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Salmonella in Reptiles in Zoological Gardens

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Salmonellosis in birds and animals in Egypt is on the increase in both numbers and serotypes. Up to the present, cold-blooded animals have not been investigated for Salmonella to any appreciable extent. This is of special interest since many of these animals were imported from different parts in Africa where many types of Salmonella are prevalent.

The present paper reports the recovery of 10 Salmonella and 4 Arizona serotypes from different cold-blooded animals in the Zoological Garden, Gizeh.

Materials and methods

Faeces were collected from the boxes of 25 reptiles. One gram faeces was first enriched in Selenite F and tetrathionate fluid media and incubated for 24 hours at 37° C. Subcultures were sown on selective solid media (McConkey and SS agar) and the plates incubated for a further 24—48 hours. Colonies simulating salmonellae were picked off and purified. Those showing the characteristic typical behaviour of the genus were identified serologically.

Results

From the 25 samples examined only 13 yielded Salmonella or/and Arizona. In 3 samples double infection with Salmonella and Arizona was found and in another 2 samples double infection with 2 types of Salmonella. In one sample 2 types of Salmonella and one Arizona were isolated.

There were 10 Salmonella serotypes of which *S. llandudno* and *S. chailey* were isolated more than one time. Arizona were met with in 7 samples.

The results are summarized in the following tables:

Table 1 Double and triple infection

Reptile	Microorganism
1. <i>Testudo gigantea</i>	<i>S. llandudno</i> , Ar. 30 : 27 : 28
2. <i>Testudo sulcata</i>	<i>S. llandudno</i> , Ar. 30 : 27 : 28
3. <i>Natrix tessellata</i>	<i>S. typhi-murium</i> , <i>S. chailey</i>
4. <i>Bitis arletans</i>	<i>S. llandudno</i> , <i>S. emek</i>
5. <i>Cerastus cornutus</i>	<i>S. saint-paul</i> , Ar. 26 : 23 : 21
6. <i>Naja nigricollis</i>	<i>S. chailey</i> , <i>S. kingabwa</i> , Ar. 24 : 22 : 25

Table 2
Salmonella and Arizona isolated from faeces of reptile

Serotype	Formula	Reptile
+ <i>S. llandudno</i>	28 ₁ , 28 ₂ : g, m, s, t : 1,5	1. <i>Testudo gigantea</i> 2. <i>Testudo sulcata</i> 3. <i>Bitis arletans</i>
<i>S. typhi-murium</i>	4, 5, 12 : i : 1,2	<i>Natrix tessellata</i>
<i>S. chailey</i>	6, 8, z ₄ , z ₂₃ : e, n, z ₁₅	1. <i>Natrix tessellata</i> 2. <i>Naja nigricollis</i>
<i>S. kingabwa</i>	43 : y : 1,5	<i>Naja nigricollis</i>
<i>S. aqua</i>	30 : k : 1,6	<i>Crotabus ruber ruber</i>
+ <i>S. negev</i>	41 : z ₁₀ : 1,2	<i>Malpolon monspessulans</i>
<i>S. eastbourne</i>	1, 9, 12 : e, h : 1,5	<i>Gecko gecko</i>
<i>S. emek</i>	(8), 20 : g, m, s : -	<i>Bitis arletans</i>
<i>S. saint-paul</i>	4, 5, 12 : e, h : 1,2	<i>Cerastes cornutus</i>
<i>S. muenster</i>	3, 10 : e, h : 1,5	<i>Coluber florulentus</i>
** Ar. 30 : 27 : 28 = (<i>S. arizonae</i>)	65 : z ₁₀ : e, n, x, z ₁₅	1. <i>Testudo gigantea</i> 2. <i>Testudo sulcata</i>
Ar. 24 : 22 : 25 = (<i>S. arizonae</i>)	60 : (k) : z ₅₃	1. <i>Naja nigricollis</i> 2. <i>Naja haja</i>
Ar. 29 : 24 : 31 = (<i>S. arizonae</i>)	64 : r : z	<i>Vipera russelli</i>
Ar. 26 : 23 : 21 = (<i>S. arizonae</i>)	61 : l, v : z ₃₅	1. <i>Coluber raver gier</i> 2. <i>Cerastes cornutus</i>

* Belong to the sub-genus II.

** Arizona species are written with the Salmonella formula since they are classified by Kauffmann as Salmonella sub-genus III.

Discussion

All the Salmonella and Arizona serotypes in the table were isolated for the first time in Egypt from reptiles, as this is the first study in this field. With the exception of *S. typhi-murium*, *S. saint-paul* and *S. eastbourne* the other microorganisms isolated have not hitherto been isolated in Egypt.

S. typhi-murium has been involved several times in outbreaks of ice cream poisoning (AZMY, 1944) and meat and fish poisoning (SANDIFORD, 1936; GOHAR et al., 1938; SANDIFORD et al., 1943/44; MOUSTAFA et al., 1948, and HABLAS, 1966). The same serotype was recovered from different animals pigs (FARRAG EL AFIFI, 1954), cattle and pigs (FLOYD, 1956), sheep (LOTFI and KAMEL, 1964) and buffaloes (ZEIN EL ABEDEEN et al., 1966).

These findings indicate that this serotype is prevalent in Egypt.

It is interesting to note that MCNEIL and HINSHAW, 1944, investigating the epidemiology of *S. typhi-murium* infection in turkey poults, were able to isolate the same serotype from a gropher snake and a garter snake caught on the infected turkey ranches.

S. saint-paul is one of the uncommon Salmonella, but like others in the subgenus I, it is potentially pathogenous for men and animals. In Egypt this type of Salmonella was recorded from slaughtered camels and cattle in Cairo abattoir (FLOYD, 1956; HAMADA et al., 1963 and KAMEL and LOTFI, 1964).

S. eastbourne isolated from the great house Gecko is a rare type which was originally found in one case of enteric fever by LESLIE and SHERA, 1931. In the Sudan, KAHN, 1962, recorded the same type in anm. In Egypt, SADEK isolated it from fresh beef sausages. EL AGROUDI, 1963, recovered it in game birds and LOTFI and KAMEL, 1964, described it in sheep. Therefore, from the public health aspect, the presence of this serotype in the Gecko is hazardous,

especially as Geckos are common in this country. This creature hides at day time and wanders at night in many houses seeking for food; unprotected foods are liable to contamination by its faeces. The *Gecko gecko* eats insects, like flies, mosquitos, ants and cochroaches etc. which might be responsible for its infection.

Salmonellosis in snakes has been the subjects of many investigators. ZWART, 1962, studied salmonella infection in wild and domestic animals in Ghana and found that infection in lizards was the highest (37.5 %) followed by snakes (29.6 %). DELAGE et al., 1963, investigated salmonella in animals in Morocco and came to the conclusion that the highest incidence was in tortoises (70.2 %), then snakes (48 %). Later, MILANOV et al., 1966, found that the proportion of carriers was greatest among tortoises, then snakes and lizards.

It is evident that reptiles whose life history has remained practically unaffected by modern developments in agriculture have recently attracted the attention of epidemiologists who considered them common sources of salmonella without clinical symptoms.

The distribution of salmonella in reptiles is puzzling. Many of the recorded isolations from snakes are from dead or sick animals or from zoological gardens where there is often a risk of infection from some other captives. Since all snakes are carnivorous and are liable to infection from their victims this might explain the simultaneous infection of gropher snakes and turkey poults recorded in Arizona (HINSHAW and McNEIL, 1945/46).

It appears that reptiles are frequently symptomless carriers and are, therefore, a hazard to the control of infection among human and domestic animals. Therefore, the public health significance of this reservoir of salmonella must be considered due to the possible faecal contamination of objects and foods as well as the spread of faecal dust.

Summary

25 faeces samples of reptiles yielded 10 Salmonella and 4 Arizona serotypes. These were: *S. llandudno*, *S. typhi-murium*, *S. chailey*, *S. kingabwa*, *S. aqua*, *S. negev*, *S. eastbourne*, *S. emek*, *S. saint-paul*, *S. muenster*, Ar. 30 : 27 : 28, Ar. 24 : 22 : 25, Ar. 29 : 24 : 31 and Ar. 26 : 23 : 21. In 3 samples double infection with Salmonella and Arizona was noticed. In another 2 samples 2 types of Salmonella and in one sample 2 types of Salmonella and one Arizona were isolated. The public health importance of salmonella infection in reptiles is discussed.

Zusammenfassung

Aus 25 Kotproben von Reptilien wurden 10 Salmonellen-Arten und 4 verschiedene Arizona-Serotypen isoliert. Es handelt sich um: *S. llandudno*, *S. typhi-murium*, *S. chailey*, *S. kingabwa*, *S. aqua*, *S. negev*, *S. eastbourne*, *S. emek*, *S. saint-paul*, *S. muenster*, Ar. 30 : 27 : 28, Ar. 24 : 22 : 25, Ar. 29 : 24 : 31 und Ar. 26 : 23 : 21. In drei Proben wurde eine Doppelinfektion mit Salmonellen- und Arizonabakterien festgestellt. In zwei anderen Proben wurden zwei verschiedene Salmonellen-Typen und in einer Probe zwei Salmonellen-Typen und einmal Arizona nachgewiesen. Die hygienische Bedeutung des Vorkommens von Salmonellen bei Reptilien wird diskutiert.

Résumé

Les salmonelles chez les reptiles des jardins zoologiques

On isole 10 souches de salmonelles et 4 souches d'arizona dans les feces de 25 reptiles différents, maintenus en captivité. Elles appartiennent aux sérotypes suivants: *S. llandudno*, *S. typhimurium*, *S. chailey*, *S. kingabwa*, *S. aqua*, *S. negev*, *S. eastbourne*, *S. emek*, *S. saint-paul*, *S. muenster*, Ar. 30 : 27 : 28, Ar. 24 : 22 : 25, Ar. 29 : 24 : 31 et Ar. 26 : 23 : 21. Dans trois des prélèvements, on a trouvé une infection mixte, avec 1 souche de salmonelle et 1 d'arizona. Dans deux échantillons, on a isolé deux types différents de salmonelles. Dans un échantillon, on a trouvé à la fois 2 types différents de salmonelles et 1 souche d'arizona.

Resumen

Salmonelas en los reptiles de parques zoológicos

En muestras de heces de 25 reptiles diferentes, mantenidos en cautiverio, se aislaron 10 estirpes *Salmonella* y 4 *Arizona*. Pertenecían a los serotipos siguientes: *S. llandudno*, *S. typhi-murium*, *S. chailey*, *S. kingabwa*, *S. aqua*, *S. negev*, *S. eastbourne*, *S. emek*, *S. saint-paul*, *S. muenster*, Ar. 30 : 27 : 28, Ar. 24 : 22 : 25, Ar. 29 : 24 : 31 y Ar. 26 : 23 : 21. En muestras se apreció una infección mixta con cada vez 1 estirpe *Salmonella* y 1 estirpe *Arizona*. Sin embargo, en 2 muestras se aislaron 2 tipos de salmonellas diferentes. En una muestra se hallaron juntos 2 tipos *Salmonella* diferentes y 1 estirpe *Arizona*.

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