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Malacological study of snail intermediate hosts of trematode parasites in Okitipupa Local Government Area, Ondo State, Nigeria

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Water bodies in specific sites were sampled for snail intermediate hosts of trematodes. Overall, a total of 949 snails were taken from the selected rivers with long handled scoop net, and in some areas with the aid of a pair of forceps. The sampled snails were placed in wide-mouthed universal bottles, loosely covered and taken to the laboratory for investigation. Examination was carried out by exposing groups of ten in beakers containing water to sunshine for 3 h, and this water was examined for cercariae. Snails that showed positivity were washed, re-exposed as earlier mentioned, and the water was checked for cercariae. Of all the snails found, only 5 (0.52%) *Lymnea natalensis* and *Physa acuta* were positive with cercariae, while other species (*Potadoma)* were not infected. The present study reveals that *Lymnaea, Physa* and *Potadoma* species are common snails found in Okitipupa Local Government Area.

Key words: Trematodes, prevalence, freshwater molluscs, malacology.

INTRODUCTION

Trematode infections continue to persist as one of the most principal and widely diffused tropical diseases in Africa, especially among communities found around the coastal regions (Black et al., 2010; World Health Organisation, 2014).

The distribution and existence of the diseases in a community depends on the availability or absence of the particular parasite's snail intermediate host, for example, *Fasciola hepatica* and *Fasciola*. *Gigantica* require the presence of the snail host*, Lymnae species*; *Schistosoma haematobium* requires the presence of snail host *Bulinus species*; *Schistosoma mansoni* requires *Biomphalaria species*; while the *Paragonimus westermani* requires the presence of *Segmentina species* (Bereket et al., 2017). This indicates that there is specificity in the intermediate host of the parasites (Adama and Hoker, 1997). Hence, the presence of a type of snail intermediate host in an area can account for the prevalence of a parasitic disease in the inhabitants of the community (Goll and Scott, 1979; Geleta et al., 2015). Most research on diseases caused by trematode parasites showed the level of rampant and threshold of

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infections in man and animal populations (Opisa et al., 2011). Knowledge of the presence of a type of snail in a locality could be used to check for local transmission which helps to clarify associations between disease point prevalence (Opisa et al., 2011; Sripa et al., 2016).

Recent malacology surveys provide information on the importance of integrations of snail observations with parasitology data from humans (Standley et al., 2011; Bereket et al., 2017). However, fragmentation of infection among man and animal populations in relation to snail survey makes it tough to indicate with certainty, the occupancy and spreading of trematode's snail host in the area (Opisa et al., 2011). This is further disconcerted by the fact that most people within endemic areas exhibit high gypsy (Standley et al., 2010) thus, complicating the pattern for locally acquired versus imported infections. Although chemotherapy plays a crucial role in reducing diseases and death rate due to trematode infections, the value and operational restraints impede its efficacy on a wider scale (Opisa et al., 2011).

Parallel preventive measures such as snail centered, whose alliance needs a complete perceptive of snail distribution seem credible. Also, the lastingness of trematode infections in man and animal hosts makes it tough to uncover the time and location of when transmissions really occur, without carrying out a snail for close observation. In as much as development of the larval stages of trematode parasites depends on snail host, their study provides important information on active transmission of foci. Therefore, the parasite and the intermediate host must be tackled with a view to breach the chain of circulation so as to get great achievement in regulating trematodes infections rates.

In this study, selected Rivers and Streams in Okitipupa Local Government Area, Ondo State, Nigeria was sampled for snail hosts of trematode parasites. Therefore, this study set out to:

(1) Identify the presence of disease spreading snail vectors in the area.
(2) Determine the prevalence of cercarial infection rates of snail intermediate hosts and
(3) Determine snail's relative abundance

MATERIALS AND METHODS

Study area

The research was undertaken in Okitipupa Local Government Area, Ondo State, Nigeria, located between 6°25[1]and 6°25[1]N Latitude, and 4°35[1]and 4°50[1]E longitudes within the tropical rainforest zone of Nigeria. It covers a total land area of 636 sq km with total annual rainfall often exceeding 200 mm.

Aqua-contact exercises

Selection of sites were based on pre-field investigation as obvious water contact points, where people frequently go to fetch water, wash clothes, bath, swim or play, and even where fishing activities takes place.

Aquatic snail sampling

Samplings of snails were conducted in June to December, 2014 in a five fresh water bodies (Igbodigo, Agbala, Ilutitun, Ikoya and Igbotako), where there was main human water contact. Most of the snails were found on the side of the leaves and water lilies. Snails were taken with long handled scoop net and a pair of forceps, where water was deep and picked with hand in gloves in some areas. The collection was randomly done for about 45 min per site. Rain boots and hand gloves were worn as precaution against infection by cercariae (Agbolade and Odaibo, 1996). The snails sampled were placed in a wide mouthed universal bottles containing water, loosely covered and taken to the laboratory.

Snail's identification

On arrival at the laboratory, the snails were separated and identified using the standard key by Brown and Kristensen (1993).

Cercariae shedding

Each species was placed in a separate container. Groups of 10 snails were placed in glass beaker containing about 100 ml of water, exposed to sunlight for 3 h to facilitate shedding of cercariae. Snails that were positive were washed clean, re-subjected as earlier mentioned, and the water was examined (Okoli and Owuala, 2001).

Physico-chemical characteristics

The physico-chemical parameters–Dissolved oxygen (DO), Alkalinity, conductivity and pH of water at each sampling site were measured using the modified Axide Winkler Method (Hach Chemical Company, 1997); while temperature was determined using a temperature probe.

Data analysis

Raw data were input into a Microsoft excel spread sheet, and descriptive statistics were used to summarize the data. The prevalence was calculated for all data as the number of infected individuals divided by number of individuals examined, and multiplied by 100 to express in percentage. Chi square test was used to assess the distribution of snail vectors with P-values <0.05 considered as statistically significant.

RESULTS

Dispersion and abundance of snail species

949 fresh water snail specimens were collected from 5 different water bodies within the same Local Government Area. From morphological point of veiw, 372 (39.35%) of the snails acquired were recognized as *Lymnaea natalensis*, 270 (28.5%) as *Physa acuta*, while 307 (32.3%) as *Potadoma spp* (Table 1). The dispersion of snails was crowded with less areas accounting for nearly

Table 1. Distribution of snail vectors among fresh water bodies in Okitipupa Local Government Area, Ondo State, June-December, 2014.

Water bodies	Snail species			Total Snail abundance
	Lymnae natalensis	*Physa acuta*	*Potadoma* spp	
Igbodigo	276 (108.18)	0(78.52)	0 (89.28)	276
Agbala	16 (232.45)	270(168.71)	307(191.83)	593
Ikoya	50(19.59)	0 (14.22)	0(16.17)	50
Ilutitun	0	0	0	0
Igbotako	30(11.75)	0 (8.53)	0 (9.70)	30
Total	372	270	307	949

$X^{2=}$ 88.380, P = 0.05.

Table 2. Prevalence of snail vectors among fresh water bodies in Okitipupa Local Government Area, Ondo State, June-December, 2014.

Water bodies	Parameter	Lymn	Phy	Pota	Overall
	Collected	276	-	-	276
Igbodigo	Infected	3	-	-	3
	% Infection	1.08	0.00	0.00	1.08
	Collected	16	270	309	593
Agbala	Infected	0	1	0	1
	% Infection	0.00	0.37	0.00	0.37
Ikoya	Collected	50	-	-	50
	Infected	1	-	-	1
	% Infection	2.0	0.00	0.00	2.0
	Collected	0	-	-	-
Ilutitun	Infected	0	-	-	-
	% Infection	0.00	0.00	0.00	0.00
	Collected	30	-	-	30
Igbotako	Infected	o	-	-	-
	% Infection	0.00	0.00	0.00	0.00
	Collected	372	270	307	949
Overall	Infected	4	1	0	5
	% Infection	1.08	0.37	0	0.526

Lymn: Lymnae natalensis ,Phy: Physa acuta, Pota: Potodoma

all the snails. Overall, of the 5 water bodies surveyed, 1 did not yield any snail (Table 1). *Lymnae spp* were found at 4 out of 5 water bodies surveyed while *Physa spp* and *Potadoma spp* were found in only 1 water bodies (Table 1).

The number of snails' species found from each of the water bodies indicated that, Agbala River had the highest number of snail species, followed by Igbodigo River, Ikoya River and Igbotako River while Ilutitun River had no snail species (Table 1).

Snail infections

Interestingly, few snails found during the survey were found to emit ceracariae. Of all the species sampled, 5 species (0.52%) of the snails were infected (Table 2).

Physico-chemical factors

Table 3 and 4 showed the mean value of physico-

Table 3. Occurrence of snails in relation to physico-chemical parameters of fresh water bodies in Okitipupa Local Government Area, Ondo State, June-December, 2014.

Fresh water bodies	Temp °C	pH (%)	Dissolved Oxygen lus/a	Conductivity Mg/l	Alkalinity	*Lymnae*	*Physa*	*Potadoma*
Igbodigo	28.8	6.0	10.0	2390	1.50	276	-	-
Agbala	29.1	5.9	11.0	2410	1.20	16	270	307
Ikoya	29.2	5.9	12.0	2380	1.60	50	-	-
Ilutitun	30.5	6.5	10.0	2370	0.90	-	-	-
Igbotako	31.4	5.8	13.0	2380	1.60	30	-	-
Total	-	-	-	-	-	372	270	307

Table 4. Mean height of snail species of fresh water bodies in Okitipupa Local Government Area, Ondo State, June-December, 2014.

Water bodies	*Lymnae natalensis* mean height (mm)	*Physa acuta* mean height (mm)	*Potadoma spp* mean height (mm)
Igbodigo	13	-	-
Agbala	12	21.5	9
Ikoya	11.5	-	-
Ilutitun	-	-	-
Igbotako	11.5	-	-
Total	12	21.5	9

chemical factors in water bodies. There were variations in physico-chemical parameters of the water bodies from months to months throughout the study period, while both conductivity and temperature values increased those of DO with a decreased in pH from June to December.

DISCUSSION

The study showed that water bodies have high abundance of aquatic snails. This study was able to identify three genera of aquatic gastropod molluscs: *Lymnaea*, *Physa* and *Potadoma*. The study showed that the prevalent species was *L. natalensis*, known for its potential as a host for *F. hepatica* in the tropics, which supported the findings of Emejulu et al. (1992). Examination of 949 snails showed that *L. natalensis* were the most abundant snails. The distribution of snails was restricted and crowded, with less areas accounting for nearly all of the snails, which was also a novel aiming to reveal the distribution and abundance of trematodes snail species in the communities.

Abundance and distribution of snails in relation to physico-chemical factors

Physico-chemical parameters that affect snail dispersion are frequently paying fewer attentions even though these can differ significantly from site to site and area to area, even within short distances (Sharma et al., 2013). Of all the physico-chemical variables gauged in this study, water temperature turnout to be the essential determinant factors of snail abundance. The positive relationship between snail quantity and water temperature noticed in this study is in agreement with investigations from Uganda that, snail distributions were limited in the North and North-Eastern parts of the country with high temperatures (Stensgaard et al., 2006).

Of important was how broadly the pH values varied; snails were found in water bodies with pH ranging from 5.8 to more than 6.5. The lack of relationship between pH and snail quantity reported in this study has also been reported previously (Kahigi, 2000), indicating that pH may not be an important determinant factors of snail abundance, as is in the case with other freshwater organisms (Macan, 1974). But, on the other side, Levitz et al. (2013) have shown that a lower pH was associated with higher snail abundance. This discordance in findings on the association between pH and snail abundance remains to be clarified.

Implication of cercarial shedding in transmission

A considerable low numbers of snails in this study shed cercariae. Some trematodes cercariae are diurnal and are typically released during daylight hours, peaking around midday and dawn (Stelnauer et al., 2008). The emergence times correlates to times when their hypo-

thetical hosts are available in water for infection. But, this is not absolutely recent and the discoveries are in support with other studies from endemic areas, with high transmission found less or none of the snails collected shed any cercariae.

In a study by McClelland (1956), it was reported that although 90% of school children were infected with *S. haematobium*, there were challenges in finding infected snails. Somewhere, contrary to the high human prevalence of *S. haematobium* infection in Msambweni along with the Kenyan coast, the rate of snails shedding *S. haematobium* cercariae was only 1.2% (Kariuki et al., 2004). Still at the Kenyan coast, another study showed that cercarial shedding was either low (range = 0.14 to 3.4%) or altogether absent (Hamburger et al., 2004).

In the Lake Victoria basin in western Kenya, only 1.04% (236/22,641) of snails collected at various sites shed cercariae (Steinauer et al., 2008), while a current research in Sesse Islands of Lake Victoria, Uganda, revealed that none of the snails collected shed cercariae (Standley et al., 2010). Various reasons may be put forward for the absence or low numbers of snails shedding cercariae.

First, it has been explained that the percentage of infected snails may be very low or cercariae may be shed for only a limited period of time (McClelland, 1956). This confounded with the focal nature of trematodes diseases and the complexity of sampling ample areas, where snails distributed makes it tedious to precisely locate which site would contain most numbers of infected snails.

Second, snail population quantity, rates of infection and cercarial output are also under seasonal influence (Hamburger et al., 1998). Perhaps, it may not be optimal for snails to shed cercariae around the peak rainy season when there may be a decreased water contact activities associated with swimming and or domestic use.

Third, the very low proportion of infected snails in water bodies may also be due to enhanced dilution of human faecal matter, associated with mixing across a larger volume of water or perhaps, difficulties in miracidia locating snail hosts in an undulating aquatic environment has been suggested elsewhere (Levitz et al., 2013).

Fourth, cercarial release from field-collected snails may also be inhibited by a variety of contaminants and invertebrates harbored by the snails. Fifth, it has been suggested that field snails in heavily endemic areas are subjected to pulses of infection rather than to a continuous flow of miracidia (Sturrock et al., 1979).

Considering the fact that prepatent infection can last for several weeks with only a proportion of snails reaching the stage of cercarial shedding (Joubert et al., 1991), and that prepatent infection rates can be substantial, and exceed patent infection rates (Wool house and Chandiwana, 1989), it is also probable that majority of snails sampled in this study may have had prepatent infections.

Clarification of such prepatent infections may be done using methods such as snail crushing in search of larvae or repeated shedding in the laboratory overtime, although such methods are unsuitable for accurate and large-scale monitoring. This may be necessary especially in light of the observation that as a method, cercarial emergence (which is routinely used) severely underestimates parasite prevalence (Curtis and Hubbard, 1990).

Although it is generally accepted that finding infected snails is the only confirmation of transmission of the disease, the study findings suggest that a cautious interpretation of transmission based on snail infection is necessary. Moreover, a single, brief exposure to cercariae-infested water is sufficient to effect transmission (Vercruysse et al., 1994), even where the number of shedding snails is low (Mubila and Rollinson, 2002).

Conclusion

Several snails' species were found in this study that act as intermediate hosts of different trematodes, which affect our livestock and birds. In this study, we identified the prevalence of trematodes cercariae on the basis of cercarial shedding, but this traditional method has several problems; first this method is laborious and time consuming, and second it does not give actual prevalence rate because this method depends upon cercarial shedding, whereas in the case of prepatent infection it gives a false result.

Due to these hindrances, parasitologists utilize molecular techniques for detection and characterization of parasites within their intermediate and final hosts. The development of a molecular approach for cercarial detection in infected snails is necessary and will be useful, such as polymerase chain reaction (PCR).

Therefore, it is recommended to use molecular techniques to diagnose the actual prevalence of snail's intermediate hosts infected with cercariae of different trematodes.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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