J. Hyg., Camb. (1981), **86**, 259
Printed in Great Britain

Salmonellae isolated from domestic meat waste

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(*Received* 25 *March* 1980)

SUMMARY

During 1977 and 1978, 172 samples from 14 batches of domestic meat waste were examined for the presence of salmonellae. Each batch was derived from the domestic refuse collected from approximately 120 houses. Thirty-five strains of ten salmonella serotypes were isolated from 32 samples from 8 batches. The probable origin of these serotypes and their significance when domestic waste is exposed to predation by birds and animals on refuse tips is discussed.

INTRODUCTION

The association of birds, rodents and insects with refuse tips and the part each plays in the dissemination of *Salmonella* has been widely discussed for many years. Work on the relationship between flies and cockroaches and salmonella infection in warm climates has been carried out over a long period of time (Torrey, 1912; Roth & Willis, 1957, 1960; Greenberg *et al.* 1963; Greenberg, 1964 and Haddock, 1970). This paper describes work done to establish whether or not salmonellae commonly exist on refuse tips, and discusses the origin of the serotypes isolated and their public health significance. The meat fraction of the waste material was selected as the most likely source of salmonellae and had the additional advantage of being attractive to the insects, animals and birds in which the carrier status is to be studied.

MATERIALS AND METHODS

Meat Waste

Fortunately meat waste which had, allegedly, never been exposed on a tip and which had had minimal exposure to insects, birds and rodents was readily available.

An occasional batch of refuse was obtained from a Hertfordshire town, but as most of the material was collected from a town in South Yorkshire, the procedure at the latter site is described. The refuse was collected in a routine manner; dustbins were emptied into a closed vehicle and the waste from approximately 120

domestic premises conveyed to a tip. The load was deposited onto a temporary hard-standing and reloaded immediately into another waiting closed vehicle which proceeded to a materials recovery plant about 150 miles distant. Here the material was deposited in an open yard and fed onto a conveyor which carried it into the materials recovery plant in a large adjacent building. The plant consisted of a revolving drum with perforations and slots which released dust, ash, waste paper and some polythene. A magnet removed ferrous material and putrescible material was released into a hopper. In order to retrieve the meat waste, it was necessary to climb into the hopper and, with gloved hands, place samples into individual polythene bags for transmission to the laboratory.

Bacteriological examination

At the laboratory an attempt was made to identify the animal species of origin of the meat waste. Then, using sterile instruments, 20 ml of buffered peptone water (BPW) of pH 7·2 and 20 ml of selenite broth (Oxoid CM 395/L 121) were each inoculated with a portion of meat or a fragment of bone about one gramme in weight from each sample. The media were then incubated for 18 h at 37 °C. Approximately 2 ml of the BPW was transferred to a tetrathionate broth (TTB, Oxoid CM343) and this was incubated in a water bath for 24 h at 43 °C. The selenite broths were subcultured onto deoxycholate citrate lactose sucrose agar (DCLS, Lab M Lab 3) and brilliant green agar (BGA, Oxoid CM263) and the TTB were plated out on bismuth sulphite agar (BSA, Oxoid CM 201) and BGA. All plates were incubated at 37 °C overnight. In 1978 the regime for TTB was changed, DCLS being substituted for BSA. Suspect salmonella colonies were tested on a slide with salmonella polyvalent O, A-S Antisera (Wellcome). Those showing agglutination were subcultured onto a urea slope (Oxoid CM 53). After 6 h those slopes in which the urea had not been hydrolysed were subcultured onto MacConkey agar (Oxoid CM7) and tested, after overnight incubation, for the presence of somatic and flagellar antigens and biochemical activity. Confirmation or final identification was provided by the Bacteriology Department of the Central Veterinary Laboratory at Weybridge, and some identification and phage typing by the Division of Enteric Pathogens of the Central Public Health Laboratory at Colindale.

RESULTS

For the purpose of this report the results for each sample are shown without distinction between the differing isolations from a particular medium used. Results for 1977 and 1978 are shown separately. In 1978 no attempt was made to identify the species of the material received.

Between January and September 1977, 102 samples were examined from 10 batches (see Table 1). Salmonellae were isolated from 12 samples from 4 batches and were of seven different serotypes. The results of the examination of the material by month is recorded in Table 1. The probable animal species of origin is shown in Table 2.

Table 1. Salmonella *isolations from domestic meat waste* 1977.
Isolations by month

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total
Batches received	1	1	—	—	1	1	1	3	2	10
Samples examined	12	6	—	—	12	12	12	32	16	102
Samples positive	1	—	—	—	—	—	1	—	10	12
S. typhimurium	1	—	—	—	—	—	—	—	4	5
S. 4, 12:d:-	—	—	—	—	—	—	—	—	4	4
S. virchow	—	—	—	—	—	—	1	—	2	3
S. bredeney	—	—	—	—	—	—	—	—	1	1
S. hadar	—	—	—	—	—	—	—	—	1	1
S. menston	—	—	—	—	—	—	—	—	1	1
S. schwarzengrund	—	—	—	—	—	—	—	—	1	1

Table 2. Salmonella *isolations from domestic meat waste* 1977.
Probable species of origin

	Avian	Porcine	Ovine	Unidentified	Total
*S. typhimurium**	2	—	—	3	5
S. 4, 12:d:-	—	2	1	1	4
S. virchow	—	1	—	2	3
S. bredeney	—	1	—	—	1
S. hadar	—	—	—	1	1
S. menston	—	—	—	1	1
S. schwarzengrund	1	—	—	—	1
Total	3	4	1	8	16

* Definitive phage type 40.

Table 3. Salmonella *isolations from domestic meat waste* 1978

	July	August			Total
Batches received	1	1	1	1	4
Samples examined	11	31	12	16	70
Samples positive	3	8	7	2	20
S. hadar	2	4	3	—	9
S. indiana	—	3	—	1	4
S. bredeney	1	1	—	1	3
S. virchow	—	—	3	—	3
*S. enteriditis**	—	1	—	—	1
S. give	—	—	1	—	1

*Phage type 8.

During 1978, 70 samples of meat waste, consisting mainly of bone, were examined in four batches as shown in Table 3. Batch 1 was obtained in July and the other batches in August.

DISCUSSION

The isolation of ten serotypes of *Salmonella* in meat waste destined for refuse tips is of some significance with regard to human and animal health. It is impossible to seal off completely and immediately every delivery of refuse, and even on a well managed tip some material is exposed to potential vectors, although the activity of

https://doi.org/10.1017/S002217240006900X Published online by Cambridge University Press

tipping operations would be sufficient to discourage most rodents. In a poorly controlled tip, where covering with soil, slag or debris is late or inadequate, access to contaminated material would be available for prolonged periods to birds, rodents and insects.

There has been a recent report of herring gulls excreting salmonellae, with strong circumstantial evidence that the sources of the organisms were refuse tips (Williams, Richards & Lewis, 1976). Gulls are common plunderers of refuse, and while the report presented no evidence that the serotypes carried by the gulls were responsible for a local endemic *S. dublin* infection in cattle, the variety of serotypes recovered from gull faeces and from sporadic cases of bovine salmonellosis suggested that infection was transferred by gulls from sources such as a tip would provide. A later paper (Williams *et al.* 1977) indicated that the origin of one of the serotypes isolated from cattle, *S. livingstone*, was probably the contents of domestic cesspits and septic tanks deposited on a tip 100 metres from a field which the cattle grazed. Other wild birds are also susceptible to salmonella infection and it has been demonstrated that strains isolated from these were capable of producing infection and death in poultry (Goodchild & Tucker, 1968).

Rodents are notorious scavengers and Ludlam (1954) gives a particularly horrific account of the activities of rats in a butcher's by-products factory where large quantities of bones and meat were left for weeks in open sheds. During this investigation 24 out of 60 rats examined in a three month period yielded salmonellae of 8 different serotypes. Hunter, Linklater & Scott (1976) suggest that mice should not be overlooked as salmonella vectors. Flies have also been implicated as natural and experimental vectors of *Salmonella*. Work by Greenberg *et al.* (1963) has shown that flies are able to carry salmonellae from an infected environment and can transmit the organisms to man in sufficient numbers to produce infection (Greenberg, 1964). In addition, flies can be dispersed over a distance of up to three miles from the site where they were first identified (Greenberg & Bornstein, 1964).

Cockroaches are not uncommon inhabitants of refuse tips and there have been several instances of their leaving tips and infesting dwellings in the area (Beatson & Dripps, 1972). Cockroaches are able to excrete *Salmonella* in their faeces for up to 20 days after experimental infection, and viable organisms may be isolated from their pronotal surfaces for up to 78 days (Mackerras & Pope, 1948; Olson & Rueger, 1950). It would also appear that the gut flora of cockroaches may vary from one period of the year to another so that at certain times their ability to transmit salmonella and other infections may become more pronounced.

There is some evidence to suggest that large numbers of salmonella organisms may be necessary to establish infection in the insect (Julseth *et al.* 1969; Klowden & Greenberg, 1976) and transmission to the human may also require a large infective dose (Greenberg, 1964). We have been unable to assess the level of salmonella contamination present in the meat waste as our isolations were obtained through enrichment broth media.

Preliminary investigations suggest that contamination of the waste from external sources was unlikely to occur during collection or transit, or at the materials recovery plant. There is a possibility that some cross contamination

occurred during the retrieval of the samples from the hopper where the same glove was used continually for handling the material. The fact that several different serotypes were present suggests that this was not a major factor and may also indicate that the numbers of salmonellae present were low.

Further work is required to assess the amount of contamination nearer the collection stage, but the conclusion to be drawn from the evidence so far available must be that the meat waste was contaminated at the domestic premises. Most of the samples received appeared well-cooked and it is unlikely that salmonellae would survive adequate cooking, even within bones. The apparently even spread of the contamination through material of several species suggests that the material was probably a vehicle for salmonellae rather than the original source. A possibility which demands investigation is that the cooked meat waste is contaminated with *Salmonella* from uncooked giblets which are normally included in packs of frozen poultry and which are frequently discarded. Wrappers of frozen poultry and other meats may also bear salmonella organisms. Dixon & Pooley (1961), and Tucker & Gordon (1968) have shown in surveys of poultry processing plants that a considerable proportion of poultry may be contaminated with *Salmonella*. Most of the serotypes isolated during this investigation are commonly associated with food poisoning outbreaks originating from poultry, but McDonagh & Smith (1958) and Edel, van Leusden & Kampelmacher (1978) indicate that pig meat may also carry *Salmonella*. In addition to these authors Williams, Bellhouse & Davidson (1978), have shown that *Salmonella* may be present in bovines at slaughter.

These findings demonstrate that viable salmonella organisms commonly exist in the meat fraction of domestic refuse which could provide a reservoir of environmental contamination, accessible to birds, rodents and insects and underline the necessity for careful controlled tipping of rubbish and immediate covering of the deposited material.

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