

## Salmonella food poisoning associated with imported canned meat

BY R. C. S. BURNETT

*Assistant Medical Officer, City of Edinburgh*

AND B. I. DAVIES

*Bacteriology Department, University of Edinburgh Medical School*

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A number of outbreaks of enteric fever and food poisoning have occurred in which canned foods have been incriminated, viz. the outbreaks of typhoid fever at Oswestry (Bradley, Evans & Taylor, 1951), Pickering (Couper, Newell & Payne, 1956), Harlow (Ash, McKendrick, Robertson & Hughes, 1964), South Shields and Bedford, and the outbreaks of staphylococcal food poisoning due to infected tins of canned peas (Bashford *et al.*, quoted by Tomlinson, 1965). The most recent outbreak of enteric fever attributed to canned meat was the outbreak in Aberdeen in the summer of 1964 (Report, 1965).

In October 1964 and in May 1965 two localized outbreaks of food poisoning, due to salmonella organisms, occurred in Edinburgh. In both outbreaks, epidemiological and bacteriological evidence pointed to imported canned meat as the source.

In the first outbreak the organism responsible was *Salmonella reading* and in the second *S. tennessee*.

The total number of persons affected was 94, 55 in the first outbreak and 39 in the second.

### THE FIRST OUTBREAK

On Monday, 12 October 1964, the Public Health Department was informed that three persons, a father and his two sons, were to be admitted to the Edinburgh City Hospital as suspected cases of food poisoning. A common factor in their diet was chopped pork which had been sold on Saturday 10 October and eaten by all three on the evening of that day. The fourth member of the family, the mother, was unaffected. She had bought the chopped pork but did not eat any of it. Symptoms had started 8–11 hr. after ingestion of the chopped pork. A rectal swab was taken from the younger son on 11 October and was sent, together with the remains of the chopped pork left over from the meal, to the Bacteriology Department, Edinburgh University. A salmonella of group B, later shown to be *Salmonella reading*, was isolated from both the rectal swab and the chopped pork.

In view of these findings incriminating the chopped pork as the likely cause of the food poisoning, the shop from which the meat had been purchased was visited on the evening of 12 October. The owner of the shop volunteered the information that a customer's family had been affected the previous day with diarrhoea and

vomiting and that a shop assistant, who had been working at the cold meat counter on the morning that the suspected chopped pork had been on sale, was ill at home with 'gastric flu'.

Visits to these persons revealed that chopped pork had been eaten by all concerned and that the shop assistant had also eaten some boiled ham which had been on sale at the cold meat counter at the same time as the chopped pork.

By routine contact tracing, and notifications from the City Hospital, the University Laboratory and general practitioners, who had been given information on the outbreak by letter, 55 cases of food poisoning, involving 21 families, were discovered.

Table 1. *Analysis of cases (first outbreak)*

	Total no. of infected cases	No. with symptoms	No. asymptomatic	No. admitted to hospital	No. of emergency admissions
Male	23	14	9	5	4
Female	32	20	12	5	2
Total	55	34	21	10	6

Table 2. *Food eaten by infected persons in first outbreak*

	No. eating C.P. only	No. eating B.H. only	No. eating C.P. and B.H.	No. eating neither
Male	11	4	3	5
Female	12	6	5	9
Total	23	10	8	14

C.P. = chopped pork; B.H. = boiled ham.

#### *Action taken at the shop*

The shop was revisited on 13 October and swabs were taken from various items of equipment, including the slicing machine. A number of unopened cans of chopped pork and minced pork and a partly used roll of minced pork which had lain on the same shelf as the suspected roll of chopped pork, were sent to the laboratory for bacteriological examination. *S. reading* was isolated from all parts of the slicing machine tested and from the counter shelf on which the suspected roll of chopped pork had lain. *S. reading* was also isolated from the external surface of the partly used roll of minced pork. Nothing was cultured from the contents of the unopened cans.

After sterilization with a hypochlorite solution, the equipment and surfaces in the shop were re-swabbed on two occasions, with negative results. At this visit on 13 October arrangements were made for bacteriological examination of all the shop assistants. On 20 October the grocer voluntarily closed the shop, because by then all five members of the staff were known to be excreting *S. reading*.

#### *Analysis of cases*

The total number of infected persons was 55, of whom 23 were males and 32 were females. Thirty-four had clinical symptoms of food poisoning and 21 were

asymptomatic excretors of *S. reading* (Table 1). Twenty-three had eaten chopped pork and 10 had eaten boiled ham purchased from the same shop. A further 14 had eaten neither chopped pork nor boiled ham (Table 2), and of these, ten could have been infected by close household contact with infected persons. The remaining four could not be linked with the outbreak. Ten persons were admitted to hospital, six as emergency admissions.

#### *Treatment and follow-up*

Ten persons were admitted to hospital for treatment, the remainder being treated at home by the family doctor. Neomycin sulphate was the antibiotic chosen initially in five of the hospital admissions and in all of the domiciliary cases. Three of the remaining hospital cases were given Ampicillin in a dosage of between 2 and 4 g. daily depending on the severity of symptoms. One hospital case was given no drug treatment. Six persons were given subsequent courses of treatment before a negative result was obtained.

Non-food handlers were allowed to return to their usual occupation after three consecutive negative stool specimens had been obtained. In the case of food handlers, six consecutive negative stool specimens were required although, owing to the pressure of business, the manager of the shop and one assistant were allowed to return to work after four consecutive negative stool specimens.

#### *Conclusions*

The shop had been established as the almost certain source of infection, and chopped pork as the vehicle, and consideration now had to be given to the question of how this food became contaminated. It was necessary at the earliest possible moment to prove that a carrier amongst the shop staff had not infected the meat after the can was opened.

Although all the shop assistants were found to be excreting *S. reading*, none had had symptoms of food poisoning before 10 October when the suspected meat was sold. One assistant, who developed symptoms shortly after this date, had been serving on the cold meat counter at the time the suspected meat had been on sale and had eaten some that morning. The only other shop assistant with gastro-enteritis became ill about a week after the meat had been sold.

Four 4 lb. tins of chopped pork were opened on 10 October, the first about 9 a.m. After opening, the contents of the tins were placed on a counter shelf in a window facing north-east. As a customer ordered it, the chopped pork was taken from the shelf, sliced on the slicing machine, and then replaced on the shelf which held other cold meats, including minced pork and boiled ham.

In this outbreak the vehicle of infection, i.e. either chopped pork or boiled ham, and its time of purchase can be fixed with reasonable accuracy and it is interesting to note that of the six emergency admissions to hospital, who were the persons most seriously affected, five had eaten chopped pork purchased on Saturday, 10 October about 10 a.m., approximately 1 hr. after the first tin of chopped pork had been opened.

Had the roll of chopped pork been contaminated by a carrier at the time of

opening it is unlikely that sufficient multiplication of organisms could have occurred in the short time available and this is made more unlikely by the fact that the roll was placed in a window facing north-east where conditions were not suitable for bacterial multiplication.

A study of the incubation periods reveals some interesting facts (Table 3). The mean incubation period in the case of those who had eaten chopped pork only was 31 hr. Two batches of chopped pork were involved, however. One batch was sold on Saturday, 10 October, and the other on Tuesday, 13 October, on the day before the sale of cold meats was forbidden and before the equipment had been sterilised.

Table 3. *Comparison of incubation periods of persons eating one or other or both cooked meats (first outbreak)*

Food eaten	No. of persons eating meats	No. of persons with incubation periods of			
		0-12 hr.	13-24 hr.	25-36 hr.	Over 36 hr.
Chopped pork	23	5	3	4	5
Boiled ham	10	0	1	1	3
Chopped pork and boiled ham	8	0	3	3	1
Total	41	5	7	8	9

If it is assumed that the original source of the outbreak was an infected tin of chopped pork opened and sold on Saturday, 10 October, around 10 a.m. (and four 4 lb. tins were opened on that day), then it might also be assumed that the contents of any further tins opened on that date would be contaminated from infected equipment and by manual handling. Persons eating chopped pork from the first infected tin bought on the morning of Saturday, 10 October, would probably have more severe symptoms and shorter incubation periods than persons affected by eating chopped pork bought on 13 October which had been contaminated in the shop from the slicing machine, the shelves, or by manual handling. This conclusion is supported by the duration of the incubation period, viz.:

Mean incubation period of persons eating chopped pork bought on 10 October 1964 was 19 hr.

Mean incubation period of persons eating chopped pork bought on 13 October 1964 was 69 hr.

The isolation of *S. reading* from the remains of the meat eaten by the family first affected and from a rectal swab taken from a member of the same family, and the absence of infection in the mother of the family who had not eaten the meat, would suggest that chopped pork was the source of the outbreak. When it is further considered that there was no clinical or bacteriological evidence to suggest the presence of a carrier among the shop staff before the opening of the original tin and that there was heavy and widespread contamination of the serving area, coupled with the evidence deduced from a study of the incubation periods, the conclusion is drawn that the source was a roll of chopped pork sold on 10 October between 10 and 11 a.m. Despite the original tin not being available for bacterio-

logical examination, it would appear likely that the meat was not contaminated by a salmonella carrier in the shop but was infected at some time during the canning process.

#### THE SECOND OUTBREAK

On 21 May 1965 the Public Health Department was notified by the University Bacteriology Department that a salmonella of group C (subsequently identified as *S. tennessee*) had been isolated from a man and his 3-month-old son. Inquiry showed that all five members of the family had had diarrhoea and vomiting the previous week-end and that a number of families in the area had had 'gastro-enteritis' about that time.

As investigations proceeded it became evident that minced pork and cold sliced pork, both bought from a supermarket in the area on 13 May, had been eaten by a number of persons affected and, accordingly, the shop was visited on the same evening as the first case was notified by the laboratory. Further investigation showed that a total of 39 persons from 17 families had a history suggestive of food poisoning.

#### *The shop and staff*

Five persons were employed in the shop and, on questioning, three admitted symptoms of diarrhoea and vomiting the previous week-end (15–16 May) while two denied having had any symptoms whatsoever. All denied ever having eaten cold meat at any time or having taken cold meat home with them. Stool specimens from all five yielded *S. tennessee* on culture.

Swabs were taken from a number of items of equipment in the shop and *S. tennessee* was isolated from the slicing machine, from the shelf on which the cold meats were put on display and from the refrigerator trays where the suspected cold meats were stored overnight.

#### *Analysis of cases*

The total number of persons involved was 39. Of these, 34 had symptoms and five were asymptomatic.

Of the 34 with symptoms, 31 yielded *S. tennessee* on stool culture and three did not. Stool cultures from the five asymptomatic cases were all positive for *S. tennessee*. Out of the group of 34 patients with symptoms, 17 had eaten canned minced pork and five had eaten cold pork sliced on the infected slicer in the shop. In the remaining 12 no history of having eaten pork could be obtained, although six of the 12 were members of the shop staff or their immediate family and could have been infected by contamination in the shop or at home.

Of the remainder, four were schoolchildren who had no direct connexion with the supermarket and had eaten neither minced nor sliced pork and two were infants aged 3 and 6 months, who were presumably infected by their parents who were positive cases. Stool cultures from all six children were positive for *S. tennessee*.

*Incubation periods*

The minimum incubation period was 10 hr. and the maximum 67 hr. Although the mean incubation period was 27 hr., the mean incubation period of those persons eating the suspected pork was 25 hr. and of those eating cold sliced pork 27 hr.

There were no hospital admissions, all cases being treated at home by family doctors.

## DISCUSSION

In both outbreaks the suspected meats had been imported in cans. In the first outbreak the country of origin was Hungary and in the second Yugoslavia. Attempts to find out how the meats had been processed and under what conditions the meats had been canned met with little success.

The two outbreaks were also similar in that there was no evidence to suggest that a carrier amongst the shop staff was responsible for contaminating the meats.

The number of cases, 14 in the first outbreak and 12 in the second, who are presumed to have contracted their infection by close contact with others, may at first sight appear large but all of them were close family contacts of a known positive case and in the absence of any other source it would seem reasonable to presume that they contracted their infection in this way.

Table 4. *Numbers of patients excreting salmonellas for periods of 1 to 7 months after infection*

	Duration of excretion in months							
	1	1- < 2	2- < 3	3- < 4	4- < 5	5- < 6	6- < 7	7 and over
<i>S. reading</i>								
Symptomatic	13	10	4	0	0	1	0	1
Asymptomatic	12	4	1	0	0	2	0	2
Total	25	14	5	0	0	3	0	3
<i>S. tennessee</i>								
Symptomatic	16	2	2	1	3	0	0	0
Asymptomatic	3	1	0	1	0	0	0	0
Total	19	3	2	2	3	0	0	0

For five patients the duration of excretion is not known.

The four cases which could not be linked with the first outbreak were all children living in widely separated areas of the city and in the county of Midlothian. All, however, were positive for *S. reading* on stool culture.

In a number of patients infected with *S. reading* symptoms were severe and in some ways resembled paratyphoid fever. In one there was bacteraemia and in several there was generalized abdominal pain with tenderness in one or other iliac fossa. The similarity was also present in the length of time some cases continued to excrete the causative organism (see Table 4). Normally patients

who have made a clinical recovery from salmonella infection continue to excrete the organism in the faeces for varying periods. The average period of excretion for adults is about 6 weeks and the majority are clear of infection after 3 months.

In the first outbreak 25 persons (45·4%) were clear of infection after 1 month, 44 persons (80%) were clear of infection after 3 months and three persons (5·4%) were still excreting the causative organism 6 months after contracting the infection and, of these, one was still excreting the organism 12 months after the initial infection.

It is interesting to note that in neither outbreak did a can show any external signs of contamination such as blowing, nor did the meat arouse suspicion, it being entirely free from obnoxious odour or discoloration. This is in keeping with evidence given to the Royal Commission on the Aberdeen Typhoid Outbreak by the Chief Veterinary Inspector for the City and Royal Burgh of Edinburgh (Report 1965, p. 38).

In both outbreaks, despite routine cleaning of equipment and surfaces, widespread contamination occurred in the shops. In the second outbreak this contamination extended to the table used by the staff at refreshment breaks, although it was situated some distance from the serving area. This table was presumably contaminated by the hands of the shop assistants, all of whom denied having taken cold meat to the table. It is easily seen how the spread of infection could be facilitated under such conditions. Improvements in the handling of cold meats in shop premises would minimize the risk of transmission to a certain extent, but the only certain course is to ensure that canned meats are rendered safe at source

#### SUMMARY

Two outbreaks of salmonella food poisoning are described. In one, involving 55 persons, the infecting organism was *Salmonella reading*, and in the other, involving 39 persons, *S. tennessee*. In both, epidemiological and bacteriological evidence pointed to imported cans of cooked meat as the source. The role of contaminated shop equipment in furthering the spread of infection is particularly emphasized.

Attention is drawn to the severity of the symptoms and prolonged excretion of the organism in a number of the patients infected with *S. reading*.

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