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Parasites of edible land snails in Edo State, Nigeria

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Summary

Land snails are sources of protein to man and are hosts to a number of parasites. It is imperative that the roles of the snail hosts and parasites are clearly defined. Before then however, the parasites of the different land snails collected in any locality should be identified. Land snails were collected in the wild in both dry and wet seasons. The internal organs and the faeces were examined for the presence of parasite. In the rainy season of 2015, a total of 272 snails were collected across four major towns (Benin, Uromi, Ekpoma and Auchi) in Edo State, Nigeria, while in the dry season, fewer snails (n=91) were handpicked. The snail species seen are: *Achatina achatina* (Linnaeus, 1758), *Achatina fulica* (Férussac, 1821), *Acharchatina marginata* (Swainson, 1982), *Limicolaria aurora* (Jay, 1839), *L. flammea* (Müller, 1774) and *Limicolariopsis* spp. The larvae of *Strongyloides stercoralis* were isolated from the various snail species with overall prevalence of 54.04 %. Snails positive with *Alaria* mesocercariae were *L. aurora*, *L. flammea* and *Limicolariopsis* spp. Additionally, few *L. flammea* were positive of the cercariae of *Drocoelium dedriticum.* Meanwhile, some samples of *A. fulica* harboured larvae of *Angiostrongylus cantonesis*, sporocysts of *Fasciola gigantica* and *Schistosoma mansoni*. Therefore, these edible snails could pose serious health hazard to man and animals by serving as a possible alternative parasite transmission route.
Keywords: Edible snails; parasites; seasons; Nigeria

Introduction

Snails by their habitat could be grouped into two: aquatic and terrestrial. However, terrestrial snails are mostly found in wet and damp areas. Both aquatic and terrestrial snails are hosts to a range of parasites (Caron *et al*., 2014; Opisa *et al*., 2011; Betterton *et al*., 1988).

Snail consumption rate is rising because people are now avoiding red meat for perceived health reasons (Omole et. al., 2006). Snail meat offers the entire amino acid requirement in man (Adeyeye, 1996) with relatively high iron content and low fat (Agbogidi *et al*., 2008). Many of the snails consumed in Nigeria are sourced from the wild, only few are reared; hence, wild snail population have considerably declined. In addition, deforestation, pesticide use and bushfires have further reduced the number of snails (Esak & Takerhash, 1992).

Snail consumption could be one route to human infection particularly when eaten raw or undercooked. The African giant snail of *Achatina achatina*, *A. fulica*, *Achachatina marginata* with *Limicolaria* spp are the common edible land snails in Nigeria (Fagbuaro *et al*., 2006). A recent report has shown the susceptibility of the African giant snail to rat lungworm parasite (*Angiostrongylus cantonensis*) (Iwanowicz *et al*., 2015) with the increasing risk of transmission to man and animals (Alica 1966; Reece *et al*. 2013).

Fig. 1. Edo state showing the study areas (◘ – State Capital; ● – Settlement)

In spite of this, the identification of parasites of edible land snails including its prevalence is yet to be documented for Nigeria. We thus present baseline data on the different land snails collected in Edo State and the parasites they harbour. The implications of these results are also discussed.

Materials and Methods

Surveyed areas

Edo (6°30'N 6°00'E) is an inland state in southern Nigeria. It has a tropical climate characterised by two seasons, wet (April to October) and dry (November to March). In the north, the area is derived savanna, while in the south, it is a forest region. The riverine communities in the south have mainly mangrove swamp vegetation. Agriculture is the predominant occupation. The major cash crops are rubber, cocoa and oil palm. Four locations (Benin, Uromi, Ekpoma and Auchi) were surveyed and these are the major towns in the state (see Fig. 1).

Snail collection

Sizable snails that have largely developed to full maturity were handpicked in the wild (farm land, bushes and around homes) on soil, leaves, on the trunk of trees, and on wall-fences of homes across all study areas. Snail-scouting was simultaneously carried out by our team and the locals and therefore only this number (272) were collected and processed by our team. Collection in the rainy season was done twice in a week for four months between May and August of 2015; while in the dry season, collections were in three months (December 2015 to February 2016). In the dry season, few snails were seen and collected in the farms and surrounding bushes.

Snail identification and dissection

Snails were identified according to their shape, size, markings, colour, spire angle, sculpture and aperture form (Bequaert, 1950; Raut & Barker, 2002). Dissections to separate some organs (mucus gland, digestive gland, intestine, stomach, crop and ovotestis) were done using standard procedures. These organs and 'others' were separately processed to detect parasite.

Parasitological investigation

Three methods [direct method (wet mount preparation), floatation technique (saturated salt solution) and concentration technique using formol-ether (Cheesbrough, 2006)] were used to process

Table 1. Prevalence of infected snails by location

Location	No. examined	No. and % infected	No. and % infected with *S. stercoralis*	No. and % infected with *Alaria* spp.	No. and % infected with *F. gigantica*	No. and % infected with *A. cantonesis*	No. and % infected with *D. dendriticum*	No. and % infected with *S. mansoni*
Benin	51	22(50)	22 (100)	-	2(9.09)	2(9.09)	-	-
Ekpoma	105	65(62.52)	65 (100)	2(13.33)	-	-	-	-
Uromi	62	27(43.33)	27 (100)	-	3(11.11)	2(7.41)	-	2(7.41)
Auchi	54	33(60)	33 (100)	2(6.06)	2(6.06)	3(9.09)	2(6,06)	-
Total	272	147(54.04)	147(100)	4(2.72)	7(4.75)	7(4.75)	2(1.36)	2(1.36)

each snail sample in order to ensure that false negatives were not recorded. Samples were viewed under the microscope (AXL (3180976) Labo Germany) and parasites seen were identified and quantified.

Results

In the rainy season months, a total of 272 large edible snails were collected and examined across locations. More than half of the snails (54.04 %) were positive to at least a species of parasite. The larvae of *Strongyloides stercolaris* were the most prevalent (Table 1). A few snails were positive of other parasites.

A total of six snail species were collected in the rainy season months (*Archatina achatina*, *A. fulica*, *Achachatina.marginata*, *Limicolaria aurora*, *L. flammea* and *Limicolariopsis* spp. *Limicolariopsis* were seen only in Ekpoma while others were collected in all surveyed areas. Six parasites (*S. stercoralis*, *Alaria* spp., *Fasciola gigantica*, *Angiostrongylus cantonensis*, *Drocoelium dendtriticum* and *Schistosoma mansoni*) were recovered in these snails. Four different parasites were isolated from *A. fulica*, three from *L. flammea*, while two each from *L. aurora* and *Limicolariopsis* spp. (Table 2). Generally, snails with other parasites were co-infected with *S. stercoralis*. Multiple infections were seen in *A. fulica* (1 snail) and *L. flammea* (1 snail).

Of the organs (mucus gland, digestive gland, intestine, stomach, crop, ovotestis) examined for the presence of parasite, three (mucus gland, digestive gland and intestine) were positive (Table 3). Motile larvae of *S. stercoralis* were seen in all positive organs [65 % were L_2, others were either L_1 (20 %) or L_3 (15 %)], while sporocysts of *F. gigantica* and *S. mansoni* were recovered only in the intestine. Additionally, motile larvae of *D. dendtriticum* were isolated in the intestine. Some parasites were recovered in the faeces (Table 3).

The mean parasite load for *S. stercoralis* being pooled from all examined organs and faeces within the host were as follows: *A. achatina* (16 parasites/5 ml), *A. marginata* (18 parasites/5 ml), *A. fulica* (25 parasites/5 ml), *L. flammea* (6 parasites/5 ml), *L. aurora* (7 parasites/5 ml), *Limicoriopsis* (5 parasites/5 ml). Other parasites were relatively scanty (2 – 4 parasites/5 ml).

In the dry season months, a total number of 91 snails [*A. archatina* (31), *A. fulica* (21), *A. maginata* (18), *L. aurora* (12) and *Limicolariopsis* (9)] were collected. Among these, one or two snails from the various snail species, harboured non-motile larva of *S. stercoralis* with this mean load (0.1parasite/ml) for each species examined. Other parasites that were isolated in rainy season snails were not seen in the dry season.

Discussion

Soil-transmitted helminth infections are found mainly in areas with warm and moist climates where sanitation and hygiene are poor. Snails are found on soil either scavenging for food or for purposes of reproduction; thus snails could get infected with parasites in the process. *Strongyloides stercoralis* being a soil parasite was the most isolated in snails. This could be attributed to its abundance in the soil coupled with its ability to easily locate snail host from

Table 2. Prevalence of snail infection with parasite

	No. examined	No. and % Infected	No. and % infected with larvae of *S. stercoralis*	No. and % infected with mesocercaria of *Alaria* spp	No. and % infected with sporocyst of *F. gigantica*	No. and % infected with larvae of *A.cantonesis*	No. and % infected with Cercariae of *D. dendriticum*	No. and % infected with sporocyst of *S. mansoni*
A, achatina	48	28 (58.33)	28 (100)	-	-	-	-	-
A. fulica	41	28 (68.29)	28 (100)	-	7(17.07)	7(17.07)	-	2(7.14)
A. marginata	42	19 (45.23)	19 (100)	-	-	-	-	-
L. aurora	48	39 (81.25)	39 (100)	1(3.44)	-	-	-	-
L. flammea	73	49 (67.12)	49 (100)	2(4.08)	-	-	2 (4.08)	-
Limicolariopsis	20	10 (50)	10 (100)	1(10)	-	-	-	-

Table 3. Parasite isolation in organs and faeces of snail

Snail species	Organs						Others	Faeces
	Mucus gland	Digestive gland	Intestine	Crop	Stomach	Ovotestis		
A.achatina	*S. stercoralis*	-	*S. stercoralis*	-	-	-	*S. stercoralis*	*S. stercoralis*
A. fulica	*S. stercoralis*	*S. stercoralis*	*F. gigantica; A. cantonesis; S. mansonia*	-	-	-	*S. stercoralis*	*S. stercoralis*; *F. gigantica*
A. marginata	*S. stercoralis*	-	*S. stercoralis*	-	-	-	*S, stercoralis*	*S. stercoralis*
L. aurora	*S. stercoralis; Alaria* spp.	-	*S. stercoloralis*	-	-	-	*S. stercoralis*	*S. stercoralis*
L. flammae	*S. stercoralis; Alaria spp.*	*D. dendtriticum*	*S. stercoralis*; *Alaria* spp; *D. dentriticum*	-	-	-	*S. stercoralis*	*S. stercoralis*; *Alaria* spp
Limicolariopsis	*S. stercoralis*	-	*Alaria* spp.	-	-	-	*S. stercoralis*	*S. stercoralis*

the chemicals they possibly exude (Safer *et al*., 2007). *Strongyloides stercoralis* by its morphological feature could readily penetrate snail foot or any exposed area and infect the visceral organs. Geohelminths such as hookworm, *Enterobious vermicularis*, *Ascaris lumbricoides* which are also common soil parasites in these areas (Omorodion *et al*., 2012; Nmorsi *et al*., 2009) were not seen to infect snails. Hence, the adaptability of *S. stercoralis* as the major parasites of these land snails needs further investigation.

Another nematode, *A. cantonensis* larvae were seen only in *A. fulica*. This nematode has been isolated in giant African land snails elsewhere (Kim *et al*., 2014; Iwanowicz *et al*., 2015). *Angiostrongylus cantonensis* is a common parasite of rats and the cause of the emerging infectious neurologic rat lungworm disease (Jarvi *et al*. 2012). We thus incriminate *A. fulica* as the likely intermediate host of *A. canonensis*. Humans are at risk of the consequences of *A. cantonensis* infection particularly when infective larvae are ingested (Cross, 1987; Heyneman and Lim, 1967). In human-infected cases, most damages are seen in the intestinal walls resulting in abdominal pain and fever (Graeff-Teixeira *et al*., 1991). Eosinophilic meningoencephalitis has been reported in both man and animals (Morassutti *et al*., 2014).

Alaria parasites were isolated from some of the snails. The definitive host of *Alaria* fluke are dogs and cats, while the known intermediate hosts are fresh water snails (helisomid) and frogs. In helisomid snails, sporocyst develop into cercariae (Nithiuthai *et al*., 2004) and then released to actively penetrate the second intermediate host (tadpoles) which then develop to infective mesocercariae. Mesocercariae accumulate and may be ingested by a number of paratenic hosts (e.g., other frogs, snakes) or directly by the definitive host. Among the species of terrestrial snails examined, only *Limicolaria* spp and *Limicolariopsis* snails harboured the mesocercariae of *Alaria* parasite. It could therefore be that these species of snails are intermediate hosts. Further investigation on this is however required to clearly define the role of these snails within the context of parasite development and disease transmission. In any case, human infection has been reported after the consumption of *Alaria*-infected host (Otranto and Eberhard, 2011). Species of the freshwater snails from the family Lymnaeidae are well known for their roles as intermediate hosts in the life cycle of *F. gigantica*. However, an increasing number of other molluscan intermediate hosts of *F. gigantica* have been reported (Soliman, 2008). In this study, *A. fulica* harboured the widest range of parasites among the snail species collected; two of which are *F. gigantica* and *S. mansoni.* In Venezuela, *A. fulica* reportedly harboured *S. mansoni* (Libora *et al*. 2010). Fascioliosis is a disease of herbivorous animals while *S. mansoni* causes intestinal schistosomiasis in man (Crompton, 1999). Results indicate that only the sporocysts of these parasites were seen. It is likely that the conditions within the host (*A. fulica*) did not support further development.

The only land snail species positive of *D. dendtriticum* was *L. flammea*. *Limicolaria flammea* is native to Nigeria with oil palm and cocoa plantation their most preferred habitats (Tan and Clements, 2011). The parasite *D. dendtriticum* have two intermediate hosts (land snails and ants) and the sexually mature is often seen in the bile ducts of sheep, goats and pigs. We suggest that this snail could be the most likely intermediate host owing to the fact that cercariae were recovered in the digestive gland and intestine. The cercariae leave the snail to the environment, and are then picked up by ants within which it develops into the metacecariae.

In conclusion, this study enriches existing data regarding the role of land snails as likely intermediate hosts to a number of parasites. It also identified *S. stercoralis* as the most prevalent parasites of land snails. Also, the risk of eating undercooked snails with respect to human and animal health is thus affirmed.

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