

**ADVISORY COMMITTEE ON THE MICROBIOLOGICAL SAFETY OF FOOD**

**SUMMARY OF RESULTS FROM FSA-FUNDED RESEARCH  
SUB-PROGRAMME ON EGGS (B15)**

1. Members will recall that both the first and second Advisory Committee on the Microbiological Safety of Food reports on 'Salmonella in Eggs' made recommendations for further research to improve the understanding of the sources of *Salmonella* Enteritidis and possible routes of infection for human disease.
2. The attached paper reports on a Food Standards Agency-funded research programme on eggs that was shaped by the deliberations of the ACMSF Working Group.
3. The purpose of this paper is to seek the Committee's views on the findings of this research programme and their recommendations regarding the need for further work in this area.
4. This paper will be presented by Dr Andrea Belcher, FSA Programme Manager for the Eggs programme.

**Secretariat**

**March 2004**

## **SUMMARY OF RESULTS FROM A FSA-FUNDED RESEARCH PROGRAMME ON EGGS**

### **Background**

1. In 1993 and 2001 the Advisory Committee on the Microbiological Safety of Food (ACMSF) produced reports on 'Salmonella in Eggs' which offered recommendations for further research and surveillance as well offering specific guidance for caterers and consumers.
2. In 1999, the Joint Food Safety and Standards Group (the predecessor of the FSA) advertised for a programme of research focused on eggs. As a result of that call the FSA has funded a programme of four projects that address several of the recommendations from the 1993 ACMSF Report on Salmonella in Eggs.
3. The programme began in 2000 and is being concluded at present with plans to formally review the programme later this year.
4. Annex A provides a list of the details of the 4 projects. The remaining annexes contain abstracts of the four projects. The full scientific reports can be made available if members would like to see any, or all, of them.

### **Project B03015 - A study to examine the egg-to-egg variations in the growth of *Salmonella* spp. in egg contents**

5. It is generally assumed that even at ambient temperatures (20-C to 25-C) the growth of *Salmonella* Enteritidis in eggs will be minimal over a period of 3 to 4 weeks. After this time there is the possibility of very rapid growth as the internal defence mechanisms of the eggs are broken down.
6. Although most research tends to support this delay of growth, there was some evidence to suggest that such a delay may not occur with all eggs. In experiments using eggs artificially contaminated with *S. Enteritidis*, rapid growth after only a few days had been observed in a small proportion of the eggs.

7. This project was commissioned to investigate whether this rapid growth is 'real' (i.e. it occurs in naturally contaminated eggs) or if it is an artefact of the methodology used to artificially contaminate eggs.
8. A principal objective of the study was to try and correlate the growth of *Salmonella* in egg contents with critical elements of egg chemistry and biochemistry. To this end a range of measurements were undertaken on egg contents, principally on egg albumen including: measurement of iron, ovotransferrin and glucose in albumen, pH, albumen quality and yolk size.
9. Additionally, the study investigated defined, isogenic and naturally occurring mutants of *S. Enteritidis* and *S. Typhimurium* to determine the bacterial factors important in the growth/survival of *Salmonella* in egg contents. The effects of bird age in commercial caged layer flocks on the ability of shell eggs to support/control the growth of *Salmonella* was also examined.
10. In summary the results of this project showed that:
  - high levels of free glucose in the albumen and a high level of saturation of ovotransferrin with iron were linked to rapid multiplication of *Salmonella*
  - eggs from older hens, known to have weaker yolk membranes, were significantly more likely to support high levels of bacterial multiplication than those from hens at the beginning or in the middle of their laying period
  - flagella of *Salmonella* Enteritidis were found to be necessary to move towards the yolk
  - SEF17 fimbriae aided yolk invasion.
11. An abstract of the project is appended (Annex B).

**B03016 - Cross contamination from the external surface of eggs in relation to risk of exposure to Salmonella**

12. It is likely that with the vast majority of contaminated eggs the organism is on, rather than in, the egg. Although there is an obvious cross-contamination risk from this external

contamination, there was limited information available to allow an assessment of this risk to be made.

13. This project aimed to consider the survival behaviour of *Salmonella* strains on the surface of the egg and the extent to which transfer from the egg shell occurs during handling and food preparation. These factors were investigated by determining the survival of *Salmonella* at different temperatures and relative humidities and the extent of transfer to hands, into egg contents on breaking and onto food preparation and egg storage surfaces.

14. The possibility that *Salmonella* enter a putative “viable non-recoverable” state during survival on eggs was also investigated.

15. The findings from this project showed that:

- survival studies based on viable counts gave variable results but the numbers of organisms that survived on the surface of eggshells declined over time. However, it was never possible to say that *Salmonella* was not present.
- while it was possible that a small number of cells entered a viable non-recoverable state this was not the general pattern of behaviour.
- transfer rates from eggshells to hands, surfaces and into egg contents on breaking were relatively high in all cases. Transfer to gloved hands was in the order of 90 to 100% under moist conditions.

16. An abstract of the project is appended (Annex C).

### **B03017 - A review of commercial egg washing with particular emphasis on the control of salmonella**

17. Egg washing is an established method of cleaning eggs but, at the time of undertaking this research it was only permitted for Class B and C eggs in the UK, under the Egg (Marketing Standards) Regulations 1995.

18. A Government review in 1996 suggested that the egg washing systems available at the time required a number of technical improvements to ensure that the process could be

carried out properly. This research was commissioned to determine what (if any) improvements had been made since the last report and to assess the ability of egg washing to reduce the level of *Salmonella* present on the shell.

19. The objectives of the project were:

- to assess the current state of knowledge about the effectiveness of egg washing, by reviewing the published scientific, technical and government literature
- to evaluate, from a technical and economic viewpoint, the practices used in other countries where egg washing is allowed and to assess the applicability of these practices to the UK industry
- to quantify the extent of *Salmonella* contamination within the egg and on egg shells as a result of egg washing including microscopic examination to assess any structural damage.

20. The results have provided a comprehensive review of egg washing and a blueprint for effective egg washing was developed on the basis of the review and industry practices. The project demonstrated that egg washing using spray jets can be a safe practice from a microbiological point of view as long as it is undertaken under optimum conditions. However, if bad practices or equipment failure allow wash conditions to change to less than ideal (especially too low a water temperature), then washing can give rise to contamination of the egg contents by *Salmonella* from the egg shell surface. Strict controls on all procedures and operators would need to be in place to ensure that food safety was not compromised by the practice of egg washing.

21. In July 2003, prior to its external evaluation, the final report of this project was provided to the European Commission on a confidential basis. The Commission requested the report to assist the deliberations of a small group who were preparing a report to address a request from the Council to examine egg consumption trends and the questions of egg hygiene, washing and marking to identify producer and production method. The Commission report concluded that washing of table eggs under strict surveillance should be authorised for a transitional period of three years for packing establishments, which on 1 June 2003 had been approved to this end. The report also recommended that the

European Food Safety Authority should prepare a comprehensive scientific report on washing of table eggs by 31 December 2005.

22. An abstract of the project is appended (Annex D).

**B03018 - Pilot study to estimate the nature and extent of adherence to government guidance on safe egg use in the catering industry**

23. This project has been presented to the Committee previously. This short pilot study was completed in 2001 and the project leader, Prof. Taylor, presented a report to the Committee at its meeting on the 18 October 2001.

24. This project was commissioned to obtain preliminary data concerning the nature and extent of adherence to Government guidelines on the safe use of eggs in catering. It was designed to overcome some of the methodological difficulties of research in the catering industry by identifying clearly the sectors to be investigated, taking a representative sample within each sector and using an investigative case study approach to data collection.

25. The results fall broadly into three categories:

- Methodological issues raised by the pilot study
- The level of knowledge of, and adherence to, the advice
- Related issues that were raised as a result of questions and observations during the visits

26. The results showed there was little awareness of food safety risks associated with eggs within the 100 premises investigated. More importantly, in terms of practice, the results indicated that recommended good practice is not widespread with evidence for concern in all four sectors. In particular, nursing homes did not appear to be better informed or use better practices than the other sectors investigated, despite the 'vulnerable' nature of the client group.

27. An abstract of the project is appended (Annex E).

28. ACMSF's views when this project was presented previously were that :

- Members had no major criticisms of the methodology
- Members felt that repeating this study in other parts of the country was not likely to provide different results and that scientifically there was no justification for doing this. However, it was acknowledged that repeating the work in other areas might demonstrate that it is not a localised problem in the pilot area but is more widespread and needs attention
- Members felt that each of the sectors was of concern (rather than any one being of particular concern)
- Members felt that the existing advice was still relevant but recommended that more use should be made of celebrity chefs and the television media to deliver hygiene messages such as how to handle and cook eggs safely

## **Action**

29. Members are asked:

- for their views on the findings of the various projects
- to advise on the extent to which the projects have answered the questions they set out to address and whether any further work should be done in this area
- to advise on the implications of the research findings on the risks to the public posed by eggs.

Microbiological Safety Division

March 2004

## Summary of Egg Programme

| Project Number | Project Title  | Contractor   | Duration  | End Date     | Cost            |
|----------------|--|--|-----------|--------------|-----------------|
| B03015         | A study to examine the egg-to-egg variations in the growth of Salmonella spp. in egg contents                              | Professor Tom Humphrey<br>Health Protection Agency (formerly Public Health Laboratory Service)                       | 20 months | April 2003   | £111,324        |
| B03016         | Cross contamination from the external surface of eggs in relation to risk of exposure to Salmonella                        | Dr Jane Sutherland<br>London Metropolitan University (formerly University of North London)                           | 40 months | January 2004 | £116,956        |
| B03017         | A review of commercial egg washing with particular emphasis on the control of salmonella                                   | Dr Tony Moore<br>Direct Laboratory Services Ltd (formerly ADAS Laboratories Ltd) & the Scottish Agricultural College | 27 months | January 2003 | £200,070        |
| B03018         | Pilot study to estimate the nature and extent of adherence to government guidance on safe egg use in the catering industry | Professor Eunice Taylor<br>University of Salford   | 10 months | July 2001    | £27,538         |
|                |  |  |           |              | <b>£455,888</b> |



## **B03015 - A study to examine the egg-to-egg variations in the growth of *Salmonella* spp. in egg contents**

### **Abstract**

#### **Background and Objectives**

The aim of this study was to identify the factors that allow *Salmonella* Enteritidis to survive and multiply within the egg and to compare these to other serovars of *Salmonella*. As well as helping to explain the success of *S. Enteritidis*, this would allow an assessment of the risk posed by other *Salmonella* serovars to be made. Identification of factors within the egg that promote or restrict bacterial growth could allow the selection of hens laying naturally 'safer' eggs.

#### **Approach**

A number of physical and chemical factors within eggs laid by two flocks of hens were examined to see how these changed during the laying life of the flock and how they varied between individual hens. The relationship of these factors with the multiplication of *Salmonella* within the egg was also investigated.

#### **Key Results**

*Salmonella* Enteritidis was found to have a number of abilities that allow survival in the albumen and movement into the yolk of the egg allowing growth to a high level, frequently greater than one billion bacteria per egg. Firstly, it was able to survive well in the albumen at hen body temperature. Other strains of *Salmonella* tested did not have this ability. It could also use the glucose present in fresh eggs as an energy source and to make the albumen less alkaline, and so more suitable for bacterial growth.

High levels of free glucose in the albumen and a high level of saturation of ovotransferrin (the principal iron-binding protein of the albumen) with iron were found to be linked to rapid multiplication of *Salmonella*. The level of saturation varied significantly between individual hens, raising the possibility of selecting laying hens to lay eggs that naturally minimise

bacterial growth. The composition of the albumen is known to vary between breeds of hen, and this is an area that merits further investigation.

Although it was not directly investigated during this work, results indicate that it is probable that there is also a link between the porosity of the yolk membrane to iron and bacterial growth. Eggs from older hens, known to have weaker yolk membranes, were also significantly more likely to support high levels of bacterial multiplication than those from hens at the beginning and in the middle of their laying period.

The role of bacterial surface structures such as fimbriae and flagella in multiplication within the egg was examined, as was the role of lipopolysaccharide in survival in the albumen. *Salmonella* Enteritidis was found to have a number of attributes that allowed it to invade the yolk and multiply rapidly within the egg. It was able to survive in albumen at hen body temperature. Work on surface structures found that flagella were necessary to move towards the yolk and SEF17, or curli fimbriae, aided yolk invasion. Some isolates were able to express these during log phase growth and had an advantage in yolk invasion.

### **Significance**

The combination of certain surface structures and the ability to survive in the albumen shown by *S. Enteritidis* is not shared by other *Salmonella* serovars that have been widespread in poultry in the past, such as serovars Gallinarum, Pullorum and Typhimurium.

Now that the factors which allow the rapid growth in eggs of *S. Enteritidis* are understood it should be possible to assess other serovars for their growth potential in eggs.

## **Annex C**

### **B03016 - Cross contamination from the external surface of eggs in relation to risk of exposure to Salmonella**

#### **Abstract**

##### **Background and Objectives**

In the absence of adequate cooking, there is an obvious and high risk of infection with *Salmonella* in the event of internal contamination. The presence of *Salmonella* on the surface of the shell presents a different problem of control. Although Salmonellas present on the eggshell will not survive any but the most perfunctory cooking, the exterior of the egg is unlikely to be recognised by consumers as requiring precautions to be taken in handling. Consumers who would wash their hands after handling raw chicken, for example, are much less likely to do so after handling eggs. Similarly, the risk of cross-contamination via contact surfaces, such as workbenches is much less likely to be recognised with eggs than with chickens and other raw meat. It can be argued that the risk of contamination of the food-handling environment from contaminated eggshells is greater than that from contaminated contents. Salmonellas present on the surface of eggs may also be transferred to the contents on breaking, although numbers are likely to be small and there is a generally held presumption that risk of human infection by this route is low. There is, however, a lack of data concerning this and other aspects of the transfer of *Salmonella* from the surface of eggshells. At the same time, data concerning the fundamental issue of survival of *Salmonella* on eggshells, or on contact surfaces, is limited and difficult to interpret due to high variability. Cells may, for example, enter a state (viable non-recoverable) in which they are alive but unable to develop on commonly used laboratory media.

The current project has, therefore, been undertaken to provide the Food Standards Agency with the data and interpretation required for the risk posed by eggshell contamination with *Salmonella* to be analysed in the context of risk to the consumer. This comprises the fundamental question of the survival ability of *Salmonella* on eggshells in conjunction with studies of the extent to which transfer from the shells occurs. It was not practical to

investigate all aspects of transfer and effort was concentrated on key areas. These were predetermined as transfer into the contents of the egg on breaking, transfer to hands during simulated culinary manipulations and transfer onto three types of simulated food contact materials. The long-term risk associated with accumulation of *Salmonella* when storage containers are subject to continued use was also investigated.

### **Approach**

It is a prerequisite for risk that cells of *Salmonella* have the ability to survive on the eggshell during the distribution and storage process between contamination and consumption. The incidence of natural contamination is too low for meaningful survival studies to be made and inoculation, with known risk of introducing artefacts, was necessary. Following preliminary experiments to determine the validity of methods, survival was determined by inoculating eggs with a “cocktail” of four strains of *S. enteritidis* PT4 and one strain of *S. typhimurium*. Inoculated eggs were stored for periods ranging from 21 days to 40 days at temperatures of 4°, 10° and 20°C and relative humidities of 80 and 90%. Survival was determined by standard counting methods. The possibility that Salmonellas were entering a viable non-recoverable state during survival was also investigated.

### **Key Results**

The outcome of survival experiments, based on viable counts, showed a high level of variability. Extensive statistical analysis was made by Dr Peter Cripps, Consultant Statistician of the University of Liverpool Veterinary School. The summarised conclusion of this work was that, while numbers tended to decline overall with storage, it is never possible to state that *Salmonella* will not be present. The outcome of statistical analysis was supported by quantitative risk analysis based on the Monte Carlo technique. The outcome confirmed that based on the prevalence of *Salmonella* across the whole of egg production, risk of exposure is very low. There is, however, likely to be a finite risk associated with contamination of eggs at particular farms. Simulations showed that in most cases, exposure would involve numbers of *Salmonella* unlikely to cause symptomatic infection in healthy persons. In a domestic situation, however, susceptible persons, including those at the extremes of age and pregnant women are also potentially liable to exposure

Investigation of the possibility that cells were entering a viable non-recoverable state required overcoming significant technical difficulties. It was possible to conclude, however, that entry into the viable non-recoverable state is not the general pattern of behaviour and that the cultural methods used provided a true measure of the numbers of viable bacteria present.

Studies concerning transfer of *Salmonella* from the eggshell, into egg contents on breaking, to gloved hands and onto simulated work surfaces demonstrated the potential for contamination of foods by a number of possible routes. In all cases, transfer rates were relatively high, with transfer to gloved hands being in the order of 90 to 100% under moist conditions. Transfer into the egg contents on breaking and onto simulated work surfaces was also high, although rates were generally lower than onto gloved hands.

### **Significance**

Dr Cripps' overall conclusion concerning survival – that it is not possible at any time to state unequivocally that death of *Salmonella* has occurred, is seen as being of major relevance to the overall problem. Subsequent work showed that transfer of Salmonellas from the surface of an egg into its contents, or to the kitchen environment, occurs at a relatively high level. On the basis of these findings, it is possible to conclude that if an egg is contaminated with *Salmonella*, it presents a finite risk to consumers. Reduction of risk primarily involves procedures at the farm, to further reduce the prevalence of contamination. Eggs contaminated with *Salmonella* are still, however, in the food chain and precautions are required during all stages after leaving the farm. In the kitchen control can be attained through ensuring adequate cooking and prevention of cross-contamination and it is recognised that good kitchen practice can provide adequate protection from infection. Problems are likely to arise, however, where there is failure to recognise the risks arising from the possible presence of *Salmonella*. An information programme is required to ensure that persons handling eggs in either commercial catering or domestic situations are aware of the nature of the risk and of specific precautions that should be taken. Careful planning and management of the information programme will be required, however, to avoid alarmism.

## **Annex D**

### **B03017 - A review of commercial egg washing with particular emphasis on the control of salmonella**

## **Abstract**

### **Background and Objectives**

Although permitted under current European Union legislation for all but Grade A eggs, the washing of table eggs is not widely practised in the European Union. This is in contrast to countries such as the United States of America and Japan, who routinely wash all eggs to remove glaze (yolk or albumen) and faecal materials prior to sale. An advantage of not permitting Grade A egg washing in the EU is that Grade A eggs have to be produced under stringent conditions of high cleanliness. Furthermore, in EU countries, soiled eggs are downgraded to class B rather than being washed and offered for sale as premium grade.

Previous work done in the 1980s and 1960s in Britain using the washing machines and technologies available at the time showed that, if not performed properly, egg washing was not particularly effective at removing shellborne microorganisms and could lower shelf life by allowing spoilage organisms into the egg contents. The objective of this project was to determine whether egg washing using modern systems is effective for removing shellborne *Salmonella* by studying the practices undertaken in other countries, reviewing the scientific literature and by performing experiments under laboratory conditions.

### **Approach**

In order to provide the Food Standards Agency with updated information on current egg washing technologies and determine any potential foodborne health implications associated with the practice, the project was broken down into several tasks which are summarised below:

### Task 1: Extensive review of all pertinent information

An extensive review was prepared by collating and summarising commonly-encountered egg washing problems (and solutions). In addition, commercial egg washing systems in the USA and Japan were viewed first-hand and government legislation and guidelines from overseas countries (USA, Japan, Australia and New Zealand) were obtained. All of this information, along with relevant scientific publications were used to prepare an egg washing “blueprint”. This blueprint detailed how best to undertake egg washing to ensure maximum effectiveness in terms of removing shellborne microbiological contamination and also considered the risks of recontamination through ineffective post washing practices.

### Task 2: A practical assessment of the blueprint performance for large-throughput washing machines

A commercial-sized egg washing machine was borrowed from a British Manufacturer for the practical stages of the project. A small laying flock of approximately 100 birds was housed in battery cages as a model for commercial conditions.

Contaminated eggs were washed using the ideal conditions described by the blueprint and also under non-optimal conditions (e.g. low wash water temperature, not enough or too much detergent, improper drying of eggs) which mimicked the likely effects of component (e.g. water heating elements, detergent introduction pumps etc) failure. Changes to the level of Salmonella on the shell surface and egg contents were determined by microbiological analyses.

### Task 3: Assessment of risks associated with small-scale “bucket-style” washing machines

A finding of this project was that small-scale bucket washers designed for low-throughput, on-farm, cleaning are used on British farms. This style of washing machine was also assessed for the risks they pose to contents contamination when used as egg sanitisers.

## **Key Results**

Spray washing: All experiments were designed to mimic a worst risk case and thus used eggs that were contaminated with high levels of *Salmonella enteritidis* PT4 or *S. typhimurium*

DT104. Washing of contaminated eggs under best practice conditions (pre wash and wash water temperature 44°C, rinse water temperature 48°C, wash agent concentration 3g Chlorwash l<sup>-1</sup>, prewash head pressure:138 kPa, wash and rinse head pressures 262 kPa, belt speed 111 cm min<sup>-1</sup>, and warm air [42°C] drying for 2 minutes), lowered the Salmonella counts from the shell surface by between 5 and 6 logs. Salmonella were not isolated from the contents of any egg washed by this best practice protocol leading to the conclusion that egg washing, when properly controlled does not cause Salmonella to enter the egg contents. However, contamination did arise if strict control was not maintained over the wash and rinse water temperatures. Both *S. enteritidis* and *S. typhimurium* were shown to enter the egg contents when water temperatures were lowered indicating that strict temperature control must be maintained in order to prevent the ingress of Salmonella into egg contents. Other washing machine parameters that were investigated included washing-chemical additive concentration, wash jet pressure, belt speed and the effect of air drying of shell surfaces. These parameters along with the age of the birds that laid the eggs, did not affect Salmonella entry to the egg contents but influenced shell surface kill levels to varying degrees. The most important factor for lowering Salmonella levels from the shell surface was that a temperature of >40°C was maintained in the wash and rinse waters.

Bucket washing: The small-scale farm bucket washer was also effective at washing eggs and reducing bacterial levels under ideal conditions. However a problem observed with this type of washer is that the water can become very dirty after a few batches of eggs have been washed. The number of bacteria recovered from the surface of particularly the 'nest clean' eggs washed in contaminated water was positively correlated to the number of organisms in the wash water. However, washing eggs in water contaminated with relatively high numbers of bacteria (e.g. 1x10<sup>7</sup>ml<sup>-1</sup>) did not cause a significant increase in the number of bacteria recovered from the egg contents.

Both spray washing and bucket washing caused damage to the surface of the eggshells. Visualisation of washed shell surfaces by electron microscopy revealed that spray jet washing caused pitting damage to the egg cuticle. During the bucket washing experiments washing tended to cause a reduction in the thickness of the cuticle and in particular caused the number of pores exposed to increase. Cuticle damage makes it more likely that



subsequent wetting of the shell surface would result in transfer of bacteria to the egg contents.

### **Significance**

This project has demonstrated that egg washing is a safe practice from a microbiological point of view **as long as it is undertaken under optimum conditions**. However, if bad practices or equipment failure allow wash conditions to change to less than ideal (especially too low a water temperature), then washing can give rise to contamination of the egg contents by Salmonella. Where washing is undertaken on eggs used for processing, strict controls on all procedures and operators would need to be in place to ensure that food safety was not compromised. The washing blueprint developed in this project provides the basis for a set of best practice guidelines for the legal practice of washing Grade B eggs in the UK.

## **Annex E**

### **B03018 - Pilot study to estimate the nature and extent of adherence to government guidance on safe egg use in the catering industry**

#### **Abstract**

##### **Background and Objectives**

Since the 1980's there has been public, industry and Government concern over the safety of the UK egg supply. This concern led directly to the Chief Medical Officer of Health advising the public that foods containing raw eggs should be avoided and that for vulnerable groups all eggs should be thoroughly cooked. In 1993 the Advisory Committee on the Microbiological Safety of Food (ACMSF) produced a 'Report on Salmonella in Eggs' which offered further, specific guidance and made recommendations for the catering industry. The committee have reviewed this guidance twice in subsequent years and continued to support all five recommendations. These include using eggs within 21 days of lay, storing under refrigeration and increasing the use of pasteurised egg products.

During recent years the UK egg industry has undertaken many initiatives to reduce the possibility of contamination of eggs with *Salmonella* species. In particular, the vaccination programme appears to have led to a dramatic fall in human infections. However, there are still outbreaks of *Salmonellosis*, frequently associated with the catering industry and with eggs often implicated as the source of infection. The recent ACSMF reports continue to warn against 'complacency' and it was against this backdrop that this research was commissioned.

##### **Approach**

The project aimed to obtain preliminary data concerning the nature and extent of adherence to Government guidelines through a pilot study. It was designed to overcome some of the main methodological hurdles to research in the vast and varied 'catering' industry by identifying clearly the sectors to be investigated, taking a representative sample within each sector and using an investigative case study approach to data collection.

## **Key Results**

Twenty-five nursing homes, restaurants, sandwich operations and function caterers were visited over a two-month period. The evidence from on-site interviews, observation and examination of documentation was subsequently analysed and then reviewed by an Advisory Panel. Little awareness of food safety risks associated with eggs was found within the 100 premises investigated. More importantly, in terms of practice, the results indicate that recommended good practice is not widespread with evidence for concern in all four sectors. In particular, nursing homes did not appear to be better informed or use better practices than the other sectors investigated, despite the 'vulnerable' nature of the client group. The findings also identify the failure of Basic Food Hygiene training to address egg safety and the extremely limited uptake of food safety management systems based on HACCP principles.

Some of the headline results with regard to the knowledge and practice of the advice were that:

- only 10% of caterers questioned were fully aware of the advice that eggs should be consumed within 3 weeks of lay but many appeared to practise good stock rotation, although this was difficult to verify
- on average only 28% of those questioned had any knowledge of the guidance that caterers should increase their use of pasteurised egg
- the actual use of pasteurised egg was limited but function caterers showed a significantly higher level of use than the other three sectors
- on average 50% of the caterers questioned reported that they had received government advice on the safe use of eggs
- only 25% claimed any recall of egg safety issues raised during food hygiene training

## **Significance**

This research project established that good practice, in relation to egg safety, was not widespread within the pilot area. It is recommended the study be extended in order to confirm this. The resultant evidence could then be used to inform a concerted action plan within the catering industry as a whole. This is considered essential if the success of initiatives further down the food chain are not to be jeopardised within the 350 catering premises in the UK. Such a study would also provide essential base-line data on HACCP implementation.