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A Survey of Helminth Parasites of the Lizard, *Agama agama* in Ile–Ife and Ibadan Southwest Nigeria

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Abstract

A parasitological survey was carried out between February and October, 2015 to determine the helminth fauna of the lizard, *Agama agama* from two locations Ibadan and Ile-Ife, Southwest Nigeria. A total of 133 specimens were collected and examined for helminth infections. The results showed that the overall prevalence of helminth infection in *A. agama* was 100%. Five species of helminths were recovered comprising three nematodes, *Strongyluris brevicaudata* (92.5%), *Parapharyngodon sp.* (89.5%) and unidentified nematode (0.8%), one species of cestode, *Oochoristica truncata* (56.4%) and one species of trematode, *Mesocoelium monas* (1.5%). *S. brevicaudata* was the most frequently encountered parasite in the Agama lizard in both Ibadan and Ile-Ife. Worm burden (intensity) was highest in the rectum. The intensity of helminth infection increased with the size of the lizard. Multiple infections with two or more parasites (81.2%) were the most common. None of these parasites have been reported in human beings.

Keywords: Lizards; Nematodes; Reptiles; *Strongyluris brevicaudata*; Helminths; Nigeria

Introduction

Lizards are apparently found everywhere in many of the tropical climates of the world because of their poikilothermic nature. Lizards vary in size, shape and colour. Most lizard species are harmless to humans unless cornered [1] which makes it a thing of interest for some to be kept as pets including bearded dragons, iguanas, anoles and geckos [2].

Lizards and other reptiles such as snakes, crocodiles are used for food in some parts of the world [3]. For example in Southwest and Southeast part of Nigeria, the clouded–monitor lizard is a source of meat among poor people. They serve an important role in insect control in some agricultural areas. In Africa, the lizards commonly found are Geckos, *Agama* lizard, Chameleons, Monitor lizard, Alligator lizard [4].

Agama agama has been reported by Wehke and Olayinka [5] to serve as transport and reservoir host to several protozoan and helminth parasites. Some parasites of lizards for example *Armillifer armilatus*, a Pentastomid has been reported to be zoonotic [6]. Humans can also be infected with *Raillietiella* species, another pentastomid by having their hands contaminated with the faeces or saliva of the reptile and accidentally ingesting the eggs which can result in a disease called pneumonitis [7].

In Nigeria, various studies [5,8,9] have reported that *Lecudina* species, a gregarinid protozoan, *Eimeria*, *Plasmodium* and *Haemogregarina* are protozoan parasites of lizards that pose risk to humans, who serve as an intermediate host. Handling faecal contaminated water, dishes and other equipment may also result in accidental transmission. Usually, there are no clinical signs; however, some people may develop localized inflammation. The larvae can encyst in various tissues, causing abdominal pain, vomiting, constipation, diarrhoea and a tender abdomen [10]. *Capillaria Philip pinensis* causes human intestinal capillariasis [10].

There have been various studies conducted on the parasites of lizards and other reptiles in various parts of Nigeria and other parts of the world [5,10-13]. However, there is still dearth of information on endoparasites of lizards in some parts of Nigeria which makes understanding of the relationship between these parasites and their hosts difficult. Studies on reptiles and their parasitic fauna will help to improve the knowledge about their diseases and zoonoses as well as that pertinent to the biodiversity and bionomics of different populations involved in these types of associations. This study is aimed at providing information on the helminth fauna of the lizard, *A. agama* in Ibadan and Ile-Ife, Southwest Nigeria.

Materials and Methods

Study Area

This study was carried out in two similar geographical locations, Ile – Ife and Ibadan, Southwest Nigeria. Ile-Ife is located within latitudes of 07°26´N–07°33´N and longitudes 004°30´E– 004°35´E. The town is about 200 km Northeast of Lagos, about 120 km north of the Atlantic coast, and about 600 km Southwest of Abuja, (the Federal Capital of Nigeria) [14]. With a population of about 403,000 [15], Ile-Ife is the only town in Osun State that belonged to the group of 18 towns in Nigeria with a human population of more than 400,000 people.

Ibadan is located in Southwestern Nigeria, it is 128 km inland northeast of Lagos and 530 km Southwest of Abuja, the Federal Capital, and is a prominent transit point between the coastal region and the areas to the north The climate of the two locations is typically tropical, with a characteristic dry season of about 6 months (October–March) and a wet season of about 6 months (April–September) [16].

The mean annual rainfall ranges between 1000 and 1250 mm [17], the mean annual relative humidity from 75 to 100% [18] and the mean annual temperature is about 30°C [19]. The vegetation of the area is tropical rainforest, characterized by large and tall trees. The inhabitants of the two locations are a mixture of people from different ethnic groups in Nigeria, although the majority are the Yoruba-speaking people of the Southwest. The people of Ile-Ife are mainly peasant farmers growing cocoa, vegetables, maize and cassava. Traders, civil servants (especially teachers), hunters, artisan workers (e.g. mechanics) and transport workers are also found in smaller numbers.

Samples Collection

A total of 133 specimens of *A. agama* (111 females and 22 males) comprising 67 specimens from Ibadan and 66 specimens from Ile-Ife were captured by hand from various locations within the study areas between February and October, 2015. The lizards were kept in ventilated cages and transported to the laboratory of the Department of Zoology, Obafemi Awolowo University, Ile-Ife for dissection and examination of helminth parasites.

Laboratory examination of lizard samples

The lizards were euthanatized with chloroform in a desiccator; the weight was taken to the nearest 0.1 g using a digital scale and the Snout-vent length (SVL) was measured using a transparent metre rule (± 0.1 cm). Each lizard was dissected open longitudinally and the digestive tracts comprising the stomach, intestine, caecum, rectum, were removed and placed in a Petri dish containing physiological saline (0.86%). Other organs comprising the heart, liver and lungs were also removed separated and put in Petri-dishes containing saline. Each organ was cut open longitudinally and the contents expressed in a Petri-dish containing physiological saline. The contents were then examined closely on a dark background under a dissecting microscope. The helminths observed were removed and sorted according to their kind, washed in saline to remove adhering debris, counted fixed and mounted according to standard techniques [20].

Nematodes were fixed in Alcohol formol Acetic (AFA) and then preserved in 70% ethanol to which 5% glycerol was added [21]. The worms were cleared and mounted in Lactophenol before examination under a binocular microscope at X40 magnification.

Trematodes and cestodes were first placed in warm water at 60°C for 10 minutes to make it relaxed and later fixed. The worms were stained in acetic haematoxylin for 10 minutes and destained in acid alcohol. Thereafter, they were differentiated in 45% acetic acid and transferred into glacial acetic acid for 10-15 minutes for dehydration. The worms were cleared in 3:1, 1:1 and 1:3 series of mixtures of glacial acetic acid and methyl salicylate. The worms were mounted in Canada balsam and examined under a binocular microscope at X40 magnification. Parasites were identified, when possible to species, and the number and location of the individual parasite species were recorded.

Statistical analysis

Data were analysed using the SPSS software package (version 17). Differences in prevalence between lizards sampled in the two locations and sex were assessed using Chi-squared (χ^2) test.

Results

All the 133 specimens of the lizard, *A. agama* examined from both Ibadan and Ile-Ife were infected with one or more helminth parasites, giving an overall prevalence of 100%. A total of five helminths were recovered comprising three nematodes, one cestode and one trematode. The nematodes recovered include; *Strongyluris brevicaudata* with a prevalence of 92.5%, *Parapharyngodon sp*. has a prevalence of 89.5% and unidentified nematode with a prevalence of 0.8%. The cestode and trematode recovered were *Oochoristica truncata* and *Mesocoelium monas* with prevalences of 56.4% and 1.5% respectively. The helminths recovered from lizards examined from Ibadan and Ile–Ife and their prevalences is shown in Table 1.

Location	No Examined	*Strongyluris brevicaudata*	*Parapharyngodon sp*	*Mesocoelium monas*	Unidentified Nematode	All Helminths
Ibadan	67	60 (89.6)	61 (91.0)	0 (0.0)	0 (0.0)	67 (100)
Ile-Ife	66	63 (95.5)	58 (87.9)	2 (3.0)	2 (3.0)	66 (100)
Total	133	123 (92.5)	119 (89)	2 (1.5)	2 (1.5)	133 (100)

Table 1: Prevalence (%) of Helminths in the *Agama* lizard in relation to location.

Both *S. brevicaudata* and *O. truncata* were recovered from the intestine and rectum of the lizard A. agama while *Parapharyngodon spp*. and *M. monas* were recovered from the rectum only. An unidentified nematode was recovered from the intestine of the lizard. No parasite was found in the lungs and stomach. *S. brevicaudata* has the highest worm burden (221 worms) recovered from the rectum.

The analysis of the worm burden with the size (SVL range) and sex of the animal showed that as the animal increased in size the worm burden increased. Juvenile lizard of length range 7.6–9.1 cm had the lowest intensity (worm burden) of 17.8 ± 3.4 while the highest intensity of 63.8 ± 10.7 was recorded in adult lizard of length range 12.4 cm and above. The mean intensity was significantly higher in male lizard (66.2 ± 10.9) than in female lizard (27.4 ± 2.2) ($p<0.05$) Table 2.

Category	Number examined	Mean ± SEM	Range

SVL Range (cm)			
6.0-7.5	4	3.3 ± 0.7	2-5
7.6-9.1	24	17.8 ± 3.4	1-53
9.2-10.7	46	29.2 ± 3.2	1-93
10.8-12.3	36	34.6 ± 4.2	5-90
≥ 12.4	23	63.8 ± 10.7	7-225
Sex			
Male	22	66.2 ± 10.9	7-225
Female	111	27.4 ± 2.2	1-93

Table 2: Intensity of Helminth Parasite in *Agama* lizard relative to Snout-Vent Length (SVL) and Sex.

Out of the five helminths recovered, it was only in the nematode *S. brevicaudata* where the prevalence reached the peak (100%) in adult lizards of both sexes. The lowest prevalence and intensity of *S. brevicaudata* infection was recorded in juvenile lizards of both sexes of length range 6.0–7.5 cm while the highest prevalence and intensity were recorded in adult lizard of both sexes of length range 10.8 cm and above and 12.4 cm and above respectively Table 3. *O. truncata* had its peak prevalence and intensity (73.9%; 7.5 ± 2.4) in adult lizards of both sexes of length range 9.2–10.7 cm and 10.8–12.3 cm respectively while the lowest prevalence (30.4%) was recorded in adult lizards of both sexes of length range 12.4 cm and above and lowest intensity of infection was recorded in adult lizards of both sexes of length range 9.2–10.7 cm Table 4.

Category	Number examined	Number infected	% infected	Mean ± SEM
SVL Range (cm)				
6.0-7.5	4	1	25	0.5 ± 0.5
7.6-9.1	24	19	79.2	12.0 ± 3.3
9.2-10.7	46	44	95.7	18.5 ± 2.8
10.8-12.3	36	36	100	16.2 ± 2.4
≥ 12.4	23	23	100	51.5 ± 10.6
Sex				
Male	22	22	100	54.9 ± 10.7
Female	111	101	91	15.3 ± 1.6

Table 3: Prevalence (%) and Intensity (I) of *S. brevicaudata* relative Snout-Vent length (SVL) and Sex of *Agama* Lizard.

Category	Number examined	Number infected	% infected	Mean ± SEM
SVL Range (cm)				
6.0-7.5	4	0	0	0.5
7.6-9.1	24	16	66.7	2.5 ± 1.0
9.2-10.7	46	43	73.9	1.2 ± 0.4
10.8-12.3	36	14	38.9	7.5 ± 2.4
≥ 12.4	23	7	30.4	5.5 ± 1.5
Sex				
Male	22	22	100	5.4 ± 1.6

Female	111	101	91	3.5 ± 1.0

Table 4: Prevalence (%) and Intensity (I) of *O. truncata* relative Snout-Vent length (SVL) and Sex of *Agama* Lizard.

Multiple infection with two or more helminth parasites (81.2%) were more common than infection with single parasite type (9.8%) Table 5.

Parasite	Frequency	Prevalence (%)
Strongyluris brevicaudata only	10	7.5
Parapharyngodon sp only	2	1.5
Oochoristica truncata only	1	0.8
S. brevicaudata + *Parapharyngodon sp*	41	30.8
S. brevicaudata + *O. truncata*	10	7.5
Parapharyngodon sp. + *O. truncata*	5	3.8
S. brevicaudata + *M. monas*	1	0.7
S.brevicaudata + *Parapharyngodon sp.* + *O. truncata*	51	38.3

Table 5: Occurrence of Single and Multiple Infections of Helminth Parasites in *Agama* Lizards.

Discussion

This study has revealed that the most prevalent helminth parasite recovered from the lizard *A. agama* examined from both Ibadan and Ile- Ife were the nematodes, especially *S. brevicaudata*. Similar findings were reported by various workers in Nigeria and other parts of the world. Four of the seven helminths recovered from *A. agama* in Lagos State, Nigeria [10] and three of the four helminths recovered from Nsugbe, Anambra State, Nigeria [11] were nematodes. In addition, seven of the 11 helminths reported from geckos by Goldberg and Bursey [22] were nematodes. Furthermore, in a study conducted in Namibia, McAllister et al. [23] reported that 14 out of 18 endoparasites reported from reptiles belong to the phylum Nematoda, Rataj et al. [13] also reported that nematodes were recovered more than any other helminths in their study of pet reptiles from the Republic of Slovenia. The abundance of nematodes in reptiles could be attributed to lack of complication in their life cycles resulting in widespread of their infective stage as suggested by Al-barwari and Saeed [24]. According to Olsen [25] infections by nematode parasites in the vast majority of the land vertebrates are bound to happen during the terrestrial stages of the life cycle of these parasites. High diversity in helminths acquisition could also be related with the diet of saurian reptiles [26].

In this study, three of the helminths observed, *S. brevicaudata*, *Parapharyngodon sp.* and *O. truncata* were recovered from the lizards examined from both Ile–Ife and Ibadan. These parasites were among the seven parasites recovered from *Agama* lizards in Lagos, Southwest Nigeria [10] and also among the four parasites recovered from the same animal in Nsugbe, Anambra State, Southeast Nigeria [11]. *O. truncata* had previously been reported from the ground *agama*, *Agama aculeata* and Namib rock agama, *Agama planiceps* from the Windhoek area of Namibia [27]; tropical spiny agama, *Agama armata* from *Zambesi*, East Africa [28]; common spiny *agama*, *Agama hispida* from South Africa [29] and Agama *aculeata* from South Africa [30]. *Parapharyngodon rotundatus* had also been reported in *A. aculeata* from South Africa [30] *A. aculeata*, *A. planiceps* and *A. atra* from Namibia [23]. This suggests that these parasites have wide range in geographical distribution.

There was no acanthocephalan recovered from the *A. agama* examined in this study and this may be due to some barriers of phylogenetic incompetency and host specificity nature [31]. Similarly, there were no reports of this parasite from the same lizards examined in previous studies in Lagos, Southwest Nigeria (10) and Nsugbe, Anambra State, Southeast Nigeria [11]. The same situation was observed from pond turtles in Turkey by Yildrimhan and Sahin [32]. However, unless proven by further studies including experimentation, other possibilities like the absence of some appropriate intermediate hosts and vectors to convey them to the reptile species under consideration cannot be ruled out.

There was scarcity of trematode species in this study and previous studies in Nigeria. The scarcity of parasitization by trematode species in previous studies in other parts of the world has also been reported [33]. This may be due to the rareness in the intermediate hosts whose requirement is obligatory by flukes to complete their life cycles [34].

The most infected organ observed in this study was the rectum which harboured four helminth species. Similar findings were reported by Adeoye and Ogunbanwo [10] and Nwadike [11]. They suggested that this might be due to the fact that endoparasites seek places in the host that provide maximum nutritional value to it. Furthermore, they stated that the rectum having a wider lumen than other organs and filled with undigested food, serves as a convenient habitat for a large number of nematodes to survive inside it.

This study also revealed *Strongyluris brevicaudata* as the most frequently observed parasite in this study with a prevalence of 92.5%. Similar findings were reported by Adeoye and Ogunbanwo [10] and Nwadike [11] where the same parasite occurred most in *Agama* lizard with prevalences of 82.3% and 85.6% respectively. *Strongyluris sp.* appears to have a wide distribution in the lizard (Family Agamidae) in Africa and Asia. *Strongyluris calotis* has been recovered from a variety of lizard species, including *Japalura swinhonis* (Agamidae), *J. polygonata xanthostoma*, Caucasian Agama, *Laudakia caucasia* and the Roughtail Rock Agama, *Laudakia stellio* (Agamidae) [35,36].

The sex of the host had no influence on the overall prevalence of helminth infections in the lizard *A. agama* examined in this study, as both sexes have the same prevalence (100%) of infection. The same finding was reported by Nwadike [11]. This may be due to the fact that both sexes were exposed to similar diet, Amo et al. [37] stated that both sexes seem to be susceptible to parasite infections as the prevalence and intensity of infection were similar. However, there was a significant difference in the overall intensity of helminth infection and the sex of the lizard. It was also observed that only in the parasite, *S. brevicaudata* that the intensity of infection was significantly higher in males than in females. Similar finding was reported by Adeoye and Ogunbanwo [10] where male lizards which are considered more active had a higher intensity of infection than female conspecifics. Ulcer and

Olsson [38] suggested that the higher intensity in males could be due to being more susceptible to parasitic infections probably as a result of immune suppressive effects of testosterone during the reproductive period. In contrast, Omonona et al. [12] reported females to have higher intensity of infection with *S. brevicaudata*.

In this study, the size of the lizard was used as a direct measurement of age. This study revealed that juvenile lizards of length range 7.6–9.1 cm harboured the least number of parasites while the adult lizards of length range 12.4 cm and above harboured the highest number of parasites. This implies that the older the lizard host, the higher the intensity of infection. Similar finding was reported by Adeoye and Ogunbanwo [10] where adult female lizards of length range 9.0-9.9 cm and adult male lizards of length range 13.0–13.9 cm harboured the greatest number of parasites. The highest intensity in adult lizard could be explained that the older the host, the tendency of having increased contact with parasites as a result of predatory mode of life, thereby resulting in increased incidence and infection level of the parasites. This further suggests that the age affects the mode of life and also determines the parasitic fauna abundance of the host, Riba et al. [39] further reported that the total mass of nematodes increased significantly with the size of the lizard suggesting there is no immunity to parasitic infection as the animal grows older.

Lizard infection with multiple helminth species were encountered frequently in this study while single infection were less commonly detected. These results are in agreement with the findings reported by Nwadike [11]. The most frequently double infection observed was the combination of *S. brevicaudata* and *Parapharyngodon sp*. with a prevalence of 30.8% while the most frequently triple infection was the combination of *S. brevicaudata*, *Parapharngodon sp*. and *O. truncata* with prevalence of 38.3%. Similar findings were reported by Nwadike [11].

Although high prevalence of helminthic infection was observed in the lizard, *A. agama* examined from the two locations, none of the parasites recovered has a zoonotic potential.

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