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Parasitic fauna of captive snakes in Tamilnadu, India

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ABSTRACT

Objective: To study the parasitic fauna on serpentines under captive condition in zoological park of Tamilnadu, India.
Methods: Fecal samples were collected from (n = 247) serpentines, Arignar Anna Zoological Park (n = 22), Vandalur, Tamilnadu, India and Snake Park (n = 27), Guindy, Tamilnadu, India and screened for endoparasites using sedimentation techniques. Ectoparasites were also reported in this study.
Results: Coprological examination (n = 247) from captive snakes (n = 49) on random analysis revealed strongyles were predominant in Arignar Anna Zoological Park, Vandalur and Snake Park, Guindy, however the parasites were absent in king cobras (*Ophiophagus hannah*). Eggs of *Capillaria* sp. showed less predominance in Vandalur and Gunidy. Rat snakes [*Ptyas mucosus* (*P. mucosus*)] showed higher prevalence of strongyle infection in Vandalur, and Russell's viper (*Daboia russelii*) showed higher prevalence in Guindy. Study on ectoparasites revealed *Aponomma gerviasii* ticks in *P. mucosus*, Indian cobras (*Naja naja*), king cobras (*Ophiophagus hannah*), reticulated pythons (*Python reticulates*) and Indian rock pythons (*Python molurus*), among them, the most heavy infestation was documented in *P. mucosus* (n = 9).
Conclusions: Confinement favour stress and dysecdysis in captive condition affect the health status of snakes in zoological park.

1. Introduction

Reptiles harbour a variety of helminthes. The infestation with parasites plays an important role. Stressful life, concentration of animals and the presence of different species in a small living space actuate development, multiplication and spreading of parasites, which in nature live in cohabitation with their hosts. All these factors suppress the immune response in reptiles and increase the opportunity for viruses, bacteria, yeast and funguses to cause infections and consequent diseases. Reptiles may carry diseases, which can be spread to other animal species and even to humans[1]. The parasitic burden is often heavy, every body surface and organ may be invaded by some kind of larval or adult parasites. In zoo, captivity causes stress and this may change the host parasite relationship and results in a disease. Wild and captive reptiles are infected and infested with a great variety of parasites. Numerous parasites are responsible for illness and death in captive reptiles. The difference in the host parasite relationship between captive and wild reptiles must be considered. Although reptiles in the wild are not without stresses, they obviously do not undergo the stresses of captivity[2]. In captivity, we confined the reptiles in most cases, to relatively small areas thus contributing to increased parasite load, especially of those parasites with direct life cycles. The variation in the diet of wild reptiles is also advantageous. The reptiles may harbour parasites for considerable lengths of time before showing signs of illness, clinical disease which may be seen later when predisposing factors compromise the host immunologically and allow the development of evident infection[3]. A broad spectrum of internal parasites harbour on reptiles, including diverse species of protozoans, nematodes, cestodes, pentastomids, acanthocephalans and trematodes[4-9]. Accurate coprological examinations for reptile parasite stages are an important part of the daily routine for

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veterinarians to ensure the health and well-being of these animals[10].

2. Materials and methods

2.1. Place and period of study

The study on snakes at Arignar Anna Zoological Park, Vandalur and Snake Park, Guindy, Tamilnadu, India was carried out during the winter season (Nov-Jan) under captive condition.

2.2. Collection and processing of coprological samples

Coprological samples (*n* = 247) collected from Arignar Anna Zoological Park, Vandalur (*n* = 22) and Snake Park, Guindy (*n* = 27) and hence a total of (*n* = 49) snakes were randomly collected in labeled containers. Fecal floatation and sedimentation technique was used for fecal examination[11,12].

2.3. Identification of nematode eggs

Nematode eggs were identified by the shape, size and other species specific characters of the particular parasitic ova[3,13].

2.4. Collection and processing of ectoparasites

Ectoparasites were collected from captive snakes (*n* = 21), nine rat snakes [*Ptyas mucosus* (*P. mucosus*)], four Indian cobras (*Naja naja*) and two king cobras (*Ophiophagus hannah*) reared at Arignar Anna Zoological Park, Vandalur and two Indian rock pythons (*Python molurus*) and four reticulated pythons [*Python reticulates* (*P. reticulates*)] reared at Guindy Snake Park. The ectoparasites were kept in collection bottle with lint cloth tied over the mouth for ventilation. The tick was processed and mounted after treatment with sodium hydroxide boiling for 10 min and in 70% alcohol for 5 min and 90% alcohol for 5 min and finally in carbolic acid for 10 min. The tick was placed in the slide and 1 or 2 drops of canadabalsam was applied over this and examined microscopically and identified[2].

3. Results

Vandalur samples (Table 1) collected from *P. mucosus* indicated high percentage of occurrence with strongyles (41.7%) and in *P. reticulates*, it was with mixed infection of strongyles, *Strongyloides* sp. and coccidian oocysts (Figure 1) (30.8%). Higher percentage was observed to be with strongyles (Figure 2) in case of *P. mucosus* (41.7%). Strongyle larvae (Figure 3) from Russell's viper were also documented in this study. Adult *Ophidascaris* sp. worm was noticed in Indian rock python (Figure 4).

Figure 1. Sporulated and unsporulated oocyst of *Eimeria* sp. (200 ×).

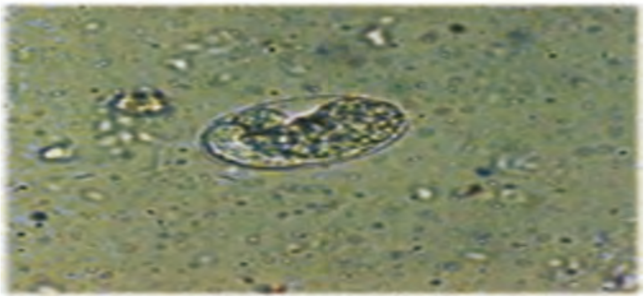

Figure 2. Strongyle egg (200 ×).

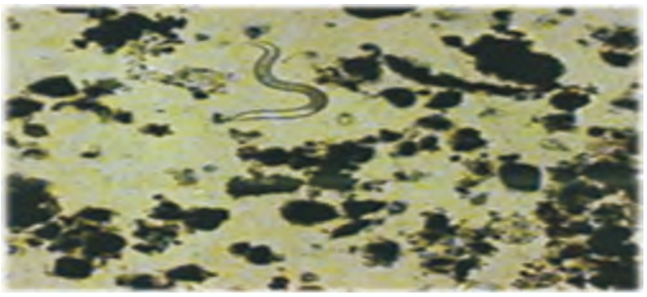

Figure 3. Strongyle larva (200 ×).

Figure 4. Adult worm (*Ophidascaris* sp.) of Indian rock python.

Table 1

Endoparasitic infection of snakes at Arignar Anna Zoological Park, Vandalur [*n* (%)].

Parasites	Species of snakes						
	P. mucosus (*n* = 5)	Reticulated python (*n* = 3)	Indian rock python (*n* = 4)	Common krait (*n* = 2)	Indian cobra (*n* = 4)	Russell's viper (*n* = 2)	King cobra (*n* = 2)
Strongyles	10 (41.7)	2 (15.4)	4 (28.6)	3 (23.1)	3 (23.1)	5 (38.5)	Nil
Strongyloides sp.	6 (25.0)	3 (23.1)	2 (14.3)	1 (7.7)	2 (15.4)	2 (15.4)	3 (30.0)
Ophidascaris sp.	3 (12.5)	1 (7.7)	3 (21.4)	4 (30.8)	3 (23.1)	2 (15.4)	1 (10.0)
Capillaria sp.	Nil	Nil	1 (7.1)	1 (7.7)	Nil	Nil	Nil
I. Strongyles + *Strongyloides* sp. + *Ophidascaris* sp.*	3 (12.5)	Nil	Nil	2 (15.4)	Nil	2 (15.4)	2 (20.0)
II. Strongyles + *Strongyloides* sp. + Coccidian oocyst*	2 (8.3)	4 (30.8)	3 (21.4)	Nil	3 (23.1)	1 (7.7)	1 (10.0)
Negative cases	Nil	3 (23.1)	1 (7.1)	2 (15.4)	2 (15.4)	1 (7.7)	3 (30.0)
Total number of fecal samples examined	24	13	14	13	13	13	10

*: Mixed infection.

Table 2
Endoparasitic infection of snakes at Snake Park, Guindy [*n* (%)].

Parasites	Species of snakes						
	P. mucosus (*n* = 5)	Reticulated python (*n* = 3)	Indian rock python (*n* = 4)	Common krait (*n* = 5)	Indian cobra (*n* = 4)	Russell's viper (*n* = 3)	Saw scaled viper (*n* = 3)
Strongyles	4 (14.3)	2 (11.8)	5 (17.9)	5 (19.2)	6 (27.3)	7 (50.0)	1 (8.3)
Strongyloides sp.	6 (21.4)	4 (23.5)	5 (17.9)	3 (11.5)	Nil	2 (14.3)	4 (33.3)
Ophidascaris sp.	3 (10.7)	Nil	4 (14.3)	7 (26.9)	3 (13.6)	2 (14.3)	2 (16.7)
Capillaria sp.	4 (14.3)	Nil	Nil	2 (7.7)	Nil	Nil	Nil
I.*Strongyles* + *Strongyloides* sp. + *Ophidascaris* sp.	9 (32.1)	4 (23.5)	3 (10.7)	4 (15.4)	4 (18.2)	Nil	2 (16.7)
II.*Strongyles* + *Strongyloides* sp. + Coccidian oocyst	2 (7.1)	2 (11.8)	4 (14.3)	3 (11.5)	5 (22.7)	Nil	Nil
Negative cases	Nil	5 (29.4)	7 (25.0)	2 (7.7)	4 (18.2)	3 (21.4)	3 (25.0)
Total number of fecal samples examined	28	17	28	26	22	14	12

*: Mixed infection.

Samples from Guindy showed adult worm of *Ophidascaris* sp. (Figure 5) recovered from *Python molurus*. The analysis (Table 2) revealed that sample from *P. mucosus* indicated presence of mixed infections (strongyles, *Strongyloides* sp. and *Ophidascaris* sp.) as the highest percentage (32.1%) and in *P. reticulates*, it was the same type of mixed infections as above, together with the *Strongyloides* sp. (Figure 6) which revealed highest percentage (23.5%). *Capillaria* sp. (Figure 7) was recorded in rat snakes, common krait and Indian rock python. Ectoparasites study revealed that the most heavy infestation of *Aponomma gerviasii* (*A. gerviasii*) ticks was in *P. mucosus* (9) from zoological park (Figure 8), while the number of *A. gerviasii* in Indian cobra and King cobra from zoological park was 4 and 2, respectively, in Indian rock python and reticulated python from snake park was 2 and 4, respectively.

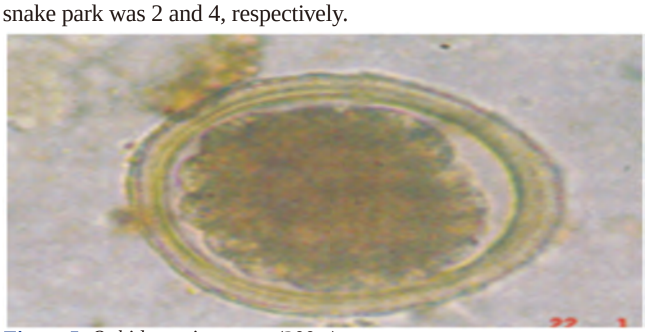
Figure 5. *Ophidascaris* sp. egg (200 ×).


Figure 6. *Strongyloides* sp. egg (200 ×).

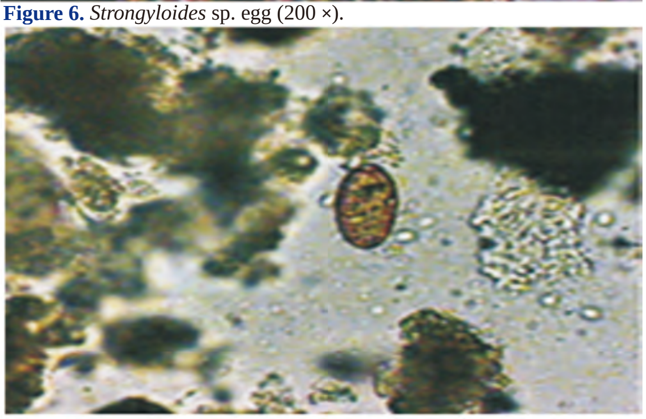
Figure 7. *Capillaria* sp. egg (200 ×).

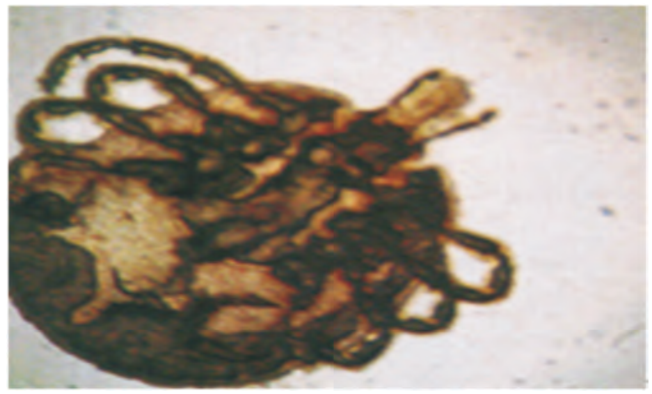
Figure 8. *A. gerviasii* (200 ×).

4. Discussion

4.1. Endoparasites in snakes

The parasitic diseases of reptiles have been reviewed[14]. The parasitic fauna of reptiles has been reported in Iranian snakes[15], Colubridae family[16], Russell's viper[17,18], green tree snake[19], Chinese wild snake[20], wild caught snake of Kerala, India[5] and Srilankan snakes[21]. The present study performed describes the possible report of parasitic fauna of snakes in captive conditions of south Tamilnadu, India. The fecal floatation and sedimentation techniques used in this study show sensitivity for detection of evolutionary forms of protozoa and helminths present in stool samples as per Souza *et al*.[22], fecal floatation proved superior in the detection of coccidian oocyst and nematode eggs[12].

Incidence of internal parasitism might be expected considerably in snakes due to the different feeding habits of the snakes. In addition to strongyle, *Strongyloides* sp., *Ophidascaris* sp. and *Capillaria* sp., the mixed infections including the coccidian oocysts were also revealed during the study at Arignar Anna Zoological Park, Vandalur and Snake Park, Guindy. Strongyles and *Strongyloides* sp. infection were reported by Soulsby[11]. Eggs of strongyle were identified in majority of the faecal samples of all species, except king cobras. Momin *et al*. stated that *Kalicephalus* was the clinically most important strongylid of snakes[14]. The eggs of strongyles were identified by thin wall and the presence of larval stage inside the egg. Encountering the eggs of *Strongyloides* sp. like the case with this study was in agreement with the findings of Holt *et al*.[23,24] who reported on the presence of numerous *Strongyloides* larva in faecal samples of snake's evinced anorexia, dehydration and weight reduction. The most frequent parasites found in snakes were

Strongylid, nematoda (*Kalicephalus* sp.)[8]. Among eleven snakes (6 different species), four had *Strongylid* eggs while others had also adults in their intestines, in the study[8]. *Kalicephalus* sp. is a hookworm from the order Strongylida, family Diaphanocephalidae. Some morphologic characteristics of *Kalicephalus* sp. are well described by Telford[25]. Ascarid eggs, *Strongyloides* sp., *Capillaria* sp., and coccidian oocysts were also detected. Similar parasite invasions are described in the literature[26,27]. Ascarid eggs which we found were spherical to subspherical with brownish-yellow shell, striated and 6.5 µm thick. We assumed the eggs belong to Ascaridoid nematode, *Ophidascaris* sp., which is frequently found in pythonid and colubrid snakes. Ascarid nematoda is one of the most important pathogen for snakes and infestation can be fatal[28]. In one Spotted Desert racer pinworm eggs were found[28] and described the same eggs in ball pythons. In our case pinworm eggs originated from eaten mice. We agree with Rajesh *et al.*[29] that some typical eggs in snake faeces cannot be found because snakes often feed with rodents.

Eggs of *Ophidascaris* sp. were identified in samples from pythons, cobras, common kraits, Russell's vipers and rat snakes, under study. This was in agreement with the findings presented by Brar *et al*.[30], who encountered worms of *Ophidascaris ajgaris* in pythons. Rosenthal[13] stated that *Ophidascaris* sp. and *Hexametra* sp. were the most common genera of *Ascarids* noticed in snakes, in which they inhabit stomach, oesophagus and/or small intestine and the worms could occlude the stomach leading to regurgitation, diarrhoea and purulent pneumonia. Ingestion of intermediate hosts like frogs and rodents might have caused this problem.

Capillaria sp. eggs were identified in this study as per the keys furnished by Rosenthal[13], who stated that *Capillaria* was the only known genus of the trichurids infecting the snakes and lizards and these affect primarily the intestines. However, eggs of *Capillaria* sp. were revealed only in lesser numbers of samples under study.

The mixed infections in this study was in agreement with the findings of Rao and Acharjyo[31] , who encountered evidences of *Ophidascaris ajgaris* including bothridium pythonis in Indian rock python. It was a common concept that parasites in reptiles were so perfectly adapted to their host under natural conditions that they would not cause disease. However, this might not be taken correct as evident from the reports presented by Momin *et al.*[32]. Existence of multiple parasites as in case of mixed infections found out in this study might interfered with the immune system of the captive snakes and thereby making these serpentine species more vulnerable to various kinds of microbial infection which is still to be detailed in case of snakes. This concept was being supported by Holt *et al.*[23], who quoted that in addition to causing dehydration and electrolyte imbalances, the parasites might render the host susceptible to fatal secondary bacterial infections. Hence, serious degree of endoparasitism as well as endoparasitism in snakes coupled with occurrence of related clinical signs, if encountered by the attending wildlife veterinarian of the zoological park or the snake park warrant the appropriate therapy with suitable anthelminthic agent. The mixed helminthic infection was almost in all snakes under study might be mostly due to the picking up of the parasites in the natural habitat and from the concerned prey species.

Evidences of coccidian oocysts as found out during the study almost in all species of snakes in both the places except the common kraits of the zoological park was in agreement with the reports given by Momin *et al.*[14] who quoted that the clinically significant genera of coccidia infecting reptiles were *Eimeria, Isospora, Caryospora* and *Cryptosporidia*. Similarly, oocysts of *Tantilla* sp. were reported by Telford[33]. Husbandry practices, crowding, concurrent presence of other infections *etc*. might be associated with the occurrence of coccidiosis in snakes or any other reptilian group. Rosenthal[13] stated that transmission of coccidiosis occurred by ingestion of sporulated oocysts from contaminated faeces or soil.

In all the coprological samples of snakes obtained at both the zoological park and the snake park revealed no evidence of parasitic infection with cestodes. In this regard, it is noteworthy to mention that the aquatic species-garter snakes, ribbon snakes, grass snakes *etc*. appeared to be at greater risk from serious cestodes infection than the rodent eating snakes[34]. Rodents were the major feed components in almost all the snake species encountered in this study. The variation in occurrence of parasitic prevalence at zoological park and snake park might be attributed to the variations in anthelminthic treatment, feeding practices, husbandry practices *etc.* The findings in the snakes under investigation indicated that most of the snakes harboured parasitic burden and whenever parasitic presence increase in quantity due to multiple factors like immuno-compromise of the body, going-down in condition *etc.*, it may affects the health status of the captive snakes. Hence, it seems to be of significance in the management of snakes under captive conditions that the live animal food offered to these snakes should be healthy and routinely dewormed. It is noteworthy to mention that periodical sampling of not only the serpentine species reared as exhibits in zoological parks, but also the prey species was highly required, in addition to the appropriate anthelminthic treatment in them and such management measures might be of more useful for the better management of the serpentine species, under captive conditions.

4.2. Ectoparasites in snakes

Aponomma sp. ticks were identified based on the keys furnished by Soulsby[11], who quoted that the species of this genus occur almost exclusively in reptiles. *A. gerviasi* ticks were revealed in snakes[35]. Ticks belonging to *Aponomma* sp. were documented in snakes by Fowler and Miller, De Meneghi[3,36]. Though *Aponomma* helvolum was encountered in both king cobra and the land monitor by Rao and Acharjyo[31], no such species was encountered in case of rat snakes, Indian cobras, king cobras, Indian rock pythons and reticulated pythons studied at both zoological park and snake park. Fowler and Miller[3] quoted that even under captive condition, ticks rarely reached the burdens achieved by mites. However, in the fifteen number of tick-infested snakes, comprising of rat snakes, Indian cobras, king cobras, Indian rock pythons and reticulated pythons, heavy infestations with *A. gerviasii* of ticks were identified in seven number of snakes and this indicated that the secondary problems due to tick infestations might well be anticipated in snakes also, like the case with other reptilian or mammalian species. However, it requires detailed study in this regard. Since, blood samples were not obtained during this study programme, anaemic status could not be revealed in these snakes. Interestingly, more number of rat snakes was found to be infested with ticks, followed by reticulated pythons and Indian cobras. The nature of skin, overall health status and habits especially, feeding nature *etc.* might be attribute to infestations with ticks as encountered in this study.

Confinement favour stress and dysecdysis in captive condition affect the health status of snakes in zoological park.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgments

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