

## **Salmonella organisms in garden fertilizers of animal origin**

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### SUMMARY

Of 120 specimens of garden fertilizers of animal origin purchased in retail shops, 40 (33·3 %) were found to be contaminated with salmonella organisms. Untreated bone meal (53·1 %) was the most heavily contaminated but 25 % of specimens of this product classed as heat-treated or sterilized were positive. In all, 32 serotypes were identified.

### INTRODUCTION

Protein supplements of diets of farm animals, such as meat, bone and fish meals, may be contaminated with salmonella organisms and many surveys have been published revealing the extent of this contamination. Similar products are used extensively as fertilizers, especially in domestic gardens. In this respect they are generally referred to as organic fertilizers. They are usually sold in gardening and chemist shops but sometimes they may be sold in multiple stores that also sell human food. That they, too, may be salmonella-contaminated was first discovered by Walker (1957) in the U.K. who found that 40 % of the 123 specimens he examined were so-contaminated; bone meals were most frequently incriminated (70 %). Because we could not find any later publications on this subject and because we recently required for a research project specimens of organic garden fertilizers that were salmonella-contaminated we extended our search until sufficient specimens were examined to permit a comparison of our results with those of Walker. This would then give some indication as to whether in the years between the two surveys an improvement had been made in the salmonella status of these products as has been made in the case of protein-containing animal diets.

## MATERIALS AND METHODS

*Collection of specimens.* These were obtained in 1980–81 as unopened packets or cartons from retail shops, principally in East Anglia. Unless stated, no more than one specimen of any one particular product was collected from any one shop.

*Examination of specimens.* Specimens, in 50 g amounts, were incubated in 200 ml of nutrient broth (Oxoid, CM67) for 18 h at 37 °C. Selenite broth (Oxoid, CM395) and tetrathionate broth (Oxoid, CM29), in 200 ml amounts, were inoculated with 20 ml of each of these broth cultures, incubated at 37 °C for 48 h and then streaked on to plates of desoxycholate-citrate agar (Oxoid, CM227) and brilliant green agar (Oxoid, CM329). The plates were incubated at 37 °C for 24 h and colonies resembling those of salmonellae were submitted to slide agglutination tests with polyvalent-O antiserum (Wellcome). Up to six colonies that gave a positive reaction with the antiserum were picked from each plate, purified and the resulting sub-cultures examined with a limited range of salmonella O group antisera and polyvalent-H antiserum (Wellcome) and their biochemical reactions determined. The identification of those thought to be salmonellae was then established at the Central Public Health Laboratory. In the survey to find the incidence of salmonella-contaminated fertilizers all specimens that did not yield organisms suspected of being salmonellae were re-examined once.

## RESULTS

Salmonellae were isolated from one-third of 120 specimens of organic garden fertilizers (Table 1), the highest incidence of salmonella contamination being in un-treated bone meal (53.1%); 19 different salmonella types were found. Of the 40 positive specimens, 23 were identified by enrichment in selenite medium followed by culture on brilliant green agar, 22 by enrichment in tetrathionate medium followed by culture on brilliant green agar, 14 by enrichment in selenite medium followed by culture on desoxycholate-citrate agar and 13 by enrichment in tetrathionate medium followed by culture on desoxycholate-citrate agar.

The five specimens of 'heat-treated' or 'sterilized' bone meal from which salmonellae had been isolated were re-examined five times. Three were positive at four of these examinations and two at one. *S. anatum* had been isolated from one of the three at the original examination and this serotype (2 isolations) and *S. tennessee* (2) were isolated at the additional examinations. *S. hadar* and *S. muenster* had been isolated from another at the original examination and *S. hadar* (3) and *S. eimsbuettel* at the additional examinations. *S. tennessee* and *S. derby* had been isolated from the third at the original examination and *S. hadar* and *S. tennessee* (3) at the additional examinations. From the two specimens that were positive only once at the additional examinations the same serotype was found at the original and at the additional examinations, *S. derby* in the case of one and *S. agona* in the case of the other.

Seven of the positive specimens of bone or blood meal were also examined in two other laboratories using isolation methods that differed in some respects from ours. The serotypes we identified in the seven were *S. agona*, *derby* (2), *infantis*,

Table 1. *The isolation of salmonellae from organic garden fertilizers*

Fertilizer	No. of specimens examined	No. of specimens positive	Type of salmonellae isolated
Bone meal	32	17 (53.1%)	<i>anatum</i> (2), <i>infantis</i> (1), <i>newport</i> (1), <i>agona</i> (4), <i>kedougou</i> (1), <i>senftenberg</i> (3), <i>bredeney</i> (3), <i>kentucky</i> (1), <i>derby</i> (2), <i>lexington</i> (2)
Bone meal (heat treated or sterilized*)	20	5 (25.0%)	<i>anatum</i> (1), <i>derby</i> (2), <i>muenster</i> (1), <i>agona</i> (1), <i>hadar</i> (1), <i>tennessee</i> (1)
Hoof and horn meal	19	8 (42.1%)	<i>anatum</i> (1), <i>kentucky</i> (2), <i>eimsbuettel</i> (1), <i>senftenberg</i> (1), un-named 1, 42:Z <sub>4</sub> Z <sub>23</sub> : - (1), 1, 4, 12, 27:l, v: - (1), <i>hadar</i> (1).
Blood meal	29	6 (20.7%)	<i>anatum</i> (1), <i>kedougou</i> (2), <i>johannesburg</i> (1), <i>senftenberg</i> (3).
Fish, bone and blood meal	16	3 (18.8%)	<i>agona</i> (1), <i>muenchen</i> (1), <i>senftenberg</i> (1), <i>derby</i> (1), <i>ohio</i> (1)
Fish meal	4	1 (25.0%)	<i>kentucky</i> (1)
Total	120	40 (33.3%)	—

\* Manufacturers' designations; all the remaining 100 specimens were believed to have had no such treatment.

*johannesburg*, *lexington*, *newport* and *senftenberg* and those they identified were *S. anatum* (3), *brandenburg*, *derby* (2), *infantis*, *lexington*, *mbandake*, *newport*, *schwarzengrund* (2), *senftenberg*, *typhimurium*, un-named 3, 10:e, h: -, un-named 3, 10:g: -, un-named, 3, 10:l, v: -, un-named, 4, 12:g: - and un-named, 6, 8:e, h: -. From only three specimens did one or other of the two laboratories isolate a serotype which we had also isolated.

The shops from which nine salmonella-positive specimens had been obtained were re-visited and specimens that were believed to belong to the same consignment as the nine specimens were purchased. Salmonellae were isolated from only 15 of the 55 that were obtained. Again, it was not uncommon to find serotypes in these additional samples that had not been found in the original samples. Serotypes that had not been found in any of the specimens previously examined, as distinct from in these nine, were *S. cubana*, *S. eastbourne*, *oranienburg* and *thomasville*, making the total number of serotypes found in the whole study 32.

## DISCUSSION

The high proportion of specimens found to be contaminated with salmonella organisms and the large number of serotypes identified suggests that there has been little alteration in the situation since Walker conducted his survey in 1957. It is noteworthy that the incidence of contamination in treated specimens was nearly half that in the untreated specimens. Presumably, this was due to contamination after treatment.

Although contaminated garden fertilizers of animal origin are probably of little

significance as a direct cause of human salmonella infection they do represent a continual source of introduction of salmonella organisms into the U.K. from abroad. This is particularly undesirable at a time when costly efforts are being made in this country to reduce the incidence of salmonellae in similar products destined for inclusion in animal feeding stuffs.

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#### REFERENCE

WALKER, J. H. C. (1957). Organic fertilizers as a source of salmonella infection. *Lancet* ii, 283–284.