Department of Health consider the modified version to be a frequency inspection rating scheme it is still based on an evaluation of potential risk (CP9, Annex A) [2].

The current scheme aims to satisfy the EC Directive on the Control of Foodstuffs [1] which requires EU Member States to develop a programme of regular inspections for food handling premises. The implication is that these inspections should assess risk to the consumer. To be effective in this context, inspections should focus upon factors most likely to be responsible for foodborne infection. These factors are poor time/temperature control and cross contamination [8, 9]. The conclusion is further supported by recent work in the field of predictive modelling. Storage temperatures were found to be one of the principal factors responsible for the ultimate microbiological condition of cooked meats [10].

The inclusion of these criteria as appropriately weighted components of the total inspection rating may provide a better reflection of risk.

ACKNOWLEDGEMENTS

We gratefully acknowledge the help of the Department of Environmental Health, Oldham Metropolitan Borough Council, in particular Mrs C. Brown and Mrs V. Johnson, and Dr A. Fielding, The Manchester Metropolitan University for advice on statistical analysis.

REFERENCES

1. EEC 89/397. Official Control of Foodstuffs.
2. Food Safety Act 1990, Code of Practice No. 9: Food Hygiene Inspections. London: HMSO, 1991.
3. Tebbutt GM, Southwell JM. Comparative study of visual inspections and microbiological sampling in premises manufacturing and selling high-risk foods. Epidemiol Infect 1989, **103**: 475–86.
4. Wyatt CJ, Guy V. Relationship of microbial quality of retail meat samples and sanitary conditions. J Food Protect 1980; **43**: 385–9.
5. Bassett WH, Kurtz JB, Moore B. The hygienic significance of bacterial counts on sliced cooked meats. Environ Health 1978; **86**: 100–3.
6. Tebbutt GM, Midwood CA. Rapid and traditional methods of assessing cleaning standards in food premises. Environ Health 1990; **98**: 235–7.
7. Gilbert RJ. Provisional microbiological guidelines for some ready-to-eat foods sampled at point of sale: notes for PHLS examiners. PHLS Microbiology Digest 1992; **9**: 98–9.

8. Roberts D. Factors contributing to outbreaks of foodborne infection and intoxication in England and Wales 1970–1982. Proc 2nd World Congress Foodborne Infections and Intoxications 1986; **1**: 157–9.
9. Johnston M, Arthur J, Campbell I. Foodhandling practices of Dunedin caterers: a cause for concern. New Zealand Med J 1992; **105**: 289–91.
10. Sutherland JP, Bayliss AJ, Roberts TA. Predictive modelling of growth of *Staphylococcus aureus*: the effects of temperature, pH and sodium chloride. International J Food Microbiol *1994*; ***21***: *217–36*.

https://doi.org/10.1017/S0950268800051992 Published online by Cambridge University Press