

Parasite Diversity, Prevalence and Intensity in Catfish (*Clarias gariepinus*) and Tilapia (*Oreochromis niloticus*) from Freshwater Bodies in Zaria Metropolis, Kaduna State, Nigeria

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ABSTRACT

Fish is an affordable protein source in northern Nigeria, but parasitic infections significantly limit fish health and productivity. This study was conducted to determine the infection indices, parasite prevalence, intensity and associated physicochemical parameters in fishes from *Clarias gariepinus* and *Oreochromis niloticus* from Ahmadu Bello University (ABU) and Zaria dams between the months of November to February representing harmattan (cool dry season). A total of 210 fish specimens were examined, comprising 130 *C. gariepinus* and 80 *O. niloticus*, collected weekly from artisanal fishermen. Standard parasitological methods were used for parasite identification, quantification and infection indices. Physicochemical parameters were measured using standard procedures. Overall, 91 (43.3%) were seen to be infected with parasites Eighty (80) *Oreochromis niloticus* were examined and 21 (25.0%) were infected and 130 *Clarias gariepinus* were examined of which 70 (54.0%) were infected. Parasitic intensity in *Oreochromis niloticus* for *Clinostomum* (1.6), *Polyonchobothrium* (0.7), and *Monobothrium* sp (0.14). *Clarias gariepinus* parasitic intensity for *Clinostomum* (0.24), *Polyonchobothrium clariae* (0.3), *Monobothrium* sp (0.2) and *Trypanosoma* sp (1.53). The prevalence of parasitic infection in Zaria dam (48.0%) was significantly higher ($p < 0.05$) than in ABU dam (37.1%). Physicochemical parameters did not differ significantly between sites, dissolved oxygen levels were low in both dams, while turbidity and total hardness exceeded WHO limits. The findings highlight a substantial parasitic burden and suggest that suboptimal water quality may contribute to infection dynamics. Further studies should identify drivers of parasite prevalence, ensure routine water quality monitoring and apply molecular tools to characterize *Trypanosoma* sp and their pathogenicity.

Keywords: Parasite Diversity; Prevalence; Intensity; *Clarias gariepinus*; *Oreochromis niloticus*

INTRODUCTION

The current population growth in Nigeria calls for increased attention to food production in order to meet the rising demand for animal protein (FAO, 2022). Fish is considered a major alternative in bridging this protein gap due to its relatively low cost, high acceptability, and perceived low cholesterol content in the Nigerian diet. Fish serves as an important source of animal protein for humans, livestock and contributes

over 40% of the animal protein intake of about two-thirds of the global population. Due to the increasing demand for animal protein in recent years, there has been significant growth in aquaculture development in Nigeria. However, the country still faces a substantial fish supply deficit, as Nigeria imports a large proportion of its fish consumption to supplement domestic production (FAO, 2022).

Given the economic importance of fish to Nigeria's rapidly growing population and the consequent increase in protein demand, information on fish parasites and diseases is particularly important. Fish parasites negatively affect production through increased treatment costs, mortality, reduced growth rates, and lowered market value during and after disease outbreaks (Austin and Austin, 2016).

Aquaculture, especially in Nigeria, has expanded rapidly in recent decades and is now recognized as a significant contributor to food security and economic development. However, one of the major constraints to aquaculture development is the incidence of parasitic infections and fish diseases. Fish diseases may be caused by viral, bacterial, fungal, rickettsial, or parasitic agents (Austin and Austin, 2016; Woo *et al.*, 2020). Ectoparasites cause direct damage to fish tissues, impair growth, reduce fish populations and may lead to increased mortality (Barber *et al.*, 2022). In cultured fish populations, parasitic infections often lead to disease outbreaks, particularly under intensive farming conditions (Basse *et al.*, 2020). Fish parasitic diseases are widely distributed globally, with higher prevalence in tropical regions due to favorable environmental conditions (Woo *et al.*, 2020).

One of the most important and universally recognized constraints to fish production is disease, which continues to threaten the sustainability and profitability of aquaculture in Nigeria (Oladipo *et al.*, 2021; FAO, 2022).

MATERIALS AND METHODS

Study Area

Zaria metropolis comprises Zaria and Sabon Gari Local Government Areas of Kaduna State, Nigeria. Zaria is situated on the high plains of northern Nigeria and is approximately 670m above sea level. It is located on latitude 11° 42' E, (Obadaki, 2007). It belongs to the tropical continental type of climate which corresponds to Koppen's tropical savannah climate, characterized by strong seasonality in rainfall and temperature distributions. It has two distinct seasons – the dry season (October – March) and wet season (April – September). Mean annual rainfall is about 1000mm, while mean monthly temperature is 27°C but is highest between the months of March and May; and lowest in December/January reaching about 22°C (Obadaki, 2007).

Fish Collection and Identification

A total number of 210 fishes consisting 130 Catfish (*Clarias gariepinus*) and 80 Tilapia (*Oreochromis niloticus*) were collected weekly from artisanal fishermen from the Ahmadu Bello University (ABU) and Zaria Dams respectively between the months of November to February. Fishes collected were transferred into labelled containers with water from their natural habitat. The fish samples were then transported live to Entomology Diagnostic Laboratory of the Department of Parasitology and Entomology,

Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria where they were examined and processed for parasite recovery and identification using “Identification Guides” by Woo (2006) and Moravec (2013).

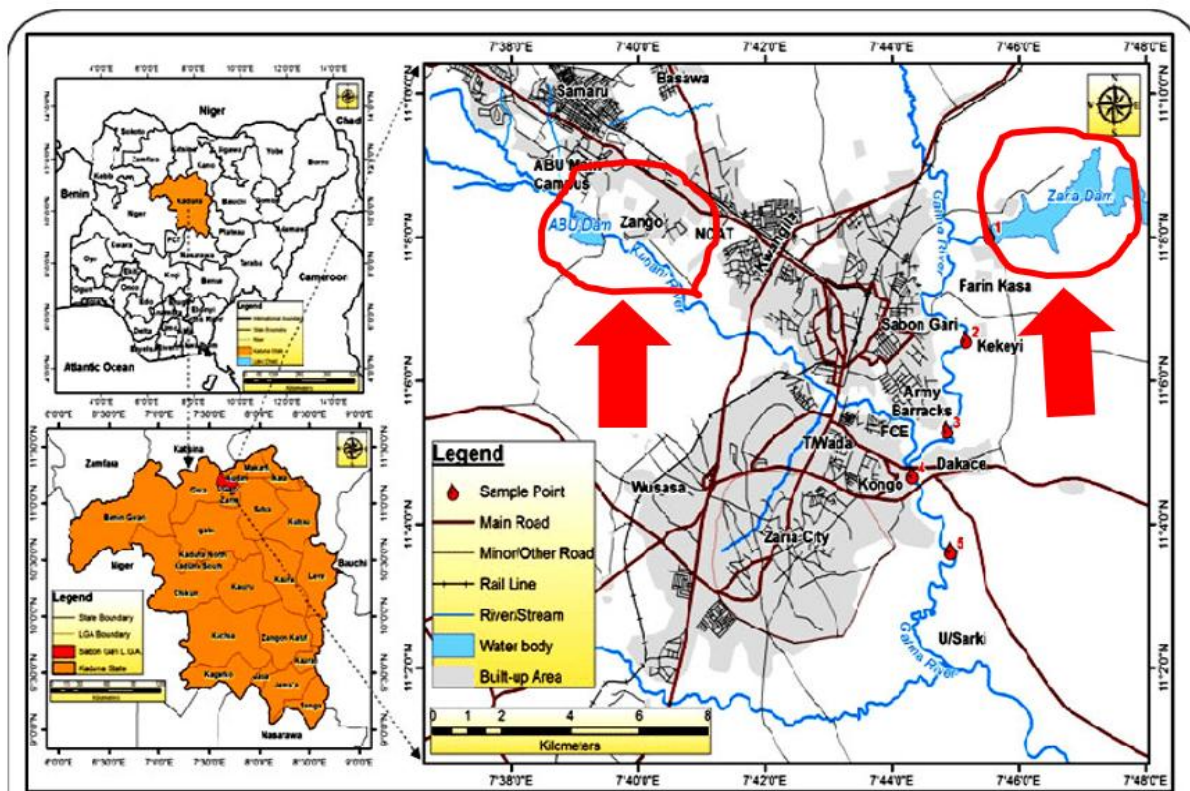


Figure 1: Map of Zaria Metropolis showing the Study Area - ABU Dam and Zaria Dam (Modified from the Administrative Map of Zaria, <https://www.researchgate.net/profile/Patrick-Samuel-3/publication/318612024/figure/fig1/AS:518736016834560@1500687712281/Map-of-Zaria-showing-Sample-Stations-Modified-from-the-Administrative-Map-of-Zaria.png>)

Examination for Ectoparasites

Gill scrapings were done and placed on a few drops of water on a clean glass slide, covered with a coverslip and examined under light microscope at $\times 40$ magnification. Gills and fins were cut using scissors and placed in Petri-dish. Gill filaments were also dissected using anatomical needle and examined under a Stereo microscope. The recovered parasites were identified using standard morphological criteria and pictorial identification keys as described by Noga (2010) and Moravec (2013).

Examination for Helminthes

The entire gastrointestinal tract samples of *Clarias gariepinus* and *Oreochromis niloticus* were removed separately, stretched out, cut open longitudinally and the content was flushed into petri dishes with normal physiological saline and examined under a Stereo microscope for helminth identification. The helminths observed were picked using fine-toothed forceps, counted and preserved in 10% formaldehyde (Adebayo *et.al.*, 2021). Helminths were mounted with lactophenol and identified based

on morphological features using the light microscope. To examine for cercariae, fish heads were sectioned with a pair of scissors and forceps exposing the gills and respiratory tracts. Direct examination of head regions, gills and body cavities of both species of fish were also done with the naked eyes for any moving cercariae. The cercariae were picked out with the aid of fine-toothed forceps, counted and preserved in 10% formaldehyde (Adebayo *et.al.*, 2021). Cercariae were mounted with lactophenol and identified based on morphological features using the light microscope.

Examination for Haemoparasites

Blood samples were collected from immobilized *Clarias gariepinus* via caudal vein puncture using a sterile hypodermic needle and syringe, with the insertion point anterior to the anal fin and just behind the genital papilla, as routinely described in recent fish parasitological studies (Sadauki *et al.*, 2024). A portion of the collected blood was transferred into EDTA-treated tubes, gently mixed and labeled. Capillary tubes were filled three-quarters with blood and sealed before centrifugation. After centrifugation, the buffy coat and plasma junction were examined directly under a microscope for the presence of blood parasites. Thin blood smears including buffy coat material were air-dried, fixed, stained with Giemsa, and examined under 40× and 100× oil immersion magnification for parasite identification, following established hematological diagnostic techniques (Alhayali *et al.*, 2023; Fouad *et al.*, 2023). Trypanosoma parasites were identified on the basis of morphology, elongated bodies with a single flagellum and an undulating membrane, consistent with freshwater fish *Trypanosoma* descriptions used in current parasitological literature.

Water Collection and Physicochemical Analysis

Water samples were collected weekly from Ahmadu Bello University and Zaria Dams on the same days that fish specimens were sampled. Samples were collected in clean plastic bottles during the morning hours and transported on ice to the laboratory for analysis. Field measurements of pH and temperature were performed immediately at the sampling site using a calibrated digital pH meter and a digital thermometer, respectively as described by Rahman *et al.*, 2021. Other physicochemical parameters (e.g., turbidity, electrical conductivity, total dissolved solids, dissolved oxygen, biochemical oxygen demand where applicable) were determined in the Multi-User Laboratory, Faculty of Life and Physical Sciences, Ahmadu Bello University, Zaria following standard procedures described in *Standard Methods for the Examination of Water and Wastewater* (APHA *et al.*, 2017). All results were evaluated against the recommended limits in the World Health Organization Guidelines for Water Quality Standard (WHO, 2022)

Data Analysis

The prevalence (%) of parasite infection was estimated using the formula of Akinsanya *et al.*, (2019)

$$\text{Prevalence (\%)} = \frac{\text{Number of fish with parasite}}{\text{Number of fish examined}} \times 100$$

while intensity of infection was estimated using the formula Okomoda *et al.*, (2020b)

$$\text{Intensity of infection} = \frac{\text{Number of parasite found in a sample of fish examined}}{\text{Number of infected fish}}$$

The results obtained from the studies were presented in percentages, Tables and analyzed using Student t- test to show the significant difference in prevalence of parasitic infection in both fish species and to compare the prevalence of parasitic infection in the two fresh water bodies and values of $P \leq 0.05$ were considered significant

RESULTS

Table 1 shows the prevalence of parasite infection in *Oreochromis niloticus* and *Clarias gariepinus*. An overall 91 (43.3%) of parasite infection was obtained in the 210 fish examined. Of the 80 *Oreochromis* species of fish examined 21 (25.0%) were infected with parasites comprising of one Trematode (41.3%) and two Cestodes (18.0% and 4.0%). Of the 130 *Clarias* species examined, 70 (54%) were infected with one Trematode (13.0%), two Cestodes species (14.0% and 9.0%) and a Protozoan parasite (54.0%). There was significant difference ($P=0.00$) between the prevalence of parasite infection between *Oreochromis niloticus* and *Clarias gariepinus*.

Table 1: Prevalence of Parasites of *Oreochromis niloticus* and *Clarias gariepinus* from Fresh Water Bodies in Zaria Metropolis

Type of Fish	Number of Fishes Examined	Number of Fishes Infected	Percentage (%) Infected
Tilapia (<i>Oreochromis niloticus</i>)	80	21	26.0 ^a
Cat Fish (<i>Clarias gariepinus</i>)	130	70	54.0 ^b
Total	210	91	43.3

Significantly different at $p = 0.00$

The intensity of parasites recovered from *Oreochromis niloticus* and *Clarias gariepinus* respectively is presented in Table 2. *Oreochromis niloticus* was observed to be infected with cercariae of *Clinostomum* sp, *Polyonchobothrium* and *Monobothrium* with respective intensities of 1.6, 0.7 and 0.14 while in *Clarias gariepinus* the respective values for intensity were 0.24, 0.3 and 0.2. *Clarias gariepinus* was infected with *Trypanosoma* sp with a prevalence of 54% and intensity of 1.53. The overall intensity of helminth infection in *Oreochromis niloticus* and *Clarias gariepinus* were 2.4 and 0.7 respectively.

Table 2: Intensity and Prevalence of Parasite Infection in *Oreochromis niloticus* and *Clarias gariepinus* from ABU and Zaria Dams

Type of Fish	Number of Fish Examined	Number of Fish Infected	TYPE OF PARASITES								Total Number of Parasite
			TREMATODE		CESTODE		CESTODE		PROTOZOA		
			<i>Clinostomum</i> sp.	<i>Polygoncho bothrium</i> sp.	<i>Monobo thrium</i> sp.	<i>Trypanosoma</i> sp.	Prv (%)	Int	Prv (%)	Int	
Tilapia	80	21	41.3	1.6	18.0	0.7	4.0	0.14	-	-	50
Cat Fish	130	70	13.0	0.24	14.0	0.3	9.0	0.2	54.0	1.53	153

Prv (%) = Prevalence (%), Int = Intensity

The prevalence of parasite infection in the fishes sampled in respect to the two water bodies (ABU and Zaria dams) is shown in Table 3. Prevalence of parasitic infection in Zaria dam (48.0%) was significantly higher (P= 0.01 compared to ABU dam (37.1%).

Table 3: Prevalence of Parasites of *Oreochromis niloticus* and *Clarias gariepinus* from ABU and Zaria Dams.

Water Body	Number of Fishes Examined	Number Infected	Percentage (%) Infected
ABU Dam	89	33	37.1 ^a
Zaria Dam	121	58	48.0 ^b
Total	210	91	43.3

Significantly different at p = 0.01

Table 4 shows the result of the physicochemical water quality of both dams compared to the recommended (WHO, 2022) values. The values obtained for water temperature in ABU dam and Zaria dam were 26.22 ± 1.08 °C and 26.41 ± 1.27 °C respectively. The pH, turbidity (NTU) and dissolved oxygen (mg/L) levels in the dams were respectively 7.26 ± 0.19 and 7.19 ± 0.22 , 35.22 ± 26.1 and 37.06 ± 30.65 , 1.52 ± 0.49 and 1.61 ± 0.32 . The values obtained for conductivity ($\mu\text{s}/\text{cm}$) and hardness (mg/L) in ABU dam and Zaria dam were respectively 145.67 ± 16.27 and 139.33 ± 21.62 ; 183.46 ± 20.20 and 208.20 ± 19.55 .

Table 4: The Mean Physicochemical Characteristics of the Waters from ABU and Zaria Dams

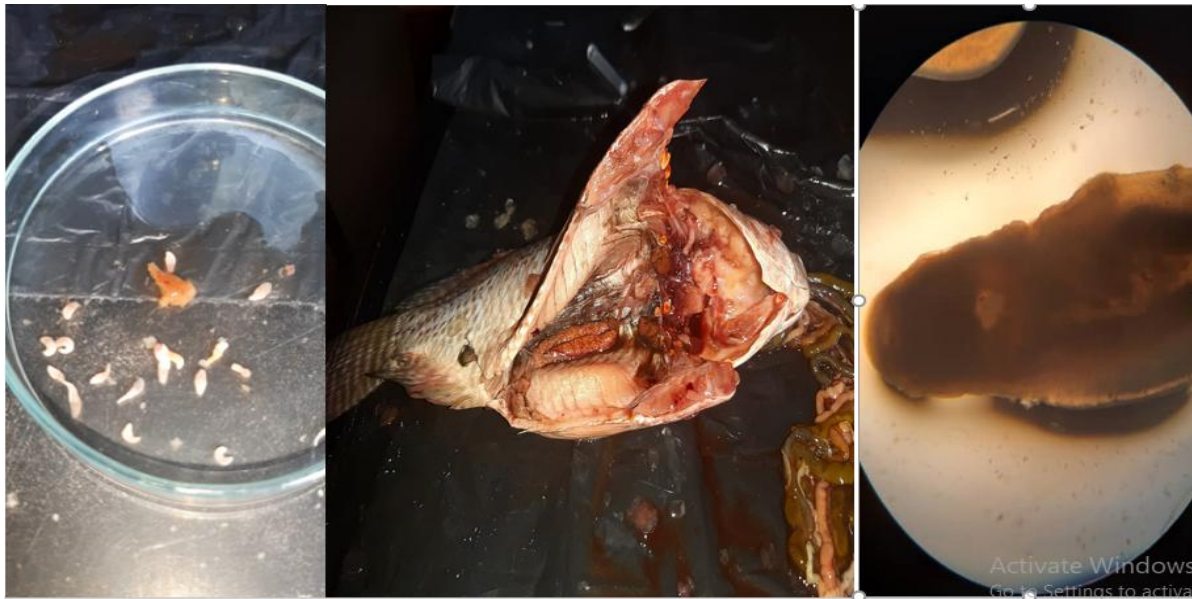
Parameters	ABU Dam (Mean ± SD)	Zaria Dam (Mean ± SD)	p-value	WHO Guideline ^a
Temperature (°C)	26.22 ± 1.08	26.41 ± 1.27	0.853	20–25
Electrical conductivity (µS/cm)	145.67 ± 16.27	139.33 ± 21.62	0.706	750
pH	7.26 ± 0.19	7.19 ± 0.22	0.698	6.5–8.5
Dissolved oxygen (mg/L)	1.52 ± 0.49	1.61 ± 0.32	0.803	5.0–7.0
Turbidity (NTU)	35.22 ± 26.17	37.06 ± 30.65	0.941	5.0
Total hardness (mg/L)	183.46 ± 20.20	208.20 ± 19.55	0.202	150

Values are expressed as mean ± SD of three determinations ^a WHO (2022)

The gross specimens of Cestodes from the fish gastro intestinal tract is shown in Plate 1 while Plate 2 shows the gross and microscopic specimen of *Clinostomum* sp. Plate 3 shows the microscopic images of *Polygonchobothrium clariae* and *Monobothrium* sp. while Plate 4 shows the *Trypanosoma* sp. from fish blood.



Plate 1: Gross Specimens of Cestodes from Fish GIT

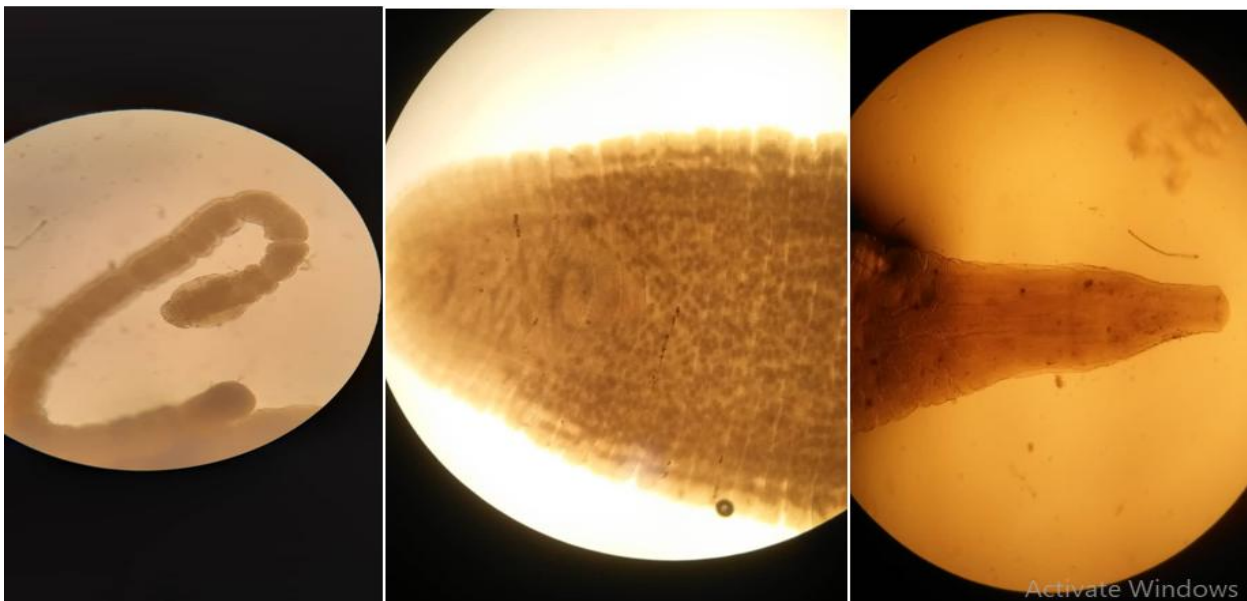


a

b

c

Plate 2: (a) Gross Specimen of *Clinostomum* sp. (b) *Clinostomum* sp. within body cavity of *O. niloticus* (c) Microscopic Specimen of *Clinostomum* sp.



a

bi

bii

Plate 3: Microscopic Images of (a) *Polygonchobothrium clariae* (bi) Posterior end of *Monobothrium* sp. (bii) Anterior end of *Monobothrium* sp.

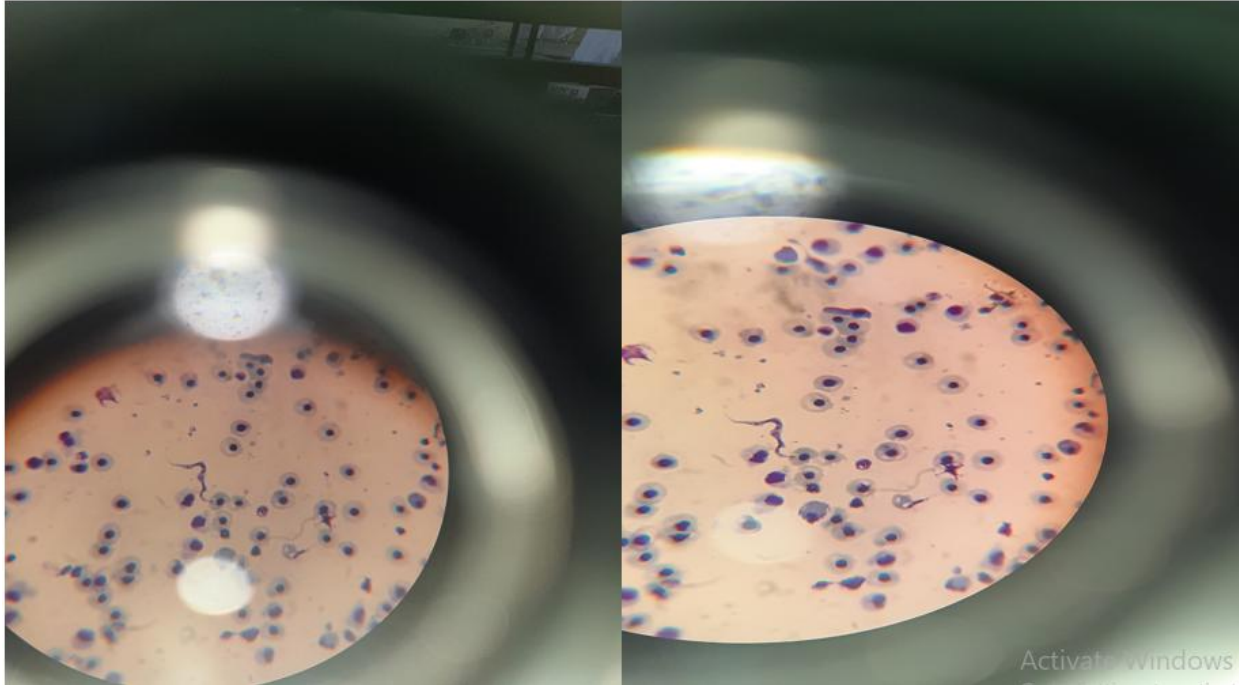


Plate 4: *Trypanosoma* sp. from Fish Blood

DISCUSSION

An overall prevalence of 43.3% parasitic infection was recorded in this study. This finding is comparable to the 48.6% prevalence reported by Omeji *et al.*, (2016) in the Upper and Lower Benue River, Nigeria. However, it contrasts with the lower prevalence of 19.2% reported by Oniye *et al.*, (2004) in *Clarias gariepinus*. Similar disparities in prevalence have been widely documented, reflecting ecological and methodological differences across studies. Higher prevalence rates than those recorded in the present study have been reported by several authors. For instance, Salawu *et al.*, (2017) reported a prevalence of 75% for the cestode *Polyonchobothrium* sp. in *C. gariepinus* from Ogun River and Asejire Dam, south-western Nigeria. Likewise, Abdel-Gaber *et al.*, (2019) reported a prevalence of 65% for helminth infections in *C. gariepinus* from Lake Manzala, Egypt. Earlier findings by Onwuliri and Mgbemena (1987) reported prevalence rates of 63.0% and 59.8% in wild and cultured *C. gariepinus* populations respectively; although dated, these studies remain relevant baseline references.

Oniye *et al.*, (2004) reported five helminth species comprising three cestodes, one nematode, and one acanthocephalan. In contrast, the present study recorded one trematode (*Clinostomum cercariae*) and two cestodes (*Polyonchobothrium clariae* and *Monobothrium* sp.), with no nematode or acanthocephalan species observed. These differences may be attributed to seasonal variation, as Oniye *et al.*, (2004) conducted sampling between March and July, whereas this study spanned November to February. Seasonal and climatic changes significantly influence aquatic parasite transmission by altering water conditions, intermediate host availability and fish feeding behavior (Woo *et al.*, 2020; Barber *et al.*, 2022). Variations in parasite prevalence and composition are

multifactorial and influenced by interactions between biotic and abiotic factors. Parasitism has been shown to vary significantly among aquatic ecosystems due to differences in environmental conditions, host ecology and parasite life cycles (Marcogliese, 2016; Barber *et al.*, 2022). Helminths are common in freshwater fishes worldwide, with prevalence and intensity influenced by parasite biology, host feeding habits, water quality, hygiene and availability of intermediate hosts (Akinsanya *et al.*, 2019; Woo *et al.*, 2020).

This study recorded prevalence rates of 26% in *Oreochromis niloticus* and 54% in *Clarias gariepinus*, with a statistically significant difference ($P \leq 0.05$) between the two species. This disparity may be attributed to the benthic and omnivorous feeding habits of *C. gariepinus*, which expose it more frequently to infective stages in turbid, vegetation-rich habitats. Similarly, parasitic prevalence in Zaria Dam (48.0%) was significantly higher ($P \leq 0.05$) than that observed in ABU Dam (37.1%), despite similarities in physicochemical parameters, indicating that ecological interactions rather than water chemistry alone may drive infection patterns (Marcogliese, 2016).

Cestodes were recovered primarily from the intestinal tract, corroborating findings by Aliyu and Solomon (2012) and Akinsanya *et al.* (2019), who reported a preference of cestodes for the intestinal lumen due to the availability of digested and semi-digested food. This is consistent with the absence of an alimentary canal in cestodes, necessitating their nutrient absorption directly from the host gut contents.

Polyonchobothrium clariae has been reported to induce pathological lesions and degenerative changes in the intestinal wall of *C. gariepinus* (Abdel-Gaber *et al.*, 2019). Trematode cercariae are known to encyst in fish tissues, damaging musculature and reducing market value, while some cestodes cause irritation of the gastric mucosa (Woo *et al.*, 2020). A prevalence of 54.0% *Trypanosoma* infection was recorded in *C. gariepinus*, although morphological characteristics were insufficient for definitive specie identification. Comparable prevalence rates have been reported by Muhammad *et al.*, (2016) in Sokoto (35.0%) and Corrêa *et al.* (2016) in Brazilian catfish (89.4%). These findings support earlier assertions that African freshwater systems harbor diverse fish *Trypanosomas*, with *Trypanosoma mukasai* frequently implicated across the continent (Smit *et al.*, 2020).

Physicochemical analysis of water samples from both dams revealed temperature and pH values within recommended limits for freshwater ecosystems (WHO, 2022; FAO, 2022). Electrical conductivity values were relatively low, possibly due to dilution from tributary inflows. Elevated turbidity and hardness levels may be associated with agricultural runoff, sewage discharge, and organic waste inputs (Chigor *et al.*, 2014; UNEP, 2021). High turbidity reduces light penetration, interferes with photosynthesis and limits oxygen availability, thereby stressing aquatic organisms (Chigor *et al.*, 2014). Low dissolved oxygen levels adversely affect fish health and may predispose them to parasitic infections.

CONCLUSION

One trematode specie (cercaria of *Clinostomum* sp.), two cestode species (*Polyonchobothrium clariae* and *Monobothrium* sp.) and one protozoan (*Trypanosoma* sp.) were detected in this study. There was significant difference ($p=0.00$) between the prevalence of parasite infection in *Oreochromis niloticus* and *Clarias gariepinus*. The prevalence of parasitic infection in Zaria dam (48.0%) was significantly ($p=0.01$) higher than in ABU dam (37.1%). The water temperature and pH in both dams were within permissible limits of WHO. High turbidity (35.22 ± 26.1 and 37.06 ± 30.65) and hardness (183.46 ± 20.20 and 208.20 ± 19.55) were observed from both dams and the dissolved oxygen levels were below the normal acceptable range (1.52 ± 0.49 and 1.61 ± 0.32 in both dams).

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CONFLICTS OF INTEREST

None

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