

An outbreak of *Salmonella saint-paul* infection associated with beansprouts

M. O'MAHONY¹, J. COWDEN^{1*}, B. SMYTH¹, D. LYNCH¹, M. HALL²,
B. ROWE², E. L. TEARE³, R. E. TETTMAR³, A. M. RAMPLING⁴,
M. COLES⁴, R. J. GILBERT⁵, E. KINGCOTT⁶ AND C. L. R. BARTLETT¹

¹PHLS Communicable Disease Surveillance Centre, ²PHLS Division of Enteric Pathogens, ³PHLS Chelmsford Laboratory, ⁴PHLS Cambridge Laboratory, ⁵PHLS Food Hygiene Laboratory, ⁶Department of Health and Social Security.

(Accepted 3 October 1989)

SUMMARY

In March 1988, there was an outbreak of infection by a strain of *Salmonella saint-paul* with a distinctive antigenic marker. A total of 143 reports were received between 1 March and 7 June. Preliminary investigations suggested that raw beansprouts were a possible source of infection and a case-control study confirmed the association. *S. saint-paul* of the epidemic type was isolated from samples of beansprouts on retail sale in different cities in the United Kingdom and from mung bean seeds on the premises of the producer who was most strongly associated with cases. In addition, *Salmonella virchow* PT34 was isolated from samples of raw beansprouts and was subsequently associated with seven cases of infection. Four other serotypes of salmonella were also isolated from beansprouts. On 8 April the public were advised to boil beansprouts for 15 seconds before consumption, and the premises of the one producer associated with many cases were closed. As a result of these actions there was a significant decrease in the number of infections with *S. saint-paul*.

INTRODUCTION

Salmonella saint-paul was first isolated in 1940[1] in the United States of America and was a common serotype in the United Kingdom for many years. In recent years the number of reports received by the Public Health Laboratory Service (PHLS) Communicable Disease Surveillance Centre (CDSC) has declined and in 1987 there were 99 reports.

On 10 March 1988, CDSC was informed by a Medical Officer for Environmental Health of a cluster of *S. saint-paul* infections in the Oxford region. On 17 March, the PHLS Division of Enteric Pathogens (DEP) provided details to CDSC of 24 isolates of *S. saint-paul* which had been identified since 1 March. All 24 isolates possessed the additional somatic antigen O5 which was not present in the 10

isolates identified by DEP during January and February 1988. The sudden national increase of reports of isolates with a distinctive antigenic structure suggested that the outbreak was associated with a common source, possibly a single widely distributed food. A preliminary epidemiological investigation was therefore carried out to identify a vehicle of infection.

PRELIMINARY INVESTIGATION

Thirteen cases were interviewed in detail by medical staff from CDSC, using a wide-ranging, but structured, questionnaire. Nine of those interviewed definitely or probably ate beansprouts in the week before the onset of symptoms. No other foods appeared to be linked to illness. Further epidemiological and microbiological investigations were carried out to test the hypothesis that the consumption of beansprouts was associated with infection. These included a case-control study, a descriptive study of further cases and microbiological sampling of suspected food.

METHODS

Epidemiological

Persons were considered to be primary cases of *S. saint-paul* infection if they had had diarrhoea, the organism isolated from their stools, and no other member of the household had had diarrhoea in the 4 weeks before the onset of their symptoms. Cases interviewed in the preliminary study were excluded from the case control study. A control was defined as a person of the same sex as the case and living within one mile radius or, if this was not possible, a person who shared their workplace. Controls were also closely matched for age (Appendix 1). Two controls were nominated by each case. A telephone-administered questionnaire inquiry was undertaken and information was requested on personal and clinical details as well as on foreign travel. A selected food history was obtained on beansprouts, various salad items, meats including poultry, eggs and cheese. The names and addresses of retail outlets where foods had been bought were recorded.

Microbiological and environmental

On 8 April, all directors of PHLS laboratories in England and Wales were requested to obtain samples of beansprouts from local retail outlets. In addition, the premises of three large producer/suppliers of beansprouts in England were inspected. Samples of mung bean seeds, beansprouts and their husks, as well as floor sweepings, sewer and water samples where appropriate, were obtained for microbiological analysis at the PHLS laboratories in Chelmsford, Cambridge, Hereford and Central Middlesex. All samples were examined for salmonellas and most were tested for coliforms and *Escherichia coli*. Mung bean seeds were sampled in batches of 500 g from sacks opened only for sampling purposes.

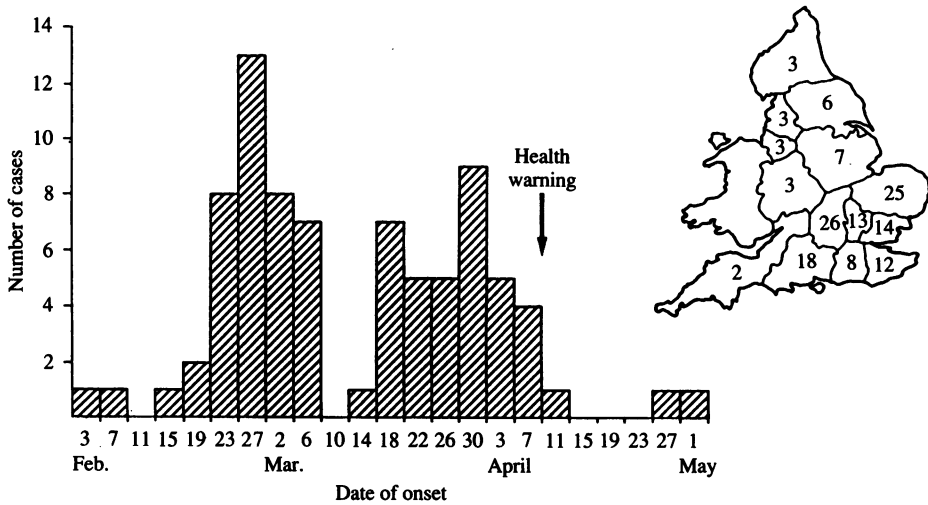


Fig. 1. Beansprouts: *Salmonella saint-paul*. Epidemic curve of 80 primary cases. Inset: 143 laboratory reports. (Prepared by CDSC.)

RESULTS

Epidemiological

Of the 143 cases of *S. saint-paul* confirmed by DEP between 1 March and 7 June, 73 were men, 67 were women, and the sex was not recorded in 3. Seventy-six were between 15 and 44 years of age and 16 were under 5 years. Cases were more common in Southern England. Eighty of 98 people interviewed were primary cases, 17 were secondary cases and 1 was asymptomatic. The dates of onset of the 80 primary cases were between 3 February and 1 May (Fig. 1). Most (95) of the 97 primary and secondary cases interviewed complained of diarrhoea and 32 noted blood in their stools, 85 complained of abdominal pain, 41 of nausea and 33 of vomiting. Eighty reported feverishness and 20 recorded raised temperatures which were between 99° and 104 °F. Reported illnesses lasted between 2 and 42 days, with a median of 10 days. Forty-seven patients had taken a median of 7 days absence from work. Eight patients were admitted to hospital with a median stay of 4 days. Of the 80 primary cases interviewed, 48 reported that they had definitely or probably eaten beansprouts in the week before the onset of symptoms and of these, 42 stated that they had eaten raw beansprouts. The beansprouts consumed came from at least five producers, of whom one was exclusively associated with 15 cases. Fourteen other cases were associated with this producer and others. Six cases were linked to four other producers, and in the remaining seven cases the producer could not be ascertained. None of the six cases who became ill after the health warning on 9 April had eaten raw beansprouts.

In the case-control study, a total of 12 primary cases and 13 controls were interviewed. A significant association was shown between infection and a history of eating raw beansprouts (Table 1). There was no association with eating cooked beansprouts or any of the other specified foods.

Table 1. *Salmonella saint-paul*; food preferences: case control study

	Cases			Controls		
	Ate	Did not eat	Not sure	Ate	Did not eat	Not sure
Food eaten 7 days before onset of symptoms						
Raw beansprouts*	8	3	1	1	11	1
Cooked beansprouts	3	8	1	3	9	1
Food eaten 3 days before onset of symptoms						
Raw beansprouts**	6	5	1	1	11	1
Cooked beansprouts	1	10	1	3	9	1

Food eaten includes those who stated they definitely ate or probably ate beansprouts in the week before onset of symptoms.

* Exact test for 1:M matching for small samples gives $P = 0.02$ 2-tailed test.

** Exact test for 1:M matching for small samples gives $P = 0.04$ 2-tailed test.

Microbiological

On the 11 April, salmonellas were isolated from beansprouts, believed to be from one producer, on retail sale in Hull, Cambridge and Sheffield. Salmonellas were also isolated from beansprouts and environmental samples from the premises of this producer whose product was associated with many of the cases; these were confirmed by DEP as *S. saint-paul* of the epidemic type and *S. virchow* PT34. *S. saint-paul* of the epidemic type and *S. virchow* P34 were also isolated from pigs which had been fed waste material from this producer's premises. On 15 April salmonella, later confirmed as *S. saint-paul* was isolated from beansprouts on retail sale in Manchester. Beansprouts from this producer were not associated with cases. *S. enteritidis* and *S. mbandaka* were also isolated from waste material examined from the premises of this producer. Later, *S. lancing*, *S. litchfield*, and *S. arizona* were isolated from beansprouts at the PHLS laboratories at Leeds, Sheffield and Hull respectively. *S. saint-paul* of the epidemic type and *S. muenchen* were isolated from samples of mung bean seeds from unopened sacks at the premises of the producer associated with many of the cases. These beans had been imported from Australia and the sacks were stored away from the growing areas in an enclosed vermin-free room. In addition, *Escherichia coli* was isolated from 38 of 104 samples of beansprouts obtained by 20 PHLS laboratories from retail outlets in different towns and cities throughout England and Wales.

Environmental

Beansprouts are grown from mung bean seeds which are imported mainly from Australia and Thailand. Production of beansprouts is often continuous with a new batch of seeds being germinated every day. The general principles of beansprouts production are shown in Appendix 2.

Salmonella virchow PT34 infection

Following the isolation of *S. virchow* PT34 from beansprouts, 9 of 13 people reported by DEP to have been infected with this phage type were interviewed. Seven of the 9 were women and 2 were men. They were between 14 and 54 years of age. Eight of the nine were symptomatic and became ill between 3 March and 13 April. Two were admitted to hospital. All eight had eaten beansprouts but one case had eaten cooked beansprouts as part of a stir-fry dish. Four cases had beansprouts supplied by one producer associated with many of the cases of *S. saint-paul*. One case became ill 24 h after eating beansprouts from a packet from the same producer, *S. virchow* PT34 being subsequently isolated from the remaining beansprouts in the same packet.

Controls measures

On April 1988, the Department of Health and Social Security advised the public to boil beansprouts for 15 seconds before consumption and on 11 April, following the isolation of salmonellas from the beansprouts of one producer whose beansprouts were associated with many cases, a decision was taken to withdraw their product from the market until further notice.

DISCUSSION

The outbreak described was detected through surveillance of routine reports from public health authorities. The epidemiological investigation indicated that *S. saint-paul* infection was associated with the consumption of raw beansprouts from several producers. The microbiological results confirmed that beansprouts from two producers were contaminated with the epidemic serotype. In addition, *S. saint-paul* of the epidemic type was isolated from samples taken from several unopened sacks of mung bean seeds. This batch of mung bean seeds had been stored in a warehouse following importation in 1987.

In the spring of 1988, a large outbreak of salmonellosis occurred in Sweden and was associated with the consumption of beansprouts. The epidemic strain was *S. saint-paul* with the same distinctive antigenic marker as in England although some cases were infected with *S. havana* and *S. muenchen*. This information strongly suggested that the bean seeds were the source of contamination. The findings reported imply that imported seeds were contaminated with *S. saint-paul* and that the growing methods did not always remove the organism. Although *S. havana* and *S. muenchen* were isolated from beansprouts in Sweden, *S. saint-paul* was not cultured from any samples.

The investigations in the UK also suggested that infection with *S. virchow* PT34 was associated with eating beansprouts and although *S. virchow* PT34 was not isolated from mung bean seeds, the isolation of a variety of salmonellas from the environment at two producers' factories suggests potential deficiencies in beansprout production.

As a result of the early recognition and investigation of this outbreak, it was possible to issue a prompt health warning to the public, stop production at the

premises of the one producer associated with many of the cases, and halt the epidemic.

Beansprouts have become popular in recent years and are widely available in supermarkets and greengrocers. They are frequently consumed raw in salads and sandwiches or lightly cooked as in a stir-fry dish. The potential for beansprouts to be a vehicle of infection has been recognized for several years [2]. Although beansprouts were the source of two outbreaks of *Bacillus cereus* food poisoning [3, 4] and another outbreak of gastrointestinal illness [4] we believe this is the first outbreak of salmonellosis associated with the vegetable.

Pathogens may contaminate beansprouts from the bean seeds, from water used during growth, and from unhygienic handling practices. [5] In the present outbreak, the vehicle of infection was contaminated beansprouts and the source of infection contaminated mung bean seeds. The degree of contamination was reflected in the frequent finding of *E. coli* on routine sampling of beansprouts. *E. coli* has been isolated from beansprouts in the past but its significance was uncertain in the absence of any associated disease (Dr C. E. D. Taylor, personal communication). It was possible for unsatisfactory growing processes to occur as the premises of beansprout producers are classified as agricultural and therefore do not have to meet the standards for premises which produce other foods. Furthermore, mung bean seeds intended only for horticultural purposes are not classified as a food and are therefore not subject to import controls.

There was a sudden decline in the number of cases who became ill after the 9 April. The decrease may have been due to the closure of the firm associated with most of the cases as well as the advice given to the general public.

As in previous salmonella outbreaks, low levels of the organism were present in the basic product and investigating laboratories found that large sample sizes and pre-enrichment were essential in isolating the organism from bean seeds. The association of salmonella infection with beansprouts, as well as the isolation of *E. coli* from the vegetables, highlights the need for a code of practice for the beansprout growers, which has now been produced [6].

REFERENCES

1. Edwards, PR, Bruner DW. The occurrence of multiple types of paratyphoid bacilli in infections of fowls, with special reference to two new Salmonella species. *J Infect Dis* 1940; **66**: 218-21.
2. Andrews WH, Mislivec PB, Wilson CR, et al. Microbiological hazards associated with bean sprouting. *J Assoc Off Anal Chem* 1982; **65**: 241-8.
3. Portnoy BL, Goepfert JM, Harmon SM. An outbreak of *Bacillus cereus* food poisoning resulting from contaminated vegetable sprouts. *Am J Epidemiol* 1973; **103**: 589-94.
4. Centre for Disease Control. Foodborne and waterborne disease outbreaks annual summary - 1973. HEW Publ/ CDC - 1975; 75-8185.
5. Patterson JE, Woodburn MJ. *Klebsiella* and other bacteria on alfalfa and bean sprouts at the retail level. *J Food Sci* 1980; **45**: 492-5.
6. Brown KL, Ocroft CA, eds. Guidelines for the hygienic manufacture and retail sale of sprouted seeds with particular reference to Mung beans. Technical Manual No. 25, Campden Food and Drink Research Association, 1989.

Appendix 1

Matched for age

0-5 months	matched within age band
6-11 months	matched within age bands
1-5 years	matched within 1 year on either side but not below one year of age
6-10 years	matched within 2 years on either side

Matched for sex as well as age

11-25 years	matched within 5 years on either side but not below 11 years old
26 and over	matched within 10 years on either side but not below 20 years of age

Appendix 2. General principles of beansprout production

Mung beanseeds from store

Pre-germination wash: seeds washed in hypochlorite solution in concentration of 7500 parts per million.

Rinse: seeds washed in water to remove hypochlorite.

Germination: seeds soaked in water for approximately 24 h at 27 °C.

Growth: seeds maintained in warm (20 °C) dark environment for 4-7 days, watering continuously.

Husk removal: beanshoots agitated in chlorinated water in concentration of 100 parts per million to separate them from husks.

Packaging: washed beanshoots packed by hand in large polythene bags, or small clingfilm covered punnets.

Distribution