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Original papers

Helminth parasites of the white-spotted wall gecko, *Tarentola annularis* (Squamata: Gekkonidae), from Shendi area, Sudan

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ABSTRACT. This is the first report on helminths parasitize the white-spotted wall gecko, *Tarentola annularis* from Shendi area in Sudan. A total of 32 geckos were collected between January and May 2018, and examined for helminth infections. Three nematode species of the family Pharyngodonidae were identified: *Pharyngodon mamillatus*, *Spauligodon brevibursata* and *Parapharyngodon* sp. The most prevalent nematode found was *P. mamillatus* followed by *S. brevibursata*. The overall prevalence and intensity of infections was 81.3% and 6.8 nematodes per one infected gecko, respectively. The prevalence and intensity of infections were observed to be more in adult male geckos compared to adult females. On the other hand, the prevalence and intensity of infections were significantly higher in adult geckos compared to the juveniles.

Key words: *Tarentola annularis*, helminth, prevalence, intensity, Sudan

Introduction

Different genera of geckos are known as common reptile of human dwellings around the world. At present, the gecko, genus *Tarentola*, family Gekkonidae [1] comprises of 21 similar species, originally found in semi-arid to arid habitats of North Africa, however, some species have been found in the Mediterranean Sea regions, Macaronesia, the West Indies and the United States [2−5]. *Tarentola* geckos are typically nocturnal and inhabit dry sandy and rocky areas, trees and human constructions [2].

The white-spotted wall gecko, *Tarentola annularis* is a medium-sized robust gecko, male larger than female and have broader head, it is primarily nocturnal and native to northern Africa [5,6]; this species resides different microhabitats and can be found in the human constructions, especially in the abandoned buildings; feeding upon a wide variety of invertebrate preys [7] or even small vertebrates [6,8]. Previous reports reveal infection of *T. annularis* with different parasite species [9−13]. However, in general, gecko species are reported to be parasitized by various parasite species such as protozoans [14], nematodes [15], cestodes [15,16] and mites [17].

Because of the limited information concerning parasites of the gecko, *T. annularis*, in Sudan, this study was carried out to investigate the prevalence and intensity of parasitic helminths as well as the relationship between prevalence and intensity to age and sex of this gecko for the first time in Shendi area, River Nile State of Sudan.

Materials and Methods

The gecko, *T. annularis*, collected between January and May 2018, using a plastic net from their hiding places in and around buildings at the Southern Campus of Shendi University, Shendi (16°40'N, 33°25'E). This area is located very close

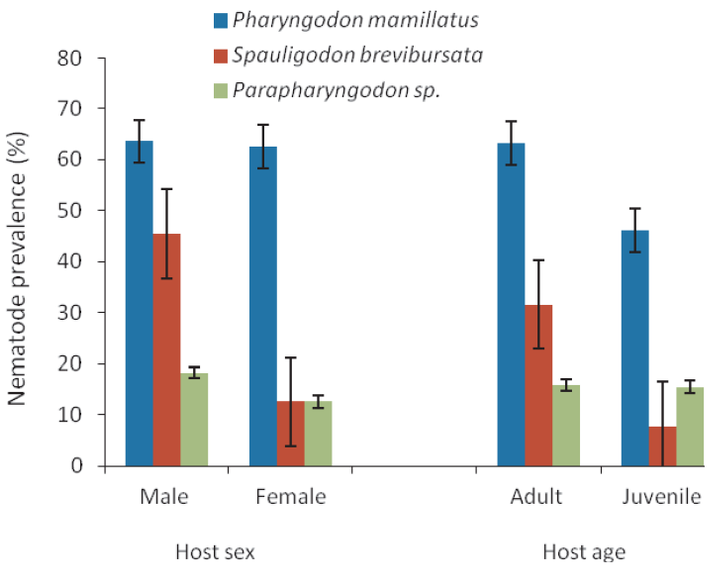

Fig. 1. Prevalence of nematode species infection, separated by sex (male: n=11; female: n=8) and age (adult: n=19; juvenile: n=13) of the gecko, *T. annularis* collected between January and May 2018, from Shendi area, Sudan
Abbreviations: Asterisk indicate significant differences between adult and juvenile, $^{*}P < 0.05$

to the Nile River course in semiarid climate with an annual mean precipitation of 29.3 mm between August and September, and annual temperature ranges from 28–41°C. The geckos were taken to the laboratory of Zoology at the campus and they were sacrificed using chloroform. Thereafter, their snout-vent length (SVL) and gender were recorded. A gecko was considered an adult if it measured > 50 mm in SVL. In necropsy, the internal organs: lungs, heart, liver, urinary bladder, esophagus, stomach, small intestine and large intestine were removed, opened and placed in a normal saline solution (0.9%) in separate petri-dishes, and examined thoroughly under a stereo microscope for helminth infections. Helminths isolated were placed in lactophenol, allowed to clear and examined using a light microscope, and were identified to genus level and species level using available literature and systematic keys [13,18,19]. The prevalence and intensity of infections in relation to the host age (adult or juvenile) and gender (male or female) were calculated [20]. Data analysis was performed using Chi-square and Mann–Whitney tests, statistical software, SPSS 16.0 for Windows (SPSS Inc., Chicago, IL, USA) and values were considered significant when $P < 0.05$.

Results

A total of 32 *T. annularis* were collected, with a mean SVL 71.4 ± 3.1 mm (range 30–121 mm), consisted of 11 adult males, 8 adult females and 13 juveniles. Out of the 32 collected geckos, 26 (81.3%) were found infected with one or more of nematode species with an overall intensity of 6.8 nematodes per infected gecko, included 3 identified species, namely: *Pharyngodon mamillatus*, *Spauligodon brevibursata* and *Parapharyngodon* sp. The dominant nematode found was *P. mamillatus*, 56.3%, followed by *S. brevibursata*, 21.9% and *Parapharyngodon* sp. 15.6%. Twenty two of the geckos examined (68.8%), harbored single infection while 4 harbored mixed infection (12.5%). All of the nematode species identified were recovered from the large intestine of the examined geckos. Overall intensity of infection with *P. mamillatus*, *S. brevibursata* and *Parapharyngodon* sp. was 7.2 (range 2–17), 4.7 (range 2–8) and 3 (range 2–3), respectively.

Relatively higher prevalence of infection was observed in adult male geckos compared to adult females, however, the difference was statistically not significant ($\chi^2 = 8.70$, df = 8, $P = 0.40$). On the other hand, a significant higher prevalence of infections was found in adult geckos compared to the juveniles ($\chi^2 = 23.2$, df = 11, $P = 0.02$), (Fig. 1).

Adult male geckos were significantly harbored higher intensity of infection than adult females, ($U = 19.5$, $Z = -2.05$, $P = 0.04$). Likewise, a significant higher intensity of infection was observed among adult geckos compared to the juveniles, ($U = 24.0$, $Z = -3.9$, $P = 0.000$), (Fig. 2).

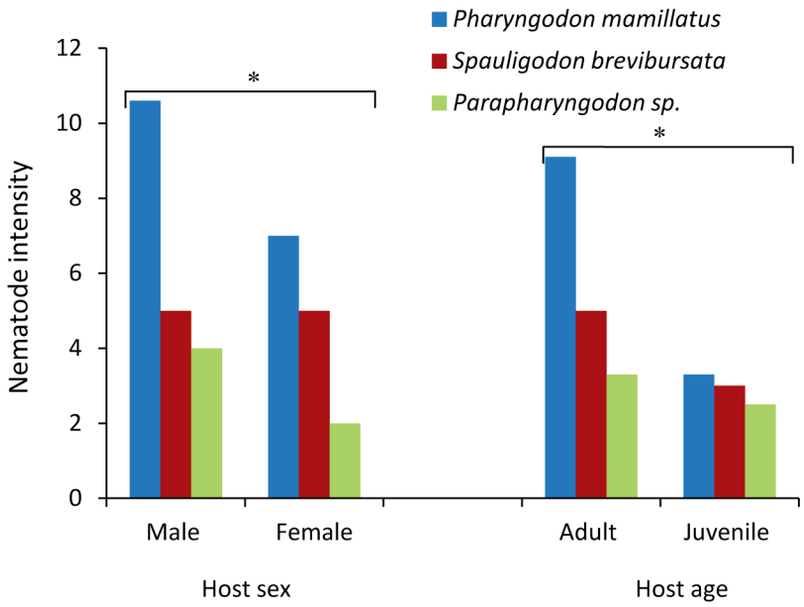

Fig. 2. Intensity of nematode species infection, separated by sex (male: n=11; female: n=8) and age (adult: n=19; juvenile: n=13) of the gecko, *T. annularis* collected between January and May 2018, from Shendi area, Sudan
Abbreviations: Asterisks indicate significant differences between male and female, and between adult and juvenile, $^{*}P < 0.05$

Discussion

This study is the first attempt to determine the helminth parasites of the white-spotted gecko, *T. annularis* from Shendi area in Sudan. Results revealed that this gecko was parasitized by three nematode species of the family Pharyngodonidae, namely, *Pharyngodon mamillatus*, *Spauligodon brevibursata* and *Parapharyngodon* sp.

Species of the nematode in genus *Pharyngodon* occur primarily in lizards worldwide; however, some species are found infecting amphibians. In this study, the dominant nematode found in terms of prevalence and intensity of infection was *P. mamillatus.* Previously, *P. mamillatus* have been determined to parasitize the gecko, *T. annularis* [13,19]. Likewise, some other reptiles such as the lizard, *Chalcides ocellatus* also found infected with this nematode species [21]. Commonly, *Pharyngodon* species found parasitized other geckos and lizards, such as the gecko, *Gehyra oceanic* parasitized by *P. oceanicus* [22] and the lizards, *Sceloporus minor* and *S. grammicus* parasitized by *S. lamothei* [23].

In this study, the nematode *S. brevibursata* have been found parasitizing only seven geckos. Previously, many species of this genus, *Spauligodon* have been reported to parasitize *Tarentola* geckos, such as *T. bocagei* and *T. nicolauensis* found parasitized by *S. nicolauensis* [24]. Likewise, many other geckos found parasitized by *Spauligodon*, such as the gecko, *P. capensis* parasitized by *S. blydeensis* [25], the gecko, *Cyrtodactylus bintangrendah* parasitized by *S. bintangensis* [26] and the gecko, *Phyllopezus pollicaris* parasitized by *S. oxkcutzcabiensis* [27].

In this study, five geckos were found parasitized by a species of *Parapharyngodon*. Previously, many *Parapharyngodon* species have been determined to parasitize reptiles worldwide such as *P. bulbosus* parasitized the lizard *C. ocellatus* [28], *P. micipsae* parasitized the gecko *T. parvicarinata* [29], and *P. maplestoni* parasitized the lizards *Hemidactylus parvimaculatus* and *H. leschenaultia* [30].

The present study showed that 68.8% of geckos harbored single infection. This is likely because of the limited space and food in intestine which leads to the competition among nematodes [31]. In this study, the prevalence and intensity of infections were observed to be higher in adult male geckos compared to adult females. This observation can be explained that the adult male geckos are likely more active and can occupy more favorable areas where they come in contact with the parasites and their vectors. Moreover, male lizards are more susceptible to parasite infections probably due to the immune suppressive effects of testosterone, during the reproductive period [32–34], or some male

lizards have a habit of touching feces of other lizards using tongue, hence they are more prone to infection [31,35]. Previously, it has concluded that the prevalence or intensity of infection is more often higher in males than in females in vertebrates of many classes [36,37].

On the other hand, the prevalence and intensity of infections were significantly higher in adult geckos compared to the juvenile. This finding agrees with previous results that old hosts tend to acquire more infections due to their long exposure time to parasite infective stages [36,38]. Moreover, older hosts are likely to have a large body mass that facilitates place for more parasites. In addition, feeding habits of an older host is likely varied and they are better competitors than juveniles [39]; hence the more chances for parasites accumulation.

In conclusion, further studies are required on the parasite fauna of the white-spotted gecko, *T. annularis* in Shendi area of Sudan.

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