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Survey of the African giant land snail (*Archachatina marginata*), intermediate host of intestinal parasites in Akure Metropolis, Ondo State

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Abstract

Background: African giant land snails (*Archachatina marginata*) are hermaphroditic pulmonate nocturnal gastropods of the Achatinidae family. The snail is one of West Africa's largest known terrestrial snails. The majority of land snails live in Nigeria's derived guinea savannah's forest litters, which range from deep tropical high forest to bordering riparian forests. Africa's giant land snails, which are noted for their ravenous feeding habits and extensive food range, are a major reservoir and intermediate host for parasites that can infect humans.

Results: Seventy snail samples were collected from the study site in total. The parasites found is a nematode rat lung worm (*Angiostrongylus cantonensis*), which have a fragile, narrow, and simple mouth with no lip or buccal cavity and belong to the order Strongylida. The parasite was found to be most prevalent in small snails (52.94%), followed by medium sized snails with a frequency of 29.41%, and the giant-sized snails with the lowest prevalence of infection. The mantle parasite has the largest prevalence (48.6%), while parasites retrieved from the stomach have the highest mean intensity (2.50 ± 0.25).

Conclusion: The African giant land snail can serve as a vector for zoonotic diseases, transmitting parasites to humans through raw or undercooked snails, infested vegetation, and contact with contaminated water. As a result, effective control measures for human infection should be established.

Keywords: Snail, Parasites, Prevalence, Zoonosis, Host, Intestinal parasites

Background

African giant land snails are *hermaphroditic pulmonate* nocturnal gastropods of the Achatinidae family. They are native to Africa and can be found throughout Sub-Saharan Africa, from the Gambia to the Lake Chad region in the east. Their range stretches all the way down to the Orange River in South Africa (Hodasi 1998). The African giant land snail (*Archachatina marginata*) is one of West Africa's largest land snails. The majority of land snails live

in Nigeria's derived guinea savannah forest litters, which range from deep tropical high forest to bordering riparian forests (Adeniyi et al. 2013).

Land snails are forest non-timber products that flourish in a humid climate when kept in captivity. Snail meat is used by many people to supplement their regular animal protein sources. Nigeria is noted for having a diverse range of snail species that vary in size, color, adaptability, and performance (Ibom 2009). *Archachatina marginata*, *Achatina achatina*, *Achatina fulica*, *Limcolaria* spp., and other garden snails are among the land snail species. The majority of land snails live in Nigeria's derived guinea savannah's forest litters, which range from deep tropical

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high forest to bordering riparian forests. Africa's giant land snails, which are noted for their ravenous feeding habits and extensive food range, are a major reservoir and intermediate host for parasites that can infect humans.

Furthermore, the trematodes of the *Dicrocoelium* genus would use *Helix aspersa*, which is found in Turkey, as intermediary hosts (Gurell and Göçmen 2007). Then, Shan et al. (2009) and Hu et al. (2011) reported on a dangerous and sometimes deadly sickness in humans known as eosinophilic méningo-encephalopathy and radiculomyélo-encéphalite, with *Achatina fulica* as the vector. The nematode Rat Lung Worm (*Angiostrongylus cantonensis*) uses this snail as an intermediate host. Only the species *H. aspersa* and *Achatina fulica* were studied in this research. *Archachatina ventricosa* and *Achatina achatina* have not been studied. However, in Côte d'Ivoire, these two species are widely consumed (Kouassi et al. 2008).

The study was designed to investigate different intestinal parasites connected with the Africa giant land snail (*Archachatina marginata*) in Aule, Akure, Ondo State.

Methods

Source of snails and collection

Seventy samples of snails were collected from March to September at different locations in Akure, Ondo State. The snails were captured at night (7:00 pm–9:00 pm) and in the morning (5:00 am–7:00 am). The captured snails were put in a ventilated plastic container before transported to laboratory for examination of the parasites.

Material used

Dissecting set, cotton wool, normal saline, 80% ethanol solution, slide, nose mask, tissue paper, stone, petri dishes and microscope.

Snail identification

Snails were identified according to their shape, size, markings, colour, spire angle, sculpture and aperture form (Raut and Barker 2002).

Examination of snails for parasites

The snails used in the study were grouped into three based on size; large size, medium size, and small size. The snail's shells were cracked with stone and the internal parts were separated into Stomach, Crop, Kidney, Haemolymph, Mantle, Digestive gland and foot were put in a separate petri dish containing 0.85% of NaCl solution, the forceps were used to tease the parts and samples were taken randomly from each petri dish using a pipette. All organs were separately processed to detect parasite.

Three methods [direct method (wet mount preparation), floatation technique (saturated salt solution) and

concentration technique using formol-ether (Cheesbrough 2006)] were used to process each snail sample in order to ensure that false negatives were not recorded. The number of parasites collected from each part was recorded and placed on the glass slide, coverslip was used to cover it and viewed under the microscope.

Identification of parasites

The parasites recovered were identified according to identification keys of Cruz and Mills (1970) and Yamaguti (1961).

Data analysis

The prevalence and mean intensities of infection were recorded per host sex, host age and parasite location. The level of significance was determined using Chi square analysis at $P < 0.05$. All statistical analyses were computed using Microsoft excel 2019 and Statistical Package for Social Sciences (SPSS) 20.0

Results

Prevalence of *Angiostrongylus cantonensis* in *Archachatina marginata* based on location/site of sample collection

The prevalence of *Angiostrongylus cantonensis* among *A. marginata* based on location or site of collection is presented in Table 1. The result shows that the African giant land snails collected from the dumping site are more infected than the African giant land snails collected from the bush with a prevalence of 23 of 34 infected representing 67.6% and 11 of 34 infected representing 32.4% respectively.

The prevalence of *A. cantonensis* among *A. marginata* based on the size

In Table 2, the results shows that the small sized presented the highest prevalence of infection with a prevalence of 52.94% followed by the medium sized snails with a prevalence of 29.41% while the big sized snail presented the least prevalence of infection. When data generated was subjected to statistical analysis it was revealed that there was no significant difference ($P > 0.05$) in the prevalence among the small, medium and big sized snails.

Table 1 Prevalence of *A. cantonensis* in *Archachatina marginata* based on location/site of sample collection

Location	Number examined	Number infected (%)	χ^2	Df	P value
Bush	35	11 (32.4)	8.741	1	0.004
Dumping	35	23 (67.6)			
Total	70	34 (48.6)			

Table 2 Prevalence of *Archachatina marginata* infected with *A. cantonensis* by size

Size	Number examined	Number infected (%)	χ^2	Df	P value
Small	30	18 (42.86)	4.346	2	0.114
Medium	20	10 (28.57)			
Large	20	6 (28.57)			
Total	70	34 (48.6)			

The prevalence of *A. cantonensis* among *A. marginata* based on predilection site is presented

In Table 3, the results shows that the mantle is the most infected with a prevalence of 48.6% and a worm burden of 81 followed by the digestive gland with a prevalence of 42.9% while the crop, haemolymph and foot of the *A. marginata* examined presented no infection hence, the prevalence of infection is zero.

Discussion

Soil-transmitted helminth infections are mostly seen in warm, humid climates with inadequate sanitation and hygiene (CDC 2020). Snails are found on dirt either scavenging for food or reproducing; as a result, parasites may infect snails. A total of seventy (70) snails (*Archachatina marginata*) were studied in this study, with an overall prevalence of 48.57%. In the investigation, only *Angiostrongylus cantonensis* was discovered. Geohelminths such as hookworm, *Enterobius vermicularis*, and *Ascaris lumbricoides*, which are prevalent soil parasites in these places (Awosolu et al. 2020), did not infect snails. As a result, the adaptation of *A. cantonensis* as a significant parasite of these land snails requires more research. This nematode has been found in big African land snails in other parts of the world (Kim et al. 2014; Iwanowicz et al. 2015).

The rat parasite *A. cantonensis* is the cause of the developing infectious neurologic rat lungworm illness (Jarvi et al. 2012). As a result, *A. marginata* is implicated as the most likely intermediate host of *A. cantonensis*. Humans

are vulnerable to the effects of *A. cantonensis* infection, especially if infective larvae are consumed (Chatterjee 2009). The majority of the damage in human-infected cases is evident in the intestinal walls, resulting in abdominal discomfort and fever. Both humans and animals have been diagnosed with eosinophilic meningoen- cephalitis (Morassutti et al. 2014).

The snail samples were divided into three groups based on their size: 20 large, 20 middle, and 30 little. Small snails were the most affected, with an infection rate of 18 (52.94%), followed by medium snails with a rate of 10 (29.41%), and large snails with a rate of 6 (6.2%) (17.65%). This contradicts the findings of Odaibo et al. (2000), who found that *A. marginata* snails were the most infected with *A. cantonensis*. Rezac et al. (1993), who also documented a drop in helminthic infection of *A. marginata* as they grew larger, attributed this to mucus suppression of larvae infectivity as the snails grew larger, explained the high prevalence of *A. cantonensis* in small snails.

The highest prevalence of infection was found on the infected snails' mantle, followed by the digestive gland, kidney, and stomach; no infection was found on the crop, haemolymph, or foot. The high parasite prevalence in the mantle, digestive gland, and kidney could be owing to these organs' high vascularization and plenty of easily accessible nutrients (Madsen 1982). The location of *A. marginata* had a significant impact on the infection's prevalence. Because the snails gathered near dumping locations had a larger worm burden than those obtained in the bushes.

Angiostrongylus cantonensis was identified as the nematode with the flimsy, slender, and simple mouth and no lip or buccal cavity. *Angiostrongylus cantonensis* parasite resides primarily in rodents like rats, but it can also infect snails and slugs that come into touch with contaminated rat feces (Igbinoso et al. 2006). Ingestion of raw or undercooked contaminated mollusks, crustaceans, or other hosts, as well as vegetables contaminated with infectious larvae, can cause infection. These larvae go up the trachea, where they are ingested and ejected along with the

Table 3 Prevalence *Angiostrongylus cantonensis* among *Archachatina marginata* examined based on the predilection site of infection

Predilection site	Number examined	Number infected (%)	Mean intensity	χ^2	Df	P value
Mantle	70	34 (48.6)	2.38 ± 0.19	8.741	6	0.004
Digestive gland	70	30 (42.9)	1.37 ± 0.09			
Kidney	70	21 (30.0)	1.76 ± 0.15			
Stomach	70	14 (20.0)	2.50 ± 0.25			
Crop	70	0 (0.0)	0.00 ± 0.00			
Haemolymph	70	0 (0.0)	0.00 ± 0.00			
Foot	70	0 (0.0)	0.00 ± 0.00			

feces. For several weeks, they remain viable and infectious in excrement or freshwater (Hu et al. 2011). Only if these larvae are eaten by a mollusk intermediate host does the life cycle come to an end (land snails or slugs). The larvae mature into infectious third-stage larvae in about 2 weeks, and the mollusks remain infected for the rest of their lives. Shrimp, fish, crabs, frogs, predacious land planarians, and monitor lizards can all eat diseased mollusks and act as paratenic hosts. Rodents become infected after ingesting either mollusks or paratenic hosts (Chatterjee 2009). Ingesting uncooked contaminated intermediate or paratenic hosts or vegetables contaminated with third stage larvae can infect humans (dead end hosts) (Chatterjee 2009).

The infection might be minor, and mortality is uncommon. When infective *A. cantonensis* larvae are consumed, they infiltrate intestinal tissue and cause enteritis. Before reaching the neurological system, the larvae pass through the liver and lungs. Cough, rhinorrhoea, sore throat, malaise, and fever might occur as the worm progresses through the lungs. The predominant clinical manifestation of eosinophilic meningitis is headache, neck stiffness, parasthesia, vomiting, fever, nausea, and impaired vision or diplopia after the nematode enters the central nervous system (CNS) after around 2 weeks. Children may also feel sleepy, and experience abdominal pain, or weakness of the extremities. Eosinophilic pleocytosis, eosinophilic encephalitis and ocular angiostrongyliasis may also occur.

Conclusions

The study found that the African giant land snail (*Archachatina marginata*) is susceptible to endoparasites, or helminth parasite infection, as a result of the African giant land snail's environment and the many feeds it consumes. Ingestion of raw or undercooked snails, consumption of infested vegetation, and contact with polluted water are all ways in which the African giant land snail can spread the virus to humans. Different diseases such as angiostrongyliasis, schistosomiasis, and others have arisen as a result of the infection and are extremely harmful to human health. As a result, adequate control methods for human infection should be established.

African giant land snails dominate the land, feeding voraciously on vegetation and starchy foods like rice. They live in an environment where various activities take place, some of which pose a threat to African giant land snails in terms of parasite infection, so snails must be properly washed and cooked before consumption.

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Authors' contributions

Prof. TAO designed the experiment. OSB carried out laboratory work, data analysis, the interpretation of results and developed the manuscript. AM collected the snail samples, identify the parasites and also carried out the laboratory work. All authors read and approved the final manuscript.

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Availability of data and materials

Materials were available for the research and all data used were gotten as a result of the experiment gotten in the laboratory.

Declarations

Ethics approval and consent to participate

The Department of Biology (BIO), Federal University of Technology, Akure ruled that no formal ethics approval was required in this particular case.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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