International Journal of Innovative Agriculture & Biology Research 8(3):27-37, July-Sept, 2020

© SEAHI PUBLICATIONS, 2020 www.seahipaj.org ISSN: 2354- 2934

Species Composition of Snail Intermediate Hosts of *Fasciola* and *Schistosoma* Species in some Local Government Areas of Borno State, Nigeria

Y. Shettima[1*], A. David[2] & Z. Abdulsalam[3]

[1]Department of Biological Sciences, University of Maiduguri, Nigeria
[2]Department of Microbiology, University of Maiduguri, Nigeria
[3]National Biotechnology Development Agency, Nigeria
***Corresponding author: yusufsab22@gmail.com**

ABSTRACT
Snail intermediate hosts serve as an important bridge in the transmission of schistosomiasis and fascioliasis from parasitic trematodes to people in communities where perennial rivers and ponds are used as sources of potable water hence, their diversity, abundance and distribution became necessary for their identification and classification for malacological studies and epidemiological investigations. This study assesses the species composition and diversity of snail intermediate hosts present in freshwater bodies of Borno State. Freshwater snail survey was carried out at some freshwater sites in three Local Government Areas i.e. Hawul, Kwaya-Kusar and Shani from March – July, 2019. A total of 1,619 snail intermediate hosts were collected out of which 631 snails were collected from Hawul, 525 were collected from Kwaya-kusar and 463 were collected from Shani. About five species of these infective snails were identified namely; *Bulinus truncatus*, *Bulinus obtusus*, *Bulinus permembranaceus*, *Biophalaria pfeifferi* and *Lymnaea natalensis*. The relative abundance of these infective snails were *Bulinus truncatus* (16.2%), *Bulinus obtusus* (3.9%), *Bulinus permembranaceus* (5.9%), *Biophalaria pfeifferi* (6.1%) and *Lymnaea natalensis* (67.9%). Shannon Diversity Index of snail intermediate host in Hawul, Kwaya-kusar and Shani were 1.17, 1.01 and 0.76 and signifies low diversity of these snail species in these Local Government Areas. The presence of snail intermediate host in freshwater bodies or sites poses significant threat to human and livestock hence, there is need for surveillance and control measures in communities in order to prevent the spread helminth-borne diseases.
Keywords: *Fasciola*, *Schistosoma*, Snail, Intermediate Host, Composition.

INTRODUCTION

Developing countries of the world have been enduring the effects of vector-borne diseases without proper control and eradication measures (Wu *et al*., 2018). These biological agents of discomforts have transmitted infective organisms to millions of people which have led to heightened levels of parasitemia and worm burdens in the bodies of their final hosts (Florey, 2014; WHO, 2010; Buscher *et al*., 2017; Bartsch *et al*., 2016). Intermediate hosts or vectors serve as a bridge between healthy organism and parasites. Their presence and concentration in the host environment determines the frequency of infection which can lead to disease epidemics in a community (Adenowo *et al*., 2015; Mas-Coma *et al*., 2018).

Snail intermediate hosts have been known to habour and transmit snail-borne diseases in the tropical regions of the world. They accommodate and nurture asexual developmental stages (sporocyst and redia) of the parasite as well as the infective stages (cercariae and metacercaria) that enter the bodies of their host (Apurba and Sandhya, 2014). Snail-borne diseases such as schistosomiasis (Bilharzia) and fascioliasis are some of the Neglected Tropical Diseases in tropical countries of the world (Dida *et al*., 2017). Millions of dollars have been spent for snail control programmes and mass chemotherapy of communities that experience persistent occurrence of snail-borne disease (Anderson and Medley, 1985; Webster, *et al*., 2009)

According to Adenowo *et al.*, (2015) schistosomiasis which is caused by *Schistosoma* species (*S. hematobium*, *S. mansoni* and *S. japanicum*) has caused more than 250 million infections and over 280,000 deaths of persons in Africa, Asia and Latin America. The W.H.O (1995) has reported that about 100 million people are infected in Africa with schistosomiasis. In Egypt, the disease is endemic in most parts of the Nile valley; some districts and governorates of the country (Barakat, 2013). In Uganda, the disease is also endemic in 82 districts of the country (Exum, *et al*., 2019). Similarly, in sub-Saharan Africa, about 192 million people are infected annually. Adenowo *et al.*, (2015) in their retrospective study on schistosomiasis infections reported that about 29 million people are infected in Nigeria, 15 million in Ghana and about 13 million people are infected in Mozambique.

In Nigeria, the prevalence of Schistosomiasis has been reported in school children and community in some states of the country. In the northern part of the country, the prevalence of the disease in Kano was 17.8%, (Dawaki *et al.*, 2016), 20% in Kaduna (Adamu *et al*, 2019), 48% in Adamawa (Birma *et al*., 2017), 24.65% in Plateau (Dawet *et al*., 2019), 46.6% in Benue (Mbata *et al*., 2009) and 60.8% Sokoto (Sinh and Muddasini, 2013). Similarly, in Western Nigeria, the prevalence of the disease is 80% in Ogun (Sam-wobo *et al*., 2009) and 46.6% in Oyo (Nwabueze *et al*., 2009). In some states of Eastern Nigeria, the prevalence of the disease in Cross river 9.3% (Emini and Enogiomwan, 2019), 5% in Enugu (Ezeadila *et al*., 2015) and 2.9% in Anambra (Ndukwe *et al*., 2019).

In Europe, North America and Australia, schistosomiasis is only found in domesticated animals. The disease also affects ruminant animals in Africa, Middle East and Asia (Jacobs *et al*., 2016). Several species of blood flukes such as *S. bovis*, *S. mathaei* and *S. nasale* are found to be responsible for ruminant schistosomiasis but the disease is not endemic to domesticated animals (Jacobs *et al*., 2016).

Furthermore, fascioliasis is also regarded as one of the Neglected Tropical Diseases transmitted by the trematode parasite *F. hepatica* and *F. gigantica*. The infective stages of the parasite (metacercaria) are found attached to aquatic plants vegetation. Edible water plants like watercress and wild vegetables are the major sources of human infections and the disease is only endemic to communities who consume raw aquatic plants (Mas-Coma *et al*., 2018).

The snail intermediate hosts responsible for transmission of schistosomiasis in Africa are *Bulinus* and *Biomphalaria* snail species (Dida *et al*., 2014). Some *Bulinid* snails i.e. *B. globosus*, *B. africanus*, *B. truncatus*, and *B. forskalii* are species found across Africa. Furthermore, some important *Biomphalaria* species found in Africa are *B. pfeifferi*, *B. rhodensiensis*, and *B. choanomphala* (Brown, 1994). Similarly, several species of *Lymnaeid* snails were identified as suitable intermediate hosts of *F. hepatica* and *F. gigantica* in Africa. Notably, they are *L. natalensis, L. truncatula, L. columella, L. Stagnalis, and L. Peregra* (Brown, 1994). However, *L. natalensis* is the most widely distributed *Lymnaeid* snails in Africa especially in sub-Saharan Africa.

Apparently, the continent of Africa has ecosystems suitable for the survival of these infective freshwater snails. There are numerous species of *Bulinid, Planorbid* and *Lymnaeid* snail species that are distributed in freshwater habitats (Dida *et al*., 2017). New species of the infective snails have also been identified as the changes in environmental factors gave suitable habitat for invasive snails or cause mutations in which new species evolved. Other invasive species of *Bulinus* and *Lymnaea* species have been identified recently in South Africa and are found adapting to the new environment (Applenton and Mirinda, 2015).

Several species of infective snail intermediate host have also been identified in some freshwater bodies of Borno State. Despite their identification, these species are not categorized adequately to ascertain various species of snail intermediate host available and shell variations that exist within them. This study tries to identify snail intermediate host of *Schistosoma* and *Fasciola* species present in some freshwater bodies in Borno State.

MATERIALS AND METHODS

The present study was conducted in some freshwater bodies located in some Local Government Areas of Southern-Borno i.e. Hawul, Kwaya-Kusar and Shani. Borno State has a climate which is characterised by longer dry seasons and shorter wet seasons within a year. The rainy season is normally from June to September in the northern part of the state and May to October in the southern part of the state. Rainfall varies from 700 – 1000mm in the southern part and 300 – 500mm in the northern part. The state has two vegetation zones; the Sahel savannah in the North with desert

covering most part of the Chad Basin area, Sudan savannah in the South, which consist of scrubby vegetation with tall trees and woodland.

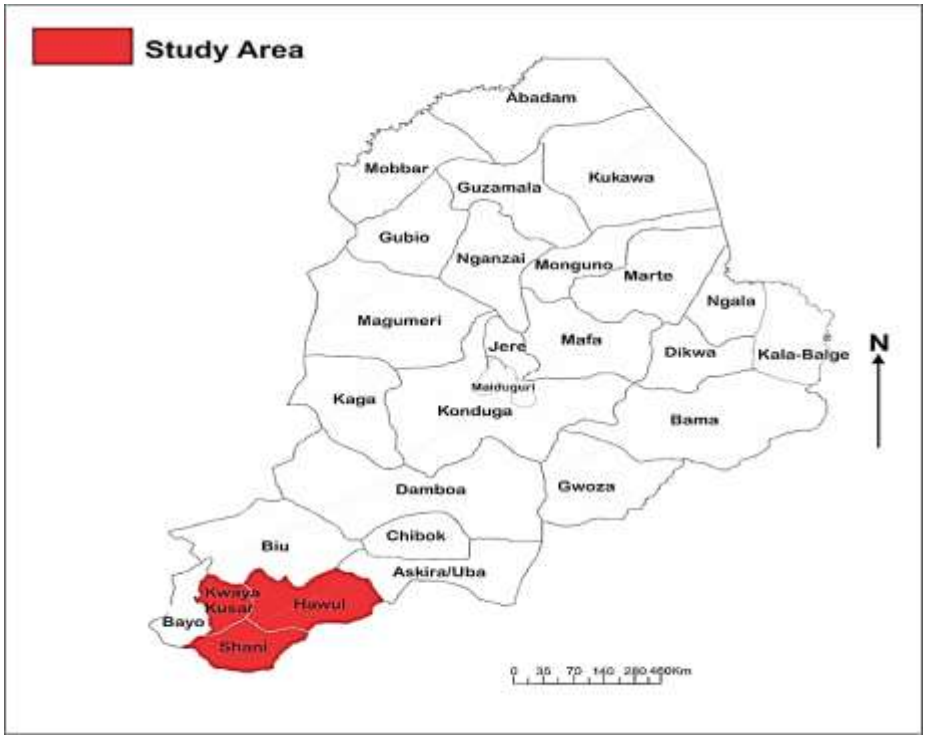

Figure 1: Map of Borno State showing the study Areas

Collection and preservation of snails

The freshwater snails were collected from different freshwater bodies from (March – July, 2019) at different sampling sites in Gwanzang (Hawul), Gashina (Kwaya-Kusar) and Bargu (Shani). They were collected using scoop net and they were transferred into a wide-perforated lid container with filtered pond water.

Identification of snails

The snails were sorted according to size and shell characteristics and are identified using special keys produced by Brown (1994) for the identification of African freshwater snails of medical importance.

Statistical Analysis

The species composition of the snail i.e. the Relative Abundance (R.A) was calculated by the formula:

$$R.A = \frac{Number\ of\ individuals\ per\ species}{Total\ number\ of\ individuals} X\ 100$$

Shanon Wiener Diversity Index (H) was also used to calculate species diversity using the formula:

$$H = -\sum (^{Ni}/_{N}) \ln N_t$$

Where:

N_i = Number of macrobenthic invertebrate species

N = The species abundance

N_t = Total number of all individuals

RESULTS

A total of 1,619 freshwater snails were collected in the surveyed Local Government Areas (Table 1). Five species of snail intermediate hosts which belong to three families i.e. *Lymnaeidae, Physidae* and *Planorbidae* were identified (Figure 1-9). One species of freshwater (*L. natalensis*) snail belonging to the family *Lymnaeidae* was identified, one species (*B. pfeifferi*) belonging to the family *Planorbidae* was identified and three species of freshwater snails (*B.* truncatus, *B. obtusus* and B. *permembranaceus*) belonging to the family *Physidae* were identified in the study. In Hawul, a total of 631 snails were collected out of which 386 were *L. natalensis*, 104 were *B. truncatus*, 39 were *B. obtusus*, 59 were *B. permembranaceus* and 43 were *B. pfeifferi.* A total of 525 snails were collected in Kwaya-Kusar out of which 352 were *L. natalensis*, 93 were *B. truncatus*, 17 were *B. obtusus*, 24 were *B. permembranaeus* and 39 were *B. pfeifferi.* Furthermore, a total of 463 snails intermediate host were collected in Shani out of which 362 were *L. natalensis*, 63 were *B. truncatus*, 8 were *B. obtusus*, 13 were *B. permembranaeus* and 17 were *B. pfeifferi.*

Table 2: Snail intermediate host species collected at sampling sites in Hawul, K/Kusar and Shani LGAs

			LGA			
Subclass	**Family**	**Species**	**Hawul**	**K/Kusar**	**Shani**	**Total (Species)**
Pulmonata	*Lymnaeidae*	*L. natalensis*	386	352	362	1,100
	Physidae	*B. truncates*	104	93	63	260
		B. permembranaceus	59	24	13	96
		B. obtusus	39	17	8	64
	Planorbidae	*B. pfeifferi*	43	39	17	99
Total			**631**	**525**	**463**	**1,619**

Figure 2: ***Lymnaea natalensis***

Figure 3*: Bulinus truncatus*

Figure 4: ***Bulinus truncatus***

Figure 5*: Bulinus truncatus*

Figure 6*: Bulinus truncatus*

Figure 7: *Bulinus obtusus*

Figure 8: ***Bulinus permembranaceus***

Figure 9: ***Biomphalaria pfeifferi***

The Relative Abundance (R.A) of snail intermediate host shows that out of 1,619 freshwater snails collected, the abundance of *L. natalensis* is 67.9%, *B. truncatus* was 16.2%, *B. premembraneus* was 5.9%, *B. obtusus* was 3.9% and *B. pfeifferi* was 6.1%. Furthermore, Shanon-Diversity Index (SDI) of snail intermediate host collected in Hawul is 1.17. Similarly, the SDI of snail intermediate host found in Kwaya-kusar is 1.01 and SDI of snail intermediate host in Shani is 0.74. These results show that there is low diversity of snail intermediate hosts in the Local Government Areas.

Table 2: Abundance and diversity of snail intermediate host in Hawul, Kwaya-Kusar LGAs

	LGAs				
Snail Species	**Hawul**	**Kwaya-Kusar**	**Shani**	**Total species**	**R.A (%)**
B. truncatus	104	93	63	260	16.2
B. permembranaceus	59	24	13	96	5.9
B. obtusus	39	17	8	64	3.9
B. pfeifferi	43	39	17	99	6.1
L. natalensis	386	352	362	1,100	67.9
Total collection	**631**	**525**	**463**	**1,619**	**100**
Shannon-Weiner Diversity Index	**1.17**	**1.01**	**0.76**		

DISCUSSION

The presence of snail intermediate host in Hawul, Kwaya-kusar and Shani LGAs has signified the diversity of snail species which are of medical and veterinary importance. The presence of these infective snails poses substantial threats in the transmission of trematode infections to the communities in the Local Government Areas (Alhassan *et al.*, 2020). In this study, various species of *Bulinid*, *Planorbid* and *Lymnaeid* snails were identified i.e. *Bulinus truncatus*, *Bulinus obtusus*, *Bulinus permembranaceus*, *Biomphalaria pfeifferi* and *Lymnaea natalensis*. This is in conformity with the study of Luka and Mbaya (2015) who reported the presence of *Bulinus* and *Lymnaea* snail species in Borno State.

Furthermore, the study also reveals that all the snail intermediate host coexist with one another. During snail collection, the infective snails are all found in the same freshwater bodies. Some studies conducted by Abe *et al*., (2016), Falade and Otarigho (2016) and Oloyede *et al*., (2016) have also encountered different species snail of intermediate host at sampling sites during their survey. In this study, *Lymnaea natalensis* is the most abundant snails found in perennial waters bodies and ponds surveyed for aquatic snails. This agrees with the findings of Oloyede *et al*., (2016) and Dida *et al.*, (2014) who in their freshwater snail survey reported high population and abundance of *Lymnaeid* snails.

The abundance and diversity of snail intermediate hosts has varied significantly in the surveyed Local Government Areas. The Shanon Diversity Index showed low diversity in the snail species (H<1.5). This may be attributed to seasonal nature of perennial rivers and ponds in the sampling sites. Similarly, Alhassan *et al*., (2020) have also reported low diversity of snail intermediate hosts at two habitats in Zaria as the Shanon Diversity Index was less than minimum scale (H<1.5).

CONCLUSION

This study has proven the existence of snail intermediate host in freshwater sites of Borno State. Various species of these infective snails have been identified which are of medical and veterinary importance. They are found in freshwater bodies of some Local Government Areas of southern-Borno State. The presence of snail intermediate hosts is of great public health importance in the study areas as they may influence the spread of schistosomiasis and fascioliasis in the region. Therefore, there is

need to conduct comprehensive surveillance and study on morphological characterization of snail intermediate hosts freshwater bodies close to human habitations. Furthermore, public awareness on the dangers these infective snails should be intensified for people in these communities. Also, preventive and control measures as well as healthy hygiene habits should be adopted so as to save human and animal lives from parasitic helminth infections.

REFERENCES

Abe, E.M., Ombugadu, A., Oluwole, A.S., Njila, H.L., Mogaji, H.O., Adeniran, A.A., Guo, Y.H., Li, S.Z., Zhou, X.N. and Ekpo, U.F. (2016). Population abundance of Bionomics of snail intermediate hosts of trematode parasites in Nasarawa, Nigeria. *Res. J. Parasitol.* 12(1): pp 1-12.

Adamu, A.M., Dzikwi, A.A., Akefe, O.I., Alimi, Y.A., Adikwu, A.A., Idoka, S.I., Kore, M., Okita, A.O., Yikare, S.S., Bello, S.G., Lamai., R.S. and Kolo, R.L. (2019). Epidemiology of Urinary Schistosomiasis among Secondary School Students in Kaduna State, Nigeria. *J. Community Med Health Edu, 2019.* 9:650 pp 1-5.

Adenowo, A.F., Oyinloye, B.E., Ogunyinka, B.I. and Kappo, A.P. (2015). Impact of human schistosomiasis in sub-Saharan Africa. *Braz. J. Infect Dis.* 2015: pp 1-10.

Alhassan, A.B., Abidemi, A., Gadzama, I.B.M., Sha'aba, R.I., Wada, Y.A. and Kelessanthodi, R. (2010). Distribuition and divesity of freshwater snails of public health importance in Kubunni Reservoir and Weir/Sediement Trap, Zaria, Nigeria. *Journal of Environmental and Occupational Science.* Vol 10(1): pp. 1-9.

Anderson, R.M. and Medley, G.F. (1985). Community control of helminth infections of man by mass and selected chemotherapy. *Parasitology* (1985) 90: pp. 629-660.

Appleton, C. and Mirinda, N.A.F. (2015). Two Asian freshwater snails newly introduced into South Africa and Analysis of alien species reported to date. *African invertebrate* 56(1): pp 1-17.

Apurba, S.S. and Sandha, B.K. (2016). Essentials of Medical Parasitology. *Jaypee Brothers Medical Publishers.* pp. 1-40.

Barakat, R.M.R. (2013). Epidemiology of Schistosomiasis in Egypt: Travel through time: Review. *J. Adv Res.* 4(5): pp 425-432.

Bartsch, S.M., Hotez, P.J., Asti, L., Zapf, K.M., Battazzai, M.E. and Diemert, D.J. (2016). The Global and Economic Health Burden of Human Infections. *PLoS Negl Trop Dis.* 10(9). pp 1-10.

Birma, J.S., Chessel, G., Shardrach, P.A., Nganjiwa, J.I., Yako, A.B. and Laurat, J. (2017). Urinary Schistosomiasis in communities around Kin Lake Shelleng Local Government Area, Adamawa State, Nigeria. *J. appl. Science. Environ. Manag.* Vol 21(1) pp 128-134.

Buscher, P., Cecchi, G., Jamanneau, V. and Priotto, G. (2017). Human African Trypanosomiasis. *Acta Tropica.* Cited at www.who.int/trypanosomiasis_african/county/enl

Dawaki, S., Al-Meklafi, H.M., Ithoi, I., Ibrahim, J., Abdulsalam, A.M., Ahmed, A., Sady, H., Atrosh, W.M., Al-Requi, M.A., Elyana, F.N., Nasr, N.A. and Surin, J. (2016). Prevalence and risk factors of schistosomiasis among, Hausa communities in Kano State, Nigeria. *Rev. Inst. Med. Trop. Soa Paulo.* 58:54. pp 1-9.

Dawet, A., Bulus, E., Joachiam, B.N., Lumi, E.B. and Yakubu, D. (2019). Schistosomiasis among primary school pupils in Pilgari District, Lantang North Local Government Area, Plateau State, Nigeria. *GSC Biological and Pharmaceutical Sciences* 2019. Vol 69(1) pp 1-14.

Dida, G. O., Gelder, F. B., Anyona, D. N., Matano, A.S., Abuom, P. O., Adoka, S. O. Ofulla, A. and Ayub, V. O. (2014). Distribution and abundance of schistosomiasis and fascioliasis host snails along the Mara River in Kenya and Tanzania. *Infection Ecology and Epidemiology*. 8(4) pp. 1–7.

Emini, E.I. and Enogiomwan, I.E. (2019). Prevalence of *Schistosoma hematobium* and its intermediate host in Abini Local Government Area, Cross River State. *Asian J. Med Health Des.* ISSN 2455-8664: 4(1): pp 1-10.

Exum, N.G., Kibira, S.P.S., Ssenyonga, R., Nobili, J., Shanon, A.K., Ssempebwa, J.C., Tukahebwa, E.M., Radloff, S., Schwab, K.J. and Makubi, F.E. (2019). The prevalence of schistosomiasis in Uganda: A cultural programs and water and sanitation interventions. *PLoS Neglected Tropical Diseases.* Vol 13(8). pp 1-9.

Falade, M. O. and Otarigho, B. (2015). Shell morphology of three medical important tropical

freshwater pulmonate snails from five sites in South-Western Nigeria. *International Journal of Zoological Research*, 11(4): pp 140–150. https://doi.org/10.3923/ijzr.2015.140.150.

Florey, L. (2014). Measures of malaria parasitemia prevalence in Natural Surveys: Agreement between Rapid Diagnostic Test and Microscopy. *DHS Analytical Studies No. 43*. ICF International Rockville, Maryland, USA. pp 1-43.

Jacobs, D., Fox, M., Gibbons, L. and Hermosilla, C. (2016). Principles of Veterinary Parasitology. John Wiley & Sons, Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK. pp 350-355.

Luka, J and Mbaya, A. W. (2015). Cercarial shedding of trematodes and their associated snail intermediate hosts in Borno State, Nigeria. *Asian Pacific Journal of Tropical Disease*, 5(4) pp. 293–298. https://doi.org/10.1016/S2222-1808(14)60786-6.

Mas-Coma, S., Bargues, M.D. and Valero, M.A. (2018). Human fascioliasis, infection sources, their diversity, incidence factors, analytical methods and presentation measures. *Parasitology*. 145: 1665-1699.

Mbata, J.I. (2009). Prevalence of Schistosomiasis in Nigeria Community. *Afr. J. Biomed*. Vol 12 No.12. pp 101-105.

Ndukwe, Y.E., Obiezue, R.N.N., Aguzie, I.O.N., Anonubi, J.T. and Okafor, F.C. (2019). Mapping urinary schistosomiasis in Anambra State, Nigeria. *Annals of Global Health* 2019. 85(1)52 pp 1-10.

Nwabueze, A.A., Fagbemi, B.O. and OPara, K.N. (2009). Prevalence of urinary schistosomiasis in Ibadan, South-Western Nigeria. *The Zoologist.* Vol.7 Doi:104314/ezool.v7il.52086.

Oloyede, O. O., Otarigho, B. and Morenikeji, O. (2016). Diversity, distribution and abundance of freshwater snails in Eleyele dam, Ibadan, south-west Nigeria. *Zoology and Ecology*, (11), pp. 1–9. https://doi.org/10.1080/21658005.2016.1245934.

Sam-Wobo, S.O., Ekpo, U.F., Ameh, I.G. and Osileye, O.T. (2009). Continued high endemicity of urinary schistosomiasis in Ogun State Nigeria. *Nigerian Journal of Parasitology*. ISSN 1117-4145. Vol. 30(1) pp 44-52.

Singh, K. and Muddasini, D. (2013). Epidemiology of schistosomiasis in school aged children in some riverine areas of Sokoto, Nigeria. *Journal of Public Health and Epidemiology*. ISSN 2006-9723. Vol. 6(6). pp 197-201.

W.H.O (1995). Control of food-borne trematode infections. *Tech. Rep. Ser.* 849: pp 1-159.

W.H.O (2010). Leishmaniasis: World Wide epidemiological and drug access update: WHO technical Report series 949. pp 1-43.

Webster, J.P., Koukounari, A., Lambutum, P.H.L., Stothard, J.R. and Fenwick, A. (2009). Evaluation and application of potential schistosome-assorted morbidity markers within large-scale mass chemotherapy programmes. *Parasitology* (2009) 139: pp. 1789-1799.

Wu, Z.D., Lu, X-I., Limponant, Y., Gu, Q-Y., Song, L-G., Okanurak, K. and LV, Z-Y. (2018). Snail-borne parasitic disease: An update on global epidemiological distribution, transmission, interruption and control methods. *Infectious Diseases of Poverty* (2018) 7:28. pp 1-28.