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Case Report

FIRST RECORD OF *SALMONELLA* PARATYPHI B IN A CAPTIVE CORN SNAKE IN BULGARIA – CASE REPORT

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ABSTRACT

This report presents a case of an adult captive corn snake (*Pantherophis guttatus*) displaying symptoms of gastrointestinal disorders, including anorexia, diarrhoea, and lethargy. Diagnostic testing using the Vitec 2 Compact System confirmed the presence of *Salmonella* Paratyphi B, a zoonotic pathogen which poses a health risk to both the snake and the humans. Antimicrobial susceptibility testing revealed resistance to cefalexin, gentamicin and amikacin, common veterinary antibiotics, but susceptibility to levofloxacin, ceftazidime, ciprofloxacin, and trimethoprim/sulfamethoxazole which could be used for treatment. This case highlights the zoonotic risks associated with *Salmonella* in reptiles and the need for regular microbiological monitoring to ensure snakes' well-being and public health. It emphasizes the importance of responsible husbandry and veterinary care in preventing the spread of antimicrobial resistance.

Keywords: Corn snake, *Salmonella* Paratyphi B, Vitek 2 Compact, zoonosis, antimicrobial resistance

INTRODUCTION

Reptiles, particularly exotic pet snakes, are recognized carriers of *Salmonella* spp. [1]. While most infections in these reptiles are subclinical, they may occasionally lead to gastrointestinal disease in the host [2]. Additionally, reptile-associated salmonellosis represents a significant zoonotic threat, particularly for children, elderly and immunocompromised individuals [3, 4].

Reports of clinically relevant *Salmonella* enterica group B infections in corn snakes (*P.guttatus*) are rare, indicating the necessity for more extensive investigations and thorough documentation of such cases.

CASE DESCRIPTION

A 2-year-old female corn snake (*P. guttatus*), was adopted from a previous owner who was unable to attend to its needs.

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The snake was kept in a controlled environment within a terrarium (sized 121.9 x 33.0 x 43.2 cm) that provided optimal temperature and humidity conditions, with no other snakes or animals present at the site. The snake was fed frozen/thawed mice at intervals of 10 to 14 days. Soon after being adopted, the snake stopped eating and lost a third of its weight within 50 days. The owners observe mushy feces, report that the snake prefers to hide and shows no interest in the food provided.

CLINICAL EXAMINATION

Clinical assessments were carried out, including measurements of body weight, evaluation of hydration status, and coelomic palpation to assess internal health. The clinical examination revealed lethargy, poor condition, weight of 550g, high-grade dehydration and tenderness on palpation of the abdominal wall. The snake tried to remain stationary during the examination, even when encouraged to move (**Figure 1**).

Figure 1. Corn snake at the time of clinical examination

DIAGNOSTIC METHODS AND LABORATORY FINDINGS

Fecal samples were collected from the cloaca using sterile swabs. Due to the inability to obtain larger amounts of feces during the examination, it was recommended to collect a larger sample after defecation for further testing, specifically for parasitological examination.

The swab samples were later inoculated for liquid enrichment, utilizing Tryptone Soya Broth and Selenite Broth (Soyabean Casein Digest Broth, HiMedia®, India). After this, a loop was taken from the broth and streaked onto solid nutrient media (Blood Agar Base supplemented with 5% defibrinated ovine blood and MacConkey Agar, HiMedia®, India) using four-quadrant streak plate method [5]. The process of incubation typically takes place at a controlled temperature of 37°C for a duration of 24 hours under aerobic conditions. Lactose-negative colonies on MacConkey agar were specifically examined with Kligler Iron agar (HiMedia®, India) to confirm or rule out lactose fermentation, sucrose metabolism, gas production from glucose, and hydrogen sulfide production for the possibility of being *Salmonella*. After suspecting the presence of *Salmonella*, the identified colonies were sent for further examination. They were transferred onto SS agar (HiMedia®, India) and incubated for 24 hours **(Figure 2).** Following this step, single colonies that appeared colorless or transparent with black centers were subjected to automated biochemical profiling using the Vitek 2 Compact system (bioMérieux, France) according to Funke and Funke-Kissling [6]. Serological differentiation was conducted using serotyping methods according to the White-Kauffmann-Le Minor scheme [7]. This process involves slide agglutination with specific sera for O- and H- antigens (Sifin Diagnostics, Berlin, Germany).

Figure 2. SS agar with *Salmonella* like colonies

RESULTS

The gastrointestinal tract interacts with the external environment, making it non-sterile. Initial bacterial isolation identified *Salmonella spp., E. coli, and Pseudomonas aeruginosa.* Semi-quantitative assessment of different bacteria revealed confluent growth of *Salmonella spp.* in the first three quadrants, characterized by overlapping colonies on the agar surface, while only single colonies were observed in the fourth quadrant. The other bacterial species were detected solely as single colonies. The Vitek 2 identification system confirmed *Salmonella enterica* subsp. *enterica*, serovar Paratyphi B, with probability of 97% **(Figure 3).** This identification was further validated through slide agglutination techniques. The isolate was characterized as *Salmonella enterica* serotype O1,4,5,12:Hb:1,2, which is classified as *S. enterica* serotype Paratyphi B according to the Kauffmann-White-Le Minor scheme.

bioMérieux Customer: MB LAB — Microbiology Chart Report — Printed September 27, 2025 9:09:10 AM EEST

Patient Name: P. guttatus, *
Location: amb.
Lab ID: Zmiq225

Patient ID: Zmiq225
Physician:
Isolate Number: 1

Organism Quantity:
Selected Organism : Salmonella ser.Paratyphi B
Source:

Collected: Sep 23, 2025

Comments:	

Identification Information	**Analysis Time:**	5.82 hours	**Status:**	Final
Selected Organism	97% Probability **Bionumber:**	**Salmonella ser.Paratyphi B** 0017610541526210		
ID Analysis Messages				

Biochemical Details

2	APPA	-	3	ADO	-	4	PyrA	-	5	lARL	-	7	dCEL	-	9	BGAL	-
10	H2S	+	11	BNAG	-	12	AGLTp	-	13	dGLU	+	14	GGT	+	15	OFF	+
17	BGLU	-	18	dMAL	+	19	dMAN	+	20	dMNE	+	21	BXYL	-	22	BAlap	-
23	ProA	-	26	LIP	-	27	PLE	-	29	TyrA	+	31	URE	-	32	dSOR	+
33	SAC	-	34	dTAG	-	35	dTRE	+	36	CIT	+	37	MNT	-	39	5KG	-
40	lLATk	+	41	AGLU	-	42	SUCT	+	43	NAGA	-	44	AGAL	+	45	PHOS	-
46	GlyA	-	47	ODC	+	48	LDC	+	53	lHISa	-	56	CMT	+	57	BGUR	-
58	O129R	+	59	GGAA	-	61	lMLTa	-	62	ELLM	-	64	lLATa	-			

Figure 3. Protocol from Vitek 2 confirmed *S.* paratyphi B

Antimicrobial susceptibility testing was conducted using the Vitek 2 AST-GN panel, with minimum inhibitory concentrations (MICs) interpreted according to CLSI standards. The antibiotics tested included ampicillin, amoxicillin/ clavulanic acid, cephalexin, cefixime, cefpodoxime, ceftazidime, ertapanem, amikacin, gentamicin, ciprofloxacin, levofloxacin, fosfomycin and trimethoprim-sulfamethoxazole **(Figure 4).**

bioMérieux Customer: MB LAB — **Laboratory Report** — Printed by: Micro1

System #:
Patient Name:
Isolate: P. guttatus-1 (Qualified)
Card Type: GN Bar Code: 2413067403038506 Testing Instrument: 000014EEE0FD (11382)
Card Type: AST-N437 Bar Code: 0693240104321998 Testing Instrument: 000014EEE0FD (11382)
Setup Technologist: MB Laborant(Micro1)

Patient ID:

Bionumber: 0017610541526210
Organism Quantity:

Selected Organism: Salmonella ser.Paratyphi B

Antimicrobial	MIC	Interpretation	Antimicrobial	MIC	Interpretation
ESBL			Ertapenem	<= 0.12	S
Ampicillin	4	S	Meropenem		
Amoxicillin/Clavulanic Acid			Meningitis	<= 0.25	S
Urine	<= 4	S	Other	<= 0.25	S
Oral	<= 4	I	Amikacin	<= 1	*R
Other	<= 4	S	Gentamicin	<= 1	*R
Cefalexin	8	*R	Ciprofloxacin	<= 0.06	S
Cefixime	<= 0.25	S	Levofloxacin	<= 0.12	S
Cefpodoxime	1	S	Fosfomycin	<= 16	IE
Ceftazidime	0.5	S	Nitrofurantoin		
Ceftriaxone			Trimethoprim/ Sulfamethoxazole	<= 20	S
Meningitis	<= 0.25	S			
Other	<= 0.25	S			

*= AES modified **= User modified IE= Insufficient Evidence that species is good target for therapy; MIC may be reported without interpretation

AES Findings:	**Last Modified:** May 5, 2025 13:56 EEST **Parameter Set:** EUCAST+Phenotypic 2025
Confidence Level:	Consistent

Figure 4. AST-GN protocol

TREATMENT

Supportive therapy included the administration of subcutaneous fluids, maintenance of temperature control, and probiotic supplementation. An antimicrobial treatment protocol was initiated using enrofloxacin at a dosage of 10 mg/kg, administered subcutaneously once daily. To increase safety and prevent transmission of bacteria to humans or other species, additional measures were recommended. These measures focused on emphasizing hygiene practices, consistent use of protective equipment, and thorough disinfection.

OUTCOME

Unfortunately, the snake was discovered deceased on day 3 following the initiation of treatment. A necropsy was not conducted due to the owner's refusal.

DISCUSSION

This case highlights the clinical relevance of *Salmonella enterica* group B infection in corn snake (*P. guttatus*). Salmonellosis in snakes is often underreported, although reptiles are recognized carriers. The clinical picture of infection can vary, and signs are frequently nonspecific. Commonly associated conditions include septicaemia, pneumonia, enterocolitis, abscesses, and osteomyelitis. Clinical disease is relatively rare and is typically linked to factors such as stress, immunosuppression, or inadequate care practices [1, 8, 9]. In this case, there is no evidence indicating that the snake was ill before its transfer to the new owner. Stressors, such as transportation, acclimatization to a new environment, and exposure to unfamiliar noise and vibration (the new owners live on a high-traffic boulevard) may have contributed to its condition [10]. In addition, the change in food supplier is notable. Numerous documented outbreaks have been associated with contaminated feeder rodents, which are recognized as a significant reservoir for various species of Salmonella [11].

Genetic immunosuppression may contribute to the development of clinical diseases in corn snakes. Different morphs of corn snakes result from selectively breeding naturally occurring genetic mutations that produce various colours and patterns. Sometimes, breeders employ inbreeding to maintain these patterns. Although inbreeding in snakes generally causes fewer issues than in mammals, it can still lead to genetic problems and health issues, particularly with designer morphs [12, 13].

The use of automated identification systems such as the Vitek 2 Compact represents a valuable diagnostic tool in exotic animal medicine [14]. The Vitek 2 system provides rapid, standardized identification and antimicrobial susceptibility results within hours, which facilitates targeted therapeutic decisions [6, 15]. In our case, the high-confidence identification of *Salmonella enterica* subsp. *enterica*, serogroup B, underscores the reliability of this system for reptile samples. Antimicrobial resistance among reptile-derived *Salmonella* isolates has been reported worldwide. Resistance to amikacin, cefalexin and gentamicin, as detected here, is consistent with previous findings in both reptiles and feeder rodents [16, 17]. This highlights the importance of culture-guided therapy, as empirical treatment may fail in the presence of resistant strains. Enrofloxacin and ceftazidime proved effective in this case, in line with reports recommending fluoroquinolones or third-generation cephalosporins for severe salmonellosis in reptiles [5, 18, 19]. Nevertheless, antimicrobial therapy in reptiles should be judicious, given the risk of resistance selection and potential impacts on the microbiota. Despite evidence-based therapy, the outcome can be death, probably due to delayed intervention and severe organ damage caused by infection and prolonged starvation. Other authors have also described possible complications that result in sudden death [20].
Serotype Paratyphi B of *Salmonella enterica* is known to cause paratyphoid fever in humans. This illness is typically milder, shorter in duration, and less prone to severe complications compared to classic typhoid fever; however, it can still be serious particularly for young children under the age of 5, adults over 65, and individuals with weakened immune systems. The zoonotic implications of this finding must be emphasized. Corn snakes are increasingly popular as pets, and their close contact with humans, particularly children, poses a risk of transmission [3, 4, 21].

CONCLUSIONS

This case demonstrates that corn snakes can develop clinical salmonellosis due to *Salmonella enterica* group B. It highlights the importance of integrating clinical, microbiological, and epidemiological

approaches in managing diseases associated with reptiles. Effective prevention hinges on providing proper care, monitoring feeder rodents, and educating owners, all of which are crucial for reducing animal morbidity and the risk of zoonotic diseases.

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Data Availability Statement: The original contributions presented in this case are included in the article. Further inquiries can be directed to the corresponding author.

Conflicts of Interest: Not applicable**.**

REFERENCES

1. Pees, M., Brockmann, M., Steiner, N., and Marschang, R. E. *Salmonella* in reptiles: a review of occurrence, interactions, shedding and risk factors for human infections. *Frontiers in cell and developmental biology*, 11, 1251036, 2023.
2. Zając, M., Skarżyńska, M., Lalak, A., Kwit, R., Śmiałowska-Węglińska, A., Pasim, P., and Wasyl, D. *Salmonella* in captive reptiles and their environment—can we tame the dragon?. *Microorganisms*, 9(5), 1012, 2021.
3. Bjelland, A. M., Sandvik, L. M., Skarstein, M. M., Svendal, L., and Debenham, J. J. Prevalence of *Salmonella* serovars isolated from reptiles in Norwegian zoos. *Acta Veterinaria Scandinavica*, 62(1), 3, 2020.
4. Meletiadis, A., Biolatti, C., Mugetti, D., Zaccaria, T., Cipriani, R., Pitti, M., Decastelli, L., Cimino, F., Dondo, A., Maurella, C., Bozzetta, E., and Acutis, P. L. Surveys on Exposure to Reptile-Associated Salmonellosis (RAS) in the Piedmont Region—Italy. *Animals*, 12(7), 906, 2022. https://doi.org/10.3390/ani12070906,
5. Sanders ER.Aseptic laboratory techniques: plating methods. *J Vis Exp* JoVE 63:e3064, 2012.
6. Funke, G., & Funke-Kissling, P. (2004). Evaluation of the new VITEK 2 card for identification of clinically relevant gram-negative rods. *Journal of clinical microbiology*, *42*(9), 4067-4071. (Sanders ER (2012) Aseptic laboratory techniques: plating methods. J Vis Exp JoVE 63:e3064)
7. Grimont, P. A., and Weill, F. X. Antigenic formulae of the *Salmonella* serovars. *WHO collaborating centre for reference and research on Salmonella*, 9, 1-166, 2007.
8. Claunch, N. M., Lind, C., Lutterschmidt, D. I., Moore, I. T., Neuman-Lee, L., Stahlschmidt, Z., and Penning, D. Stress ecology in snakes. *editor Penning D. Snakes. Nova Science Publishers, Inc*, 415-478, 2023.
9. Khan, H. A., Almalki, M. H., Felemban, R., Elbanna, K., and Abulreesh, H. H. Antibiotic-resistant salmonellae in pet reptiles in Saudi Arabia. *Microbiology Independent Research journal*, 9(1), 31-36, 2022.
10. Mancera, K. F., and Phillips, C. J. Effects of noise and light. In *Health and welfare of captive reptiles* (pp. 357-378). Cham: Springer International Publishing, 2023.
11. Basiouni, S., Rodriguez-Morales, A. J., Shehata, A. A., and Duarte, P. M. Silent Carriers: The Role of Rodents in the Emergence of Zoonotic Bacterial Threats. *Pathogens*, 14(9), 928, 2025.
12. Fankhauser, G., and Cumming, K. B. Snake hybridization: A case for intrabaraminic diversity. In *Proceedings of the International Conference on Creationism* (Vol. 6, No. 1, p. 13), 2008.
13. Clark, M. I., Hileman, E. T., Moore, J. A., Faust, L. J., Junge, R. E., Reid, B. N., and Fitzpatrick, S. W. Inbreeding reduces fitness in spatially structured populations of a threatened rattlesnake. *Proceedings of the National Academy of Sciences*, 122(34), e2501745122, 2025.
14. Cristina, R. T., Kocsis, R., Dégi, J., Muselin, F., Dumitrescu, E., Tirziu, E., and Oprescu, I. Pathology and prevalence of antibiotic-resistant bacteria: a study of 398 pet reptiles. *Animals*, 12(10), 1279,2022.
15. Kitchens, S. R., Wang, C., and Price, S. B. Bridging classical methodologies in *Salmonella* investigation with modern technologies: A comprehensive review. *Microorganisms*, 12(11), 2249, 2024.
16. Gwenzi, W., Chaukura, N., Muisa-Zikali, N., Teta, C., Musvuugwa, T., Rzymski, P., and Abia, A. L. K. Insects, Rodents, and Pets as Reservoirs, Vectors, and Sentinels of

Antimicrobial Resistance. *Antibiotics*, 10(1),68, 2021. https://doi.org/10.3390/antibiotics10010068

17. Marin, C., Lorenzo-Rebenaque, L., Laso, O., Villora-Gonzalez, J. and Vega, S. Pet reptiles: a potential source of transmission of multidrug-resistant *Salmonella*. *Frontiers in Veterinary Science*, 7, 613718, 2021.
18. Hedley, J., Whitehead, M. L., Munns, C., Pellett, S., Abou-Zahr, T., Calvo Carrasco, D., and Wissink-Argilaga, N. Antibiotic stewardship for reptiles. *Journal of Small Animal Practice*, 62(10), 829-839, 2021.
19. Maugeri, G., Lychko, I., Sobral, R. and Roque, A. C. Identification and antibiotic-susceptibility profiling of infectious bacterial agents: a review of current and future trends. *Biotechnology journal*, 14(1), 1700750, 2019.
20. Meletiadis, A., Romano, A., Moroni, B., Di Nicola, M. R., Montemurro, V., Pitti, M., and Acutis, P. L. A case of food-borne salmonellosis in a corn snake (Pantherophis guttatus) after a feeder mouse meal. *Animals*, 14(12), 1722, 2024.
21. Pasmans, F., Martel, A. N., and Jacobson, E. R. Bacterial diseases of reptiles. *Infectious diseases and Pathology of reptiles*, 705-794, 2020.