

Two outbreaks of *Salmonella enteritidis* phage type 4 infection associated with the consumption of fresh shell-egg products

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SUMMARY

In 1988 there were two outbreaks of infection with *Salmonella enteritidis* phage type 4 in adjacent local authorities. The first affected 18 of 75 helpers and guests who attended a private function. Investigations revealed that home-made vanilla ice-cream containing uncooked eggs was the vehicle of infection and the causative organism was identified at the premises of the egg producer. The second affected 84 of 422 delegates attending a conference dinner, and 12 of 50 hotel staff at risk. A dessert made with lightly-cooked egg yolk and raw egg white was associated with infection, and the epidemic strain was cultured from the shell of an egg and an environmental sample from the producer's farm. It is of interest that one outbreak involved free-range and one battery-produced eggs, and that in one the vehicle was prepared at home and in the other in commercial premises. In neither incident was any deficiency in standards of egg production or catering practice discovered.

INTRODUCTION

Between 1981 and 1988, there was a striking increase, from 392 to 12522, in the number of human isolates of *Salmonella enteritidis* phage type 4 (PT4) identified by the Public Health Laboratory Service (PHLS) Division of Enteric Pathogens (DEP). A similar increase between 1981 and 1988 was observed in the catchment area of PHLS Hull laboratory, the number of isolates increasing from 5 to 326. There was also an increase in the number of reports of outbreaks received by the PHLS Communicable Disease Surveillance Centre (CDSC) which were due to *S. enteritidis* PT4. In 1987, none of six egg-associated outbreaks of salmonellosis formally reported to CDSC was due to *S. enteritidis* PT4. In 1988, however, 19 of 34 egg-associated outbreaks were caused by this organism (PHLS, CDSC provisional unpublished data). This paper describes two egg-associated outbreaks

of *S. enteritidis* PT4 which occurred in the catchment area of PHLS Hull Laboratory.

OUTBREAK 1

Background and methods

In May 1988, CDSC received a report from PHLS Hull laboratory of two cases of infection with *S. enteritidis* in guests who attended a bridge drive on 29 April. The organism was subsequently identified as PT4 by DEP. About 70 people were said to have attended, and various dishes prepared by guests at their homes had been served. Names and addresses of guests and helpers were obtained from the organizers, and six guests were interviewed. On the basis of the interview findings which suggested a link with home-made vanilla ice-cream a cohort study was carried out to identify the probable vehicle of infection. Information on symptoms and food items consumed was collected by a single investigator using a standard questionnaire administered by telephone over a 6-day period. The questionnaire included questions on all foods consumed at the function. A case was defined as anyone who had attended the bridge drive and who either had diarrhoea in the week following the function, or had other gastrointestinal symptoms such as nausea, vomiting or abdominal pain, as well as *S. enteritidis* PT4 isolated from their stools. A case was defined as secondary if they fell ill 24 h after another household member. Secondary cases were excluded from the statistical analysis. Only subjects who were sure they either had, or had not eaten a specific foodstuff were included in the analysis. Faecal specimens were obtained from 53 of 75 guests and helpers.

No foods served at the bridge drive remained for culture except for a very small sample of rum and raisin ice-cream made with raw shell eggs. In addition chicken livers from a packet used to make a pâté served at the function were examined. A visit was made to the household where the implicated foodstuff was prepared and the mode of preparation documented. The premises of the egg producer were inspected and samples of hen faeces, dust, and eggs were cultured.

RESULTS

Sixty-three of the 75 guests were interviewed, all but 8 in a 3-day period. The 8 interviewed later than 3 days after the suspect meal, 3 of whom had been ill, were excluded from analysis as at least 4 had become aware of the hypothesis being tested. Sixteen primary and 2 secondary cases were identified. One affected guest was admitted to hospital. A highly significant association was identified between consumption of vanilla ice-cream and illness (Table 1). The association remained when analysis included the 8 subjects who had been excluded. No other food item was independently associated with illness. *S. enteritidis* PT4 was cultured from 14 of 53 stool samples examined. All 14 samples were from guests who met the clinical case definition. Salmonella was not isolated from the rum and raisin ice-cream. *S. typhimurium* definitive type 204a was isolated from the raw chicken liver.

Eight eggs bought from the farm shop of a battery producer of eggs were used in the preparation of the implicated vanilla ice-cream. All the eggs were clean and

Table 1. Consumption of vanilla ice-cream at Bridge Drive

	Ill	Not ill	Total
Ate vanilla, ice-cream	13	14	27
Did not eat vanilla ice-cream	0	25	25
Total	13	39	52

$P = 0.0002$ Yates corrected chi-squared.
Relative risk is undefined.

Table 2. Consumption of almond parfait at conference dinner

	Ill	Not ill	Total
Ate almond, parfait	59	51	110
Did not eat almond parfait	9	80	89
Total	68	131	199

$P < 1 \times 10^{-8}$ Yates corrected chi-squared.
Relative risk = 5.3 (95% C.I. 2.8–10.1).

intact, and the method of preparation of the ice-cream reported by the preparer to the Environmental Health Officer was hygienic, the eggs being used immediately after being broken out, and spending the minimum possible time at ambient temperature. The ice-cream was frozen immediately after preparation, and remained so until it was served to the guests the following day. *S. enteritidis* PT4 was isolated from 3 of the 4 samples of hen faeces and from 4 out of 7 dust samples at the producer's premises. The organism was not found in 41 eggs obtained from the producer. Two dust samples yielded *S. enteritidis* PT7, and one was negative. About 50000 eggs were produced each day from some 60000 birds. The producer's records were well kept and revealed no increase in the mortality of the birds, nor any decline in laying, or in feed or water consumption. Standards of production and management were good and no deficiencies in husbandry practice, storage, or distribution were noted.

OUTBREAK 2

Background and methods

In July 1988 PHLS Hull laboratory informed CDSC of an outbreak due to *S. enteritidis* PT4 affecting members of a large company who had attended a conference at Hull University. Gastrointestinal illness had also been reported amongst staff at the hotel which provided the conference dinner on 7 July. Preliminary enquiries suggested an association between illness and consumption of almond parfait, one of two desserts at the meal.

Two cohort studies were carried out to test this hypothesis. A standard self-administered postal questionnaire was distributed to delegates which inquired into meals eaten during the conference and food items consumed on 7 July. In addition, 50 questionnaires were issued to hotel staff on duty at the time of the main conference dinner. A case was defined as a delegate or an at-risk member of hotel staff who had diarrhoea, or at least two other gastrointestinal symptoms such as nausea, vomiting or abdominal pain, from the start of the conference until

7 days after it ended. Meal-specific, and food-specific attack rates were calculated. Delegates who were ill were urged to consult their doctors and have faecal specimens examined. Isolates were forwarded from eight laboratories throughout the country to the PHLS, DEP for serotyping and phage typing. Faecal samples were also obtained from relevant hotel staff and cultured by PHLS Hull laboratory. The hotel kitchens were inspected and the means of food preparation reviewed with special attention to the almond parfait and other foods served at the conference dinner. The farm supplying free-range eggs to the hotel was investigated by a veterinary surgeon from a Veterinary Investigation Centre (VIC). Eggs from the hotel, which came from the same batch and the same farm as those used in the almond parfait, were examined by PHLS Hull laboratory. Some almond parfait prepared in the hotel for a subsequent banquet was also tested.

RESULTS

Of 422 questionnaires posted to delegates 376 were returned, and 34 of 50 questionnaires returned by members of the hotel staff. Ninety-six cases were identified; 84 amongst delegates and 12 among hotel staff. Although no-one was admitted to hospital, 42 delegates had to take time off work. Of the meals eaten during the conference, at a number of venues, only dinner at the hotel on the evening of 7 July was significantly associated with illness. There was a highly significant association with illness during the 3 days following this meal and consumption of almond parfait (Table 2). A significant association between illness and consumption of almond parfait was also observed among staff. *S. enteritidis* PT4 was cultured from the stools of 7 of 8 cases from the delegates who submitted specimens. Stool samples from six hotel staff who developed symptoms after the dinner were also positive. No other food was independently associated with illness.

S. enteritidis PT4 was cultured from the shell of one egg from the same farm which supplied the eggs used for the almond parfait. *S. enteritidis* was not cultured from the contents of this egg, or five other eggs from the same source. The organism was isolated by the VIC from one of three litter samples at the producer's farm.

The hotel had modern kitchens in good condition and there was no evidence of poor hygiene. The almond parfait dessert had been prepared individually by breaking 200 eggs and separating yolks and whites by hand into two large containers. The yolks were warmed with other ingredients including sugar, flavourings, brandy, and almonds, before folding in the whipped egg whites. Preparation was said to have taken half an hour. The dessert was put into a freezer immediately after preparation, and was served chilled at the meal. No organism was cultured from the almond parfait prepared for a subsequent banquet. Inspection of the farm revealed that the free-range flock of 200 birds had not shown any unexpected increase in morbidity or mortality, nor any decline in food consumption or egg production. Egg collection, storage, and frequency of distribution were satisfactory, although some eggs from this source were noted to have visibly soiled shells.

DISCUSSION

These two outbreaks in adjacent local authorities in North Humberside took place against a background of increasing reports of *S. enteritidis* PT4 at a local and national level. The hotel outbreak is one of the largest outbreaks of *S. enteritidis* PT4 so far reported in the UK. The epidemiological investigations in both episodes implicated egg dishes as the vehicles of infection and microbiological examination confirmed the epidemic strain in environmental samples from farm premises and from an egg from an implicated producer.

Finding the aetiological agent in environmental samples from both farms supports the strong statistical evidence that dishes containing uncooked egg were the source of infection. However, it is not always possible to determine the source of implicated eggs, and in these circumstances the second outbreak showed the benefit of sampling eggs from the batches associated with illness. The usefulness of both these approaches has been documented in other recent egg-associated outbreaks (1).

The eggs in the two outbreaks came from different types of farms. Those used for the home-made ice-cream came from a local battery flock. The almond parfait was made of free-range eggs from another local producer.

There was a difference in the preparation of the two implicated egg dishes. The ice-cream was made in a domestic kitchen and on a domestic scale whereas the almond parfait was prepared on a commercial scale in a hotel kitchen. There was no evidence of poor kitchen practice in either investigation. In both cases, prompt refrigeration or freezing would have ensured that there was no opportunity for multiplication of organisms to occur between preparation and consumption of the vehicles. Both outbreaks, however, occurred before public warnings and advice were given by the Department of Health and Social Security, which stated that it would be prudent to avoid eating uncooked foods made from raw eggs (2).

The cause of the national increase in the numbers of egg-associated outbreaks of infection with *S. enteritidis* PT4 is the subject of continuing PHLS investigations. Although poor kitchen hygiene may contribute to outbreaks, the increased number of outbreaks in 1988 is believed to reflect the occurrence of egg contamination with this organism. It is most unlikely that there has been a massive change in catering practice in the space of one year, in either commercial, institutional, or domestic kitchens. An explanation for part of the increase in egg-associated infection may be the transmission of the organism to the egg contents before laying (3–5). This may cause illness despite accepted kitchen practice (5).

These two outbreaks provide evidence supporting the view that the present increase in *S. enteritidis* PT4 in the UK is due, at least in part, to the contamination of eggs with this organism.

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