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Study on Physico-Chemical Parameters and Prevalence of Fish Parasites in Jibia Reservoir, Katsina State, Nigeria

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Abstract

A study was carried out to determine the relationship between physico-chemical parameters and prevalence of helminth parasites of fishes in Jibia Reservoir, Katsina State. Fishes and water samples were collected on monthly basis and analyzed. Fish samples were analyzed following standard parasitological technique and water analysis procedures was used to determine water quality. Seven species of helminth parasites were identified and these include Trematode: Neascus sp, Nematodes: Procamallanus laevionchus and Contracaecum sp, Cestodes :Polyonchobothrium clarias, Bothriocephalus aegyptiacus and Proteocephalus glanduliger and Acanthocephalan: Neoechinorhynchus rutili. Prevalence was found to be highest (55.88%) in January and the least prevalence (21.74%) was recorded in August. A t- test revealed no significant difference (p>0.05) between the monthly prevalence of parasitic infection. There were variations in the monthly values of investigated physico-chemical parameters, though it was not statistically significant (p>0.05). The percentage of parasitic infection showed a perfect positive correlation with temperature (r=0.783), pH (r=0.250), Electric Conductivity (r=0.514), and Biological Oxygen Demand (r=0.135) and a negative correlation with Turbidity (r=-0.145) and Dissolved Oxygen (r=-0.699). However, further studies are recommended with greater intervals in order to identify the effects of physico-chemical parameters in the infestation success of helmith parasites in the study area.

***Keywords**: Correlation, Helminth Parasites, Jibia Reservoir, Physico-chemical parameters, Prevalence*

INTRODUCTION

Parasitic infections in fishes have been reported to enormously disrupt aquaculture production and its economic viability.The occurrence and rate of parasitic infections are closely related to the environmental conditions of the water body and also the general health of the fishes.Water quality deals with the physical, chemical and biological characteristics in relation to all other hydrological properties (Ahmad *et al.*, 2016).Various physico-chemical and biological factors are used as determinant of water quality, as they may directly or indirectly affect suitability of aquatic environment and invariably distribution and production of fish and other aquatic animals (Yerima *et al.*, 2017).

Continuous anthropological activities coupled with seasonal variation in the quantity and quality of water runoffs and tributaries that supply the reservoir may alter the physical and chemical constituent of the water and may invariably affect the wellbeing of the fish. It has been reported that global warming and climate change could contribute to the alteration of the quantity and quality of the runoffs and tributaries. Health status of the aquatic ecosystem directly or indirectly influences fish health, thereby affecting immunity of fish and leading to disease susceptibility. Fishes in polluted water bodies are more susceptible to diseases (Ajala and Fawole, 2016; Biswas and Pramanik, 2016).

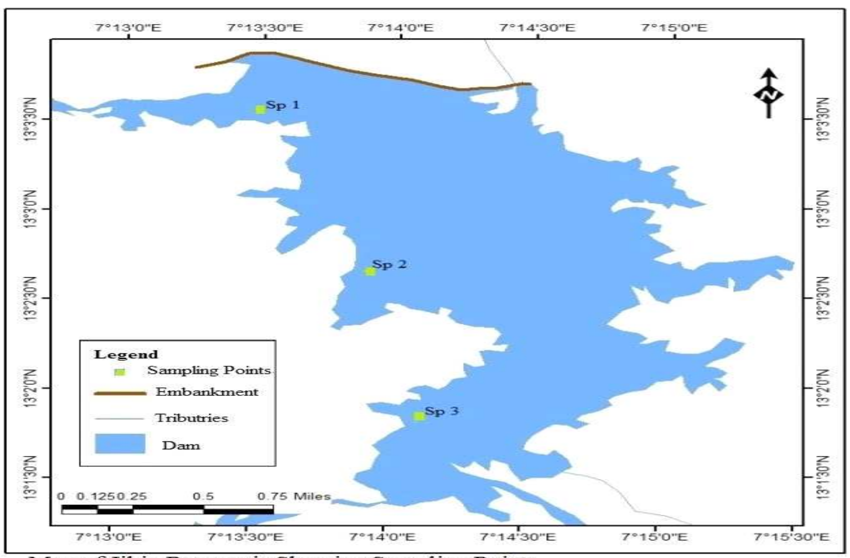
Water pollution can effectively limit the occurrence of some species of fish parasites and affect their qualitative and quantitative composition through influencing their eggs, free living larval stages and intermediate or final host (Dzika and Wyzlic, 2009).It is possible that adverse environmental conditions may decrease the ability of organisms to maintain and effective immunological response system, so that an increased susceptibility to different diseases might be expected to occur (Dwivedi and Banerjee, 2017).

Host availability, transmission environment (typically detected by abiotic conditions), and infection site specificity all have major influences on the species richness and relative abundance in parasite communities.Fish parasite communities may therefore provide important information on ecosystem conditions due to their intimate contact with both the host and aquatic environments (Singh and Mishra, 2013). Ecological factors of any aquatic habitat are presumed to determine its parasitic fauna; hence the present study was aimed to investigate the relationship between physico-chemical parameters and prevalence of helminth parasites of fishes in Jibia reservoir, Katsina State, Nigeria.

MATERIALS AND METHODS

Study area

The Reservoir is located in Jibia Local Government Area of Katsina State. Jibia lies between latitude 13^{o} 05^{I} N and 7^{o} 13^{I} E and longitude 13^{o} 09^{I} N and 7^{o} 23^{I} E. It has a total human population of 169,748 and total land mass of about 1,037km^{2}. The Reservoir lies on the coordinates 13^{o} $04^{'}$ 18^{I} N and 07^{o} $15^{'}$ 06^{I} E (Fig.1). It has a height of 23.5m, a length of 3,660m and a total capacity of 142million m^{3}. The main purpose of the dam was irrigation. Other purposes include supply of potable drinking water, domestic uses and fishing activities.



Map of Jibia Reservoir Showing Sampling Points
Source:- NASA/NOAA Spot Image 2016.

Figure 1: Map of Jibia Reservoir, showing the Sampling Sites /Points.

Samples Collection and Examination

Water and fish samples were collected for a period of six months (August 2016 – January, 2017). Three sites of the reservoir were selected for the study based on their intense anthropogenic activities carried out (purposive sampling).Samples collection was done in the morning between 06:00 to 08:00am. Samples collected were transported to the Biological Sciences Laboratory of Umaru Musa Yar'adua University Katsina for further examination.

Water Samples

Water samples were collected on monthly basis using 600 ml dark bottles. The bottles were immersed slowly into the water at the depth of about 0.5 meters and were allowed to fill. It was then covered tightly after collection of the sample. Temperature, pH and Dissolved Oxygen (DO) were determined *in situ* using thermometer; pH meter and Auto-Cal oxygen meter respectively whereas electric conductivity (EC) and turbidity were analyzed in the Biological Science Laboratory Umaru Musa Yar'adua University using Conductivity meter and Turbidity tube respectively. Biological Oxygen Demand (BOD) was determined by the difference between dissolved oxygen values before and after five days of incubation (APHA, 1992).

Fish samples

A total of two hundred and forty two (242) freshwater fish specimens were randomly purchased from the catches of the local fishermen of the reservoir. The samples collected were kept in a plastic aquaria containing water and then transported immediately to Biological Sciences Laboratory of Umaru Musa Yar'adua University Katsina for further examination.

The fish was killed by cervical dislocation to ease examination. The body cavity was opened with the aid of scissors and the gut and the liver were separated. The gut was then placed in a large Petri dish, stretched out and cut into four regions (oesophagus, stomach, intestine and duodenum). Each section was then placed in a separate labeled dish. The separated gut sections were opened by longitudinal incision to expose the inner surface which was washed with very little quantity of distilled water into labelled test tubes. A drop of the residue was placed on the slide, and observed under x10 and x40 objectives of dissecting and light microscope for the various parasites. This was repeated until the entire residue was examined (Ajala and Fawole, 2014; Okoye *et al*., 2014). Fish specimens found with parasite were given separate serial numbers to differentiate them from those without parasites. Parasites obtained were counted, labeled with the serial number of the fish and placed in physiological saline overnight to allow them stretch and relax; they were then fixed and stained using acetocarmine and lactophenol for identification to generic and species level where possible. Identification was carried out using keys provided byYamaguti, (1959 and 1963), Gibson, (1996), and Barson and Avenant-Oldewage, (2006) with the assistance of a parasitologist.

Statistical Analysis

Percentages of parasitic infections were determined. One way analysis of variance (ANOVA) was used to compare the mean values of the physico-chemical parameters. T –test was used to determine monthly variations in the physico-chemical parameters as well as association between prevalence and months. Pearson correlation was used to determine the relationship between physico-chemical parameters and prevalence of helminth parasites. All the analyses were carried out using Graph pad Instant Statistical Software Version 3.0 at a significant level of 0.05.

RESULTS

The mean values of physico-chemical parameters recorded in this study in different months are shown in (Table 1). The highest mean water temperature recorded in the reservoir during the study was 29.8^{0}C in the month of October and the lowest was 27.1^{0}C in the month of August. The range of pH recorded was 7.4-7.7 with the highest value 7.7 in the month of October and lowest value 7.4 recorded in August and November. There is no significant difference ($p>0.05$) in the mean values of pH during this study. The mean monthly values of EC ranged between 81.1-93.4µS/cm with the highest value recorded in the month of January and lowest in December. The highest value of water turbidity 326.7NTU was recorded in the month of September and lowest water turbidity values 296.7NTU in August and November. The highest DO value (8ppm) and lowest (7.1ppm) were recorded in the months of December and September respectively. BOD values ranged between 2.8-2.0ppm with the highest value 2.8ppm recorded in December.

Table 1: Monthly Variations of the Physico-chemical Parameters in Jibia Reservoir.

Parameters	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.
T (^{0}C)	27.1	28	29.8	28.9	29	29.6
pH	7.4	7.5	7.7	7.4	7.5	7.5
EC (µS/cm)	82.3	85.2	87.5	87.8	81.1	93.4
Turb. (ntu)	296.7	326.7	306.7	296.7	303.3	306.7
DO (ppm)	7.7	8.0	7.7	7.8	7.6	7.1
BOD (ppm)	2.2	2.0	2.4	2.2	2.8	2.4

Keys: T = Temperature; EC = Electric Conductivity, Turb. = Turbidity, DO = Dissolved Oxygen, BOD = Biological Oxygen Demand

The present study recorded seven species of helminth parasites belonging to four different species/groups namely; Trematode (*Neascus* sp), Cestodes (*P. clarias*, *B. aegyptiacus* and *P. glanduliger*), Nematodes (*P. laevionchus* and *Contracaecum* sp) and Acanthocephalan (*N. rutili*) infecting the *Oreochromis niloticus* and *Clarias gariepinus* in Jibia Reservoir. The monthly prevalence of infection of helminth parasites during the study period is shown in Table 2. The highest prevalence of infection (55.88%) was observed in January and the least prevalence of infection (21.74%) was recoded in August. Moreover, infection was more pronounce in the dry season months than the rainy season.

Table 2: Monthly Prevalence of Helminth Parasites of Fishes in Jibia Reservoir.

Variables	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.
No. of fishes Examined	46	41	44	39	38	34
No. of fishes Infected	10	12	16	17	19	19
Prevalence (%)	21.74	29.27	36.36	43.59	50.0	55.88

Correlation analyses between prevalence of helminth parasites and different physico-chemical parameters investigated in the study area is shown in Table 3. The percentage of infection showed a perfect positive correlation (r = 0.783; P<0.05) with temperature. There were positive associations between prevalence of infection with pH, EC and BOD and negative correlation with turbidity and DO. Water temperature showed positive correlation with pH, electric conductivity and biological oxygen demand and a negative correlation with turbidity DO. pH showed positive correlations with temperature, EC, turbidity and BOD and a negative correlation with DO. EC indicated a positive correlation with temperature and pH and negative correlations with turbidity, DO and BOD. Turbidity showed a positive correlation with pH and DO and negative correlations with temperature, EC and BOD. DO showed positive correlation with turbidity and a negative correlation with temperature, pH and EC and BOD. On the other hand, BOD values showed a positive correlation with temperature and pH and a negative correlation with EC, turbidity and DO.

Table 3: Correlation matrix between prevalence of helminth parasites and different physico-chemical parameters investigated in the study area.

Parameters	Prevalence BOD	Temperature	pH	EC	Turb.	DO
Prevalence	-					
Temperature	0.783*	-				
pH	0.250	0.112	-			
EC	0.514	0.311	0.269	-		
Turb.	-0.145	-0.023	0.333	-0.484	-	
DO	-0.699	-0.488	-0.061	-0.590	0.310	-
BOD	0.135	0.534	0.276	-0.087	-0.329	-
0.485	-					

Keys: EC = Electric Conductivity, Turb. = Turbidity, DO = Dissolved Oxygen, BOD = Biological Oxygen Demand, *Correlation is significant at 0.05 significant level

DISCUSSION

The balance of physical, chemical and biological properties of water in ponds, lakes and reservoirs is an essential ingredient for successful production of fish and other aquatic resources (Olanrewaju *et al.*, 2017). Variations in the physico-chemical parameters have been reported by many authors (Ajala and Fawole, 2016; Usman, 2016; Ibrahim *et al.*, 2009). Variations in the values of different physico-chemical parameters observed during the study period could be attributed to changes in weather conditions and anthropogenic activities in and around the reservoir (Yerima *et al.*, 2017). Mean water temperature of the reservoir fluctuates between 27.1-29.8°C and was within the range reported by Lawal and Ahmed (2014). The low water temperature recorded might be due to the characteristic cool weather while the relatively high water temperature may be due to low water level and higher atmospheric pressure (Ikongbeh *et al.*, 2017). The mean pH values obtained felt within the range for inland waters (6.5-8.5) for most biological activities (Ibrahim *et al.*, 2009). The exposure of water body, biological activities, temperature changes and decaying vegetation could account for the monthly variation of the water pH (Yerima *et al.*, 2017). Trend in electric conductivity values obtained in this work was similar to that of Usman (2016) and Ibrahim *et al.* (2009) who attributed high conductivity value to higher rate of evaporation that result to reduced water volume and increase nutrients concentration and attributed the low value to increase in rain water which causes dilution of the dissolved solids.

Turbidity of the water body also varied slightly between the months and felt within the ranged recorded by Sulaiman and Audu (2014) in the same reservoir. The highest water turbidity recorded might be related to cloudiness of water body as a result of particulate matter being suspended within it (Nafi'u and Ibrahim 2017). Higher DO recorded could be as a result of low temperature and increased mixing of water whereas high temperature coupled with high rate of decomposition may be suggestive of lower DO values (Mustapha, 2008). The high value of BOD obtained confirmed the findings of Ikongbeh *et al*. (2017) and attributed the higher BOD values to biodegradable matter, higher pollution load, and higher oxygen consumption by heterotrophic organisms present in the reservoir.

Parasitic infections were more pronounced in dry season months than the rainy season. Similar trend of parasitic infections were reported by Ajala and Fawole (2014). Persistent anthropogenic activity and eutrophication plays an important role in rise, maturation and abundance of fish parasites in water bodies. Therefore, findings from this research agreed with Ahmad *et al*.(2016) who suggested that deterioration of water quality with changing seasons might have resulted to high stress response in fishes making them vulnerable to parasitic infections in dry season.

Impact of environmental factors on the prevalence of parasites have been stressed by many authors (Modu *et al*., 2016;Wali *et al*., 2016; Qayoomand Shah 2017) who indicated that several physico-chemical parameters including water temperature, dissolved oxygen, pH, and total ammonia-nitrogen and eutrophication might have influence on the occurrence of parasite populations.

Correlation of water quality parameters with the prevalence of helminth parasites in this study suggests the influence of the parameters monitored on the prevalence of helminth parasites. Temperature was the most significant parameter influencing the prevalence of helminth parasites in Jibia reservoir, indicating parasites prevalence increases with increasing water temperature. This is in line with the findings of Modu *et al*. (2016) who reported that strong positive and highly significant relationship of temperature with the prevalence of helminth parasites. pH and EC indicated a positive correlation with the prevalence of helminth parasites and this does not agree with the result of Punyabati *et al*., 2013. Negative correlations were observed between waterturbidity and DO with parasites infestation rate and these corresponds with the work of Ahmed *et al*. (2016) who reported a negative correlation between water turbidity and *Alitropustypus* (isopod) infestation.

CONCLUSION

This study revealed the prevalence of helminth parasites in Jibia Reservoir and seasonal variations in its physico-chemical parameters. It was noted that some of the physicochemical parameters in the reservoir fell within acceptable limits for aquaculture. Furthermore, the study also revealed relationships between the prevalence of helminth parasites and water quality parameters in the reservoir. However, further studies are recommended with greater intervals in order to identify the effects of physico-chemical parameters in the infestation success of helmith parasites in the study area.

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