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Full Length Research Article

EFFECTS OF SOME PHYSICO-CHEMICAL PARAMETERS ON PREVALENCE OF INTERMEDIATE HOST OF ANIMAL TREMATODES IN BAUCHI STATE, NIGERIA

Usman, A.M.[1*]; Babeker, E.A.[2,3] and Malann, Y.D [4]

[1*]Department of Integrated Science College of Education, Azare, Bauchi State. Nigeria.
[2]Department of Biological Sciences, University of Bakht Alruda, Ed-dueim, Sudan.
[3]Department of Basic Science, College of Science and Arts in Oqlat Alskoor, Qassim University, K.S.A.
[4]Department of Biological Sciences, University of Abuja, FCT. Nigeria.

Corresponding Author's e-mail addresses: usman.alhajimohammed55@gmail.com Phone: +2348035175659

ABSTRACT
The effect of physicochemical parameters on the prevalence, distribution and vector aspects of snail borne diseases was conducted in Bauchi State, from January to December, 2016. Nine (9) of the twenty (20) Local Governments Areas, three (3) from each senatorial zone and two (2) water bodies in each selected Local Government Area were randomly selected for the study. Standard keys were used to identify the snail vectors. Three physicochemical parameters of the water were measured temperature, pH and dissolved oxygen. Temperature and pH were measured using Hanna instrument temperature tester-H198311 and pH tester-H198107 respectively while dissolved oxygen of the water was measured using Winkler method in the laboratory. One thousand six hundred and five (1605) snails were collected and identified which include 1581 *Bulinus globosus* and 24 *Biomphalaria pfeifferi.* Out of this, only 59(3.7 %) of the *Bulinus globosus* shed cercariae in the water with low temperature and pH value and high dissolved oxygen. The snail abundant varied significantly. Therefore effective snails control programme as well as public awareness on the role of snails in transmitting animal trematode in the area is recommended.

Keywords: Physico-chemical parameters, Snail, Animal trematode, Bauchi State, Nigeria

INTRODUCTION

Snails have a wide range of importance to humans both economically and medically. A sizeable number, especially the aquatic forms of freshwater snails in tropical freshwater are known to be inevitable agents of trematode diseases of man and his domestic animals as stated by Cowper (1959) and Brown (1994). The freshwater snail causes number of diseases such as schistosomiasis, paragonimiasis, dicrocoeliasis and fascioliasis. NHS (2011) and Patient Info (2013) stated that Schistosomiasis also known as bilharzias or snail fever or katayama fever is the common disease among all the diseases transmitted by the freshwater snails. Schistosomiasis affect almost 210 million people worldwide (Fenwick, 2012) and an estimated 12000 (Lozano *et al.,* 2012) to 200,000 people die from it in a year (Thetiot-Laurent *et al.,* 2013). The disease is most commonly found in Africa, as well as Asia and South America (WHO, 2014). Around 700 million people in more than 70 countries live in area where the disease is common (Thetiot-Laurent *et al.,* 2013; WHO, 2014). In tropical countries, schistosomiasis is second only to malaria as a parasitic disease with the greater economic impact (Carter center, 2008). It is classified as a neglected tropical disease (CDC, 2013). Five species of schistosome infect humans *S. haematobium, S. mansoni, S. japanicum, S. mekongi and S. intercalatum. S. intercalatum*is parasites of cattle in West Africa, also occasionally causes the disease in human. All the species are intestine and liver parasite with the exception of *S.haematobium* that effect urinary tracts (WHO, 2014).

In Nigeria, snail borne diseases are considerable and growing importance due to inadequate portable water and activities related to water resource development schemes for irrigation, fishing, and hydro-electricity "as stated by Ofoezie (2002). The infections are widespread and prevalent in areas where the snail intermediate hosts breed in water bodies contaminated by feces or urine or even infected animals. Animals acquire these infections through repeated grazing on contaminated vegetation. The snails are considered to be intermediate host because snail habour the asexual stage of the parasite while humans or animal habour the sexual stage of the parasites. Transfer of the infection requires no direct contact between snails and the animal.

Under natural conditions snails are exposed to a range of varying and often interacting environmental factors which produce collective effect on them and it is usually difficult to separate the effect of any one factor from others (Berrie, 1970). Similarly, aquatic vegetation and other physical factors such as temperature, favorable pH and other chemical factors such as dissolved gases in water bodies as well as biological factors such as availability of food, competition and predator-prey interactions have been identified to affect the ecology of snails and other intermediate hosts of the diseases, hence their focal and seasonal distributions (Ofoezie, 1999; Owojori *et al.,* 2006).

Having identified the importance of snail intermediate hosts in transmitting the parasite and other factors that lead to the high population of the snail, an adequate knowledge of physico chemical parameters, population dynamic and other factors that lead to the high population of snails is of paramount important in controlling the disease. Therefore, this study is, carried out to determine the effect of some physico-chemical parameters on the prevalence of snails vector as well as the infected snail in the study area thereby providing information that can be utilized in designing a suitable programme for effective control of the diseases Bauchi State, Nigeria.

MATERIALS AND METHODS

Study Area

Bauchi state occupies a total land area of 49,119 km² representing about 5.3 % of Nigeria's total land mass and is

located between latitudes 9° 3′ and 12° 3′ north and longitudes 8° 50′ and 11° easts. The state has a total population of approximately 4,653,066 million people according to National Population Census (NPC, 2006) and 20 local governments. Bauchi state is one of the states in the northern part of Nigeria that has two distinctive vegetation zones, namely, the Sudan savannah and the Sahel savannah. The Sudan savannah type of vegetation covers the southern part of the state while the Sahel savannah, also known as semi-desert vegetation manifested from the middle of the state as one moves from the state's south to its north. The vegetation types as described above are conditioned by the climatic factors, which in turn determine the amount of rainfall received in the area. Rainfall in Bauchi state ranges between 1300 mm per annum in the south and only 700 mm per annum in the extreme north. The rains start earlier in the southern part of the state where rain is heaviest and last longer. In contrast, the northern part of the state receives the rains late, usually around June or July, and records the highest amount of 700 mm per annum. Temperature is high throughout the year with day time range of 23 ^{0}C to 35 ^{0}C while the coldest months are December and January.

Sampling Techniques

Sample Site Selection
Nine Local Governments were randomly selected for the purpose of the research bases on senatorial zone. Bauchi, Dass and Toro local government were selected in Bauchi South, Dambam, Misau and Ganjuwa local government were selected in Bauchi Central and Katagum, Itas/Gadau and Jama'are in Bauchi North. However two water bodies were also selected randomly from each selected local government for the purpose of this study.

Collection of Snails and Water Samples
Snail and water samples were collected from the selected water bodies. A long handed dip net was used to scoop at each site of the water for 10 minutes as adopted by Hira (1970) while hand picking of snails from vegetation around the selected water bodies was done concurrently. Water samples were also collected immediately after the snail collection.

Identification of Snails
Standard key described by Brown and Christensen (1993) was used to identify the snail. Each species were placed in a separate glass beaker bearing labels showing the location of collection; reference number and date of collection. Ten (10) snails were placed in each beaker 500 ml capacity. One hundred 100 ml of water was added before exposing them to sun- light for 30 minutes to facilitate the shedding of cercariae by the snails. Then, the water in the snail containers were examined for cercariae under a dissecting microscope. Each snail in the containers that is positive with cercariae was separated and examined further, by placing each of them in a separate beaker. Ten (10 ml) of water was added and exposed to sunlight for another 30 minutes for further examination.

Physicochemical analysis of water
Three physicochemical parameters of the water bodies were measured (Temperature, pH and Dissolved oxygen).Temperature was determined using portable Hanna instruments Dist 5 EC/TDS/Temperature Tester HI98311.^{o}C, pH was determined using Hanna instrument pHep$^{(R)}$ pH Tester – HI98107 while dissolved oxygen was determined using Wicklers method (2011).

Ethical Clearance
Permission was sought from the Bauchi State Government (MOH/GEN/S/1409/1) before proceeding with the research after which the chairman as well as District heads of the selected Local Government Areas were approached for same purpose.

Statistical Analysis
The data collected were subjected to Chi-square test and values at $p<0.05$ were considered significant.

RESULTS
A total of 1,605 snails were collected made up of 1,581 *Bulinus* species and 24 *Biomphalaria* species. Out of the snails collected only 59 (3.7%) of *Bulinus* species encountered were infected with cercariae and none for *Biomphalaria* species. The month of October had the highest infected snails 17, followed by November, September, December, January, May and March with 15, 14, 7, 3, 2 and 1 respectively while February, April, June, July and August had no snail infected with cercariae. The infections rate among the snails collected was not significantly different ($p<0.05$) in relation to the month (Table 1).
Two different types of species were encountered *Bulinus globosus* and *Biomphalaria pfeifferi*. *Bulinus globosus* were encountered in all the three senatorial zones of the state while *Biomphalariapfeifferi* were only encountered in the Bauchi south senatorial zone and none of them were infected with cercariea (Table 2).

Table 3 shows the average values of pH, temperature and dissolved oxygen of the water bodies sample collected which ranged from 7.0-8.5, 22.2-31.9^0 C and 7.0 -8.3mg/l respectively.
The month that cercariea were shed had the lowest pH and temperature values but highest dissolved oxygen value as shown in Table 3A total of 1,605 snails were collected made up of 1,581 *Bulinus* species and 24 *Biomphalaria* species. Out of the snails collected only 59 (3.7%) of *Bulinus* species encountered were infected with cercariae and none for *Biomphalaria* species. The month of October had the highest infected snails 17, followed by November, September, December, January, May and March with 15, 14, 7, 3, 2 and 1 respectively while February, April, June, July and August had no snail infected with cercariae. The infections rate among the snails collected was not significantly different ($p<0.05$) in relation to the month (Table 1).

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Table 1: Prevalence of snails collected according to month during the study

Months	No of snail collected	No Infected	infectivity rate (%)
January	158	3	1.9
February	84	0	0.0
March	48	1	2.1
April	32	0	0.0
May	16	2	12.5
June	0	0	0.0
July	0	0	0.0
August	5	0	0.0
September	102	7	6.7
October	338	17	5.0
November	470	15	3.2
December	352	14	3.9
Total	**1605**	**59**	**3.7**

X^2 calculated = 14.97; X^2 tabulated = 19.68, df= 11, p>0.05

Table 2: Distribution of snail vectors according to location

Senatorial Zone	Snails encountered *Bulinus globosus*		*Biomphalaria pfeifferi*	
	No Examined	No Infected (%)	No Examined	No Infected (%)
Bauchi South	627	23(3.7)	24	0(0)
Bauchi Central	422	21(4.9)	0	0(0)
Bauchi North	532	15(2.8)	0	0(0)
Total	**1581**	**59(3.7)**	**24**	**0**

Table 3: Relationship between snails shedding cercariae and average water quality values

Month	No of snails collected	No of snail shed Cercariae	Average Water Quality Values		
			pH	Temp °C	Dissolve oxygen mg/l
January	158	3	7.0	22.2	8.3
February	84	0	7.0	24.7	7.9
March	48	1	7.2	27.8	7.5
April	32	0	7.8	31.9	7.0
May	16	2	8.1	29.0	7.4
June	0	0	8.2	28.6	7.4
July	0	0	8.0	25.1	7.8
August	5	0	8.5	24.3	8.0
September	102	14	7.7	25.0	7.9
October	338	17	7.4	26.0	7.7
November	470	15	7.2	24.1	8.0
December	352	7	7.1	22.3	8.3
Total	**1605**	**59**			

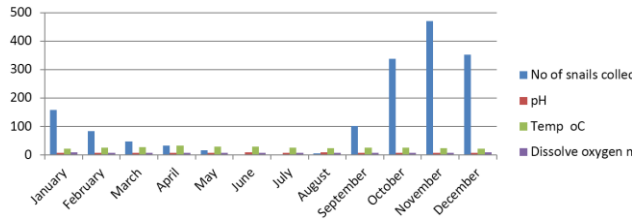

Fig 1: Relationship between Snails and Average Water Quality

DISCUSSION

This study has revealed the co-existence of the two important intermediate host of schistosomiasis namely *Bulinus globosus* and *Biomphalaria pfeifferi*. *Bulinus globosus* is known to be intermediate hosts of *S. haematobium* in Nigeria as stated by Adewunmi *et al.* (1990) and other parts of Africa (Doumenge *et al*., 1987).*Biomphalaria pfeifferi* is host of *S.mansoni* in Nigeria (Cowper, 1973; Adewunmi *et al*., 1990). The population of the snails shows a great variation between the two seasons with the highest population at the beginning of the dry seasons. This observation is in agreement with earlier report of Ndifon and Ukoli (1989), Utzenger and Tanner (2001), and Sodeman, (1979) who reviewed studies of monthly changes in snail vector population in several West African countries. However, out of the 1605 snails collected and examined only 59(3.73 %) of the *Bulinus globosus* were infected and observed with shed cercariae and none of the *Biomphalaria pfeifferi* was infect. This observation may be the reason for the low prevalence of *S.mansoni* in the study area because the snail vectors of the parasite are not habouring the infective stage of the parasite.

The average of three physio-chemical parameters of the selected water bodies were measured and found to be within the range that can support snail population. WHO, (1993) and Jordan, *et al.,* (1993) reported that, the optimal temperature for snail reproduction is 22 °C-26 °C and the higher the temperature, the lower the dissolve oxygen. The lower dissolve oxygen of less than 1 % caused suffocates of snail WHO, (1990). Also snails prefer alkaline pH but it seems it has no effect on snail's population when considered along. The values recorded in this study are in consonance with those recorded by other researchers such as Ntonifor and Ajayi (2007) and Njoku-Tony (2011) in Bauchi and Imo States respectively. Low populations of snails were found in water bodies with low dissolved oxygen and high temperature or even absent in some cases. Herbert (2010) and Njoku-Tony (2007) state that dissolved oxygen in water bodies plays an important role in snail breeding, even if all other parameters are within the normal range. However, the World Health Organization (1990) reported that, at the tail end of dry season, the oxygen tension falls below 1 % and snails tend to suffocate.

Temperature has also been recognized as an important factor on any biotope especially freshwater (Hira, 1970). High temperature causes thermal stress in snail vectors (Hofkins *et al*., 1991) it also reduces dissolved gas content of the water body. Most of the snail recorded in this study tolerated the minimum /maximum temperature of 22.3 °C -31.9 °C in their natural habitats. This report is in agreement with the earlier report made by Njoku-Tony (2007) and Ntonifor and Ajayi (2007). However, the pH values measured during the study were range 7.0 -8.5 and most of the snails is found within the pH value of less than 8. In the period or month with high pH value of above 8, the snails were low or even absent. Ntonifor and Ajayi (2007) reported that snails prefer base or alkaline pH but it seem it has no effect on snails population and abundance when consider alone as observed

In conclusion, this study has established the occurrence of aquatic snails, some of which are known to be vectors of schistosomiasis in the study area and also the effect of some physico chemical parameters such as temperature, pH and Dissolve oxygen as well as other factors such as vegetations that surrounded the water bodies which lead to high density of snail population. However, most of the snails vectors are not harbouring the infective stage of the parasite (cercariae) as only

3.9 % of the snails examined were infected. From the result of this study, it is concluded that the snail borne diseases are not endemic in the study area and temperature and dissolved oxygen are very important physico chemical parameter in any biotope and they go hand in hand. This study therefore, calls for effective snails control programme and public awareness on the role of snails in transmitting animal trematode in the area.

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