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Salmonella excretion by pet terrapins

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INTRODUCTION

Salmonellas were first isolated from turtles by McNeil & Hinshaw (1946) and from tortoises by Boycott, Taylor & Douglas (1953) who recognized the risk of spread of infection from these animals to man. Probably the first recorded finding of a salmonella in a small aquatic turtle (which would be called a terrapin in Britain) was in Florida between 1949 and 1953 (Report, 1962).

Seventeen years after the original observation the first case of human salmonellosis with a terrapin as source was reported (Hersey & Mason, 1963) and since then over fifty American cases which were epidemiologically associated with terrapins have been described (Kaufmann & Morrison, 1966). In the United Kingdom Plows, Fretwell & Parry (1968) have very recently recorded the infection of a patient with an *Arizona* species which came from an infected terrapin. They also isolated several salmonellas from one of the patient's terrapins, and refer to a case of salmonellosis in Liverpool where the most likely source was again a terrapin.

We wish to bring to notice that pet terrapins in this country may be infected with salmonellas and suggest that this be borne in mind when any case of salmonellosis is investigated.

A four-year-old boy living in the area served by this laboratory developed gastro-enteritis due to *Salmonella paratyphi B* phage type Battersea. Subsequent enquiries revealed that there were three pet terrapins kept in his home and that he had been in the habit of playing with them. The water in which they lived was cultured and found to contain *Salmonella paratyphi B* phage type Battersea. Each of the three terrapins was subsequently shown to be excreting *S. paratyphi B* phage type Battersea. As a result of these findings we examined terrapins and water from terrapins' tanks taken from pet stores, schools and private houses in the same district.

MATERIALS AND METHODS

Samples of tank water were inoculated directly on brilliant green MacConkey agar (Harvey, 1956) and deoxycholate citrate agar (DCA) plates and were also mixed with equal volumes of selenite F medium and incubated at 37° C. Subcultures were made after 1 and 5 days on DCA and brilliant green MacConkey agar. All plates were incubated overnight. Any non-lactose-fermenting colonies were subcultured and identified by the usual serological and biochemical tests. Each terrapin received was washed and placed in a sterile bowl filled with tap water and kept for 1 week. Samples of the water were taken at intervals and were examined as described. After 5–7 days each terrapin was killed with nembutal. Its viscera were removed and macerated, and were added to selenite F and nutrient broths and incubated at 37° C. After 1 and 5 days subcultures were made and examined.

RESULTS

Water samples taken from 21 tanks in schools, shops or homes, each containing one or more terrapins, were examined. Only four of these yielded salmonellas and one was water from the tank containing the terrapins of the index case. Salmonellas isolated were: *S. paratyphi B* phage type Battersea (from two tanks), *S. madelia* and *S. houten*.

Table 1. *Details of isolations from infected terrapins*

Terrapin Identification no.	Organism excreted during life in laboratory	Organism isolated only from viscera
1	*S. paratyphi B*, phage type Battersea	—
2	*S. paratyphi B*, phage type Battersea	—
3	*S. paratyphi B*, phage type Battersea	—
4	—	*S. paratyphi B*, phage type Battersea
6	*S. paratyphi B*, phage type Battersea	—
9	*Arizona* sp	—
10	*S. urbana*	—
19*	—	*Arizona* sp
27	*S. newport*, *Arizona* sp	—
28*	—	*S. newport*, *S. panama*, *Arizona* sp
29	*S. madelia*	—
30	*S. newport*	—
31	*S. newport*	—
32	—	*S. saintpaul*, *S. infantis*, *Arizona* sp
33	—	*S. madelia*, *S. saintpaul*
34	*S. heidelberg*	—
38	—	*Arizona* sp

* These animals were received dead. It was not possible to study their excretion in life.

Thirty-nine terrapins were sent to the laboratory for examination. Of these 14 were found to be carrying salmonellas and six to be carrying members of the closely related *Arizona* species. Most carried only one organism but two of the creatures each carried two different salmonellas and an arizona, one carried two salmonellas and one a salmonella and an arizona. The majority of the terrapins

excreted their organisms into the bowl of water in which they were kept in the laboratory but a minority did not; the organisms that they carried were only demonstrated when their viscera were cultured. The exact distribution of the organisms found is given in Table 1.

DISCUSSION

Terrapins are well known to carry salmonellas and thus to be a source of human salmonellosis (Kaufmann & Morrison, 1966). Indeed Williams & Helsdon (1965) considered them such an important source of certain salmonellas as to refer to these types as 'terrapin associated'. Reardon & Wilder (1964) were sufficiently impressed with this association to look specifically, and successfully, for a terrapin source whenever a certain serotype (in their case they chose *S. braenderup*) was found in children. For similar reasons Rosenstein, Russo & Hinchliffe (1965) sought and found a terrapin source in an outbreak they were investigating.

Terrapins are imported into the United Kingdom mainly from the United States. They are bred in captivity in large 'farms' in Louisiana and Mississippi, and are fed on rendered meat scraps (Ager, 1963). Investigations at one such 'farm' (Quist & McQueen, 1963) revealed that 2 out of 10 adult terrapins carried salmonellas and at another farm Kaufmann & Morrison (1966) demonstrated salmonellas in the feed stuff, pool water and soil around the bank and also in the ovaries, gallbladder and eggs of the terrapins themselves. The water in these farms was not potable. Moreover meat scraps have been shown to contain salmonellas (Ager, 1963). It was therefore suggested that water and meat scraps were the sources of contamination. It should be remembered, however, that reptiles as a group (both wild and captive) frequently harbour salmonellas (Hinshaw & McNeil, 1945, 1947; Lee & Mackerras, 1955). Thus it may be that the terrapins themselves are the source of the salmonellas. Certainly Kaufmann & Morrison (1966) have demonstrated means by which the female could infect her own young and so perpetuate infection in the species.

Now that the problem has become known and in response to suggestions for salmonella-free terrapins (Kaufmann & Morrison, 1966; Williams & Helsdon, 1965) the more responsible breeders are taking steps to avoid contamination of their stocks by using salmonella-free foods and chlorinated water where possible, and by generally increasing their hygienic standards. However, many of the salmonella types we have isolated are uncommon in this country and this suggests that they are still being imported with the terrapins.

After their arrival in the United Kingdom the terrapins are fed by the larger dealers on raw meat scraps, earthworms and tubifex worms. Meat scraps are a potent source of salmonellas and tubifex worms from river mud may also be contaminated with salmonellas, as river sludge is a known source of salmonellas (Taylor *et al.* 1965). These represent other ways in which infection may be introduced or maintained in a terrapin population. The dried insect foods used by the smaller dealers and in the home seem to be safer, however. We have examined ten samples of these and have isolated no pathogens. Other workers (Williams & Helsdon, 1965; Rosenstein *et al.* 1965; Reardon & Wilder, 1964) report similar

negative findings. Kaufmann, Feeley & De Witt (1967) have shown that small batches of terrapins will remain infected for at least a year and we found two terrapins to be excreting after a year's captivity in a Sheffield household. Thus despite Williams & Helsdon's (1965) observation that the proportion of terrapins infected falls with the time of existence away from their hatchery it should not be assumed that they will all become infection-free after a given period.

We have examined the terrapins by culture of their environmental water and of their viscera and we report salmonellas isolated from both materials. It could be argued that only salmonellas present in the water represent a hazard. However, Kaufmann *et al.* (1967) have shown that some terrapins contaminated their water only intermittently and so a negative water sample is no guarantee that the water may not become infected later. For this reason we consider that all carrier terrapins may be dangerous and accordingly we report any salmonellas isolated from the animal as well as its water.

In our survey we detected salmonellas in only four of twenty-one specimens of water from tanks in the owners' homes. This was much less than the proportion of positive results from the water in the bowls of the terrapins which we kept in the laboratory. This may well have been due to the larger volumes of water used in home aquaria and also to the lack of water changes while the terrapins were kept in the laboratory, whereas in the home water is changed every 2–3 days. Negative results from occasional tank-water testing are therefore no guarantee that a terrapin is not a salmonella carrier. Our findings indicate that a considerable proportion of the terrapins in this country may be expected to be carrying salmonellas, and the case we report demonstrates forcibly that these creatures represent a health hazard to the community.

All the creatures that we examined were red-eared turtles (*Pseudemys scripta elegans*) but this is not the only species which has been shown to be infected (Plows *et al.* 1968; Williams & Helsdon, 1965). The related land turtle, the tortoise, has been shown on many occasions in this and many other countries to carry salmonellas (Boycott *et al.* 1953; Douglas & Taylor, 1954; Kaufmann & Morrison, 1966). The tortoise has been implicated as the source of human infection (Ludkin, 1955) but it is rarely so because its infected excreta are unlikely to find their way into human mouths. The terrapin, in contrast, excretes salmonellas into a warm fluid environment, in which the organisms will survive well or even multiply. Moreover this infected fluid is situated inside the house where it is very likely to contaminate hands or food, more especially if water changes are carried out (as they usually are) in the kitchen sink.

It is easy to see from this how dangerous this seemingly very clean pet may be and how easily its organisms may be spread in the home. If these animals are to be kept there, we think that considerable care should be taken to reduce the risk of infection to the family. Sensible control measures have been recommended to persons possessing pet terrapins by Williams & Helsdon (1965). These are: (1) children should not be allowed to handle turtles unless they are responsible enough to wash their hands after contact; (2) turtle water should not be discharged into the kitchen sink or allowed to contaminate the food preparation area; (3) a

special container should be designated as the turtle dish and be used for nothing else; (4) only one person who is careful to wash his hands should care for the turtle and (5) other household pets should be prevented from drinking the water from the turtle dish.

It is current practice in some infant schools to keep terrapins for the children's interest and observation. Here, too, is a very distinct risk of children being infected, especially if they are allowed to play with the terrapins. Strict precautions should be taken to prevent contamination of fingers. Similarly, the staff of pet stores must also be at risk and this must underline the importance of applying the provisions of the Offices, Shops and Railway Premises Act which is designed, among other things, to protect personnel from such hazards.

We hope that this account will alert those who keep terrapins to their dangers and suggest that simple hygienic measures, to prevent contamination of hands, kitchen and food, are instituted. We hope, also, that it will serve to keep in the mind of any worker investigating an outbreak of salmonellosis that a terrapin may be the source of infection.

SUMMARY

The infection of a child with *Salmonella paratyphi B* phage type Battersea caught from his pet terrapins is recorded. In a small subsequent survey a relatively large proportion of these animals was found to be excreting salmonellas. The danger of these seemingly harmless pets is emphasized.

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