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Prevalence and Diversity of Helminth Parasites in Tilapia (*Oreochromis niloticus*) from Sewage Ponds in Kano, Nigeria

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ABSTRACT

Background and Objective: Helminth infections in aquaculture species pose significant threats to fish health, productivity, and food safety. However, data on the prevalence and species composition of helminths infecting Tilapia (*Oreochromis niloticus*) in sewage-fed ponds of Kano State, Nigeria, remain limited. This study aimed to determine the prevalence, species diversity, and site-specific distribution of helminth parasites in *O. niloticus* from two sewage ponds. **Materials and Methods:** A total of 385 *O. niloticus* were randomly sampled between January, 2024 and March, 2025 from Bayan Gari Pond (Pond A, n = 257) and Kukkuba Pond (Pond B, n = 128). Fish were examined using standard parasitological techniques to recover helminths from the gastrointestinal tract and gills. Parasites were morphologically identified using established taxonomic keys. Statistical analysis was conducted using Chi-square tests to determine differences in prevalence between ponds, with significance set at $p<0.05$. **Results:** The overall prevalence of helminth infection was 31.43%, with a significantly higher prevalence in Pond A (35.4%) compared to Pond B (23.44%) ($\chi^2 = 5.62$, $p<0.05$). Three helminth species were identified: *Clinostomum* spp., *Euclinostomum* sp., and *Polyonchobothrium polyepiteri*. Trematodes accounted for the majority of infections (84.8%), affecting both gill and intestinal tissues, while the cestode *P. polyepiteri* was restricted to the intestines. **Conclusion:** This study demonstrates that sewage-fed ponds serve as important reservoirs for helminth parasites in *O. niloticus*, posing risks to public health and aquaculture productivity. Findings highlight the need for improved pond management and monitoring strategies to mitigate parasite transmission from contaminated habitats.

KEYWORDS

Fish, helminth, parasite, prevalence, Kano, Nigeria

INTRODUCTION

Tilapia fish (*Oreochromis niloticus*) is one of the most economically important freshwater species in aquaculture due to its rapid growth, adaptability to a wide range of water conditions, and significance in food security across Sub-Saharan Africa[1]. In Nigeria, tilapia is widely consumed and represents a major protein source for low-income populations. However, fish harvested from unmanaged or sewage-impacted aquatic environments may be exposed to a wide range of parasitic infections that compromise both fish health and consumer safety[2,3].

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Helminth parasites, including trematodes, cestodes, and nematodes, are common pathogens of freshwater fish. They can cause significant pathological effects such as tissue damage, growth retardation, reproductive impairment, and even mortality[4]. In tilapia, trematodes of the genus *Clinostomum* (commonly known as "yellow grubs") are especially important due to their high occurrence.

Sewage ponds, such as those found in urban areas of Kano State, serve as artificial aquatic ecosystems where domestic wastewater accumulates. Despite their high contamination levels, these ponds are frequently fished due to economic necessity. The presence of nutrient-rich effluents in these water bodies promotes the growth of snail intermediate hosts and creates ideal conditions for the life cycles of helminth parasites. In Gwale Local Government Area, several former burrow pits, now converted into sewage receptacles, support large populations of Tilapia fish (*O. niloticus*). However, data on the parasitological risks associated with fish harvested from such habitats remain limited. This study addresses this gap by investigating the prevalence and species composition of helminth parasites in *O. niloticus* from two sewage ponds in Gwale LGA, Kano State, Nigeria.

The primary objective is to determine the prevalence and identify the taxonomic groups of helminth parasites recovered from *O. niloticus* and to compare the infection rates between the two study sites.

MATERIALS AND METHODS

Study area: The study was carried out in two sewage ponds located in Gwale Local Government Area of Kano State, Northwestern Nigeria. Pond A is known as '*Bayan Gari Pond*' located within the coordinates of (Latitude 11.98153°, Longitude 8.50481°), behind Kano city tower (Ganuwa) at '*Hauren shanu*' along BUK road. Pond B is known as '*Kunkuba Pond*' located within the coordinates of (Latitude 11.98221°, Longitude 8.50899°) at '*Hauren Makaranta*' along BUK road opposite to Nigerian police headquarters Kano zone 1[5]. These ponds were originally former burrow pits that have been transformed into wastewater receptacles due to the deliberate channeling of household effluent (Fig. 1 and 2).

Sampling procedure: The sampling procedure followed the method[6] in which A total of 385 *Oreochromis niloticus* specimens were randomly procured from fishermen's catches over 15 months, spanning from January, 2024 to March, 2025. Of these, 257 fish were collected from Pond A and 128 from Pond B. After capture, the fish were immediately placed in clean, aerated containers and transported to the Parasite Biodiversity Laboratory, Department of Biological Sciences, Northwest University, Kano. Fish total length (TL) was measured using a calibrated measuring board to the nearest centimeter before dissection.

Identification of fish samples: Fish specimens were identified up to species level using morphological features described in the standard reference texts[7,8]. Identification confirmed all samples as *Oreochromis niloticus* (Nile Tilapia).

Parasitological examination: All fish were humanely euthanized before dissection. The alimentary tract was excised by making incisions at the anterior end of the oesophagus and the posterior end at the cloaca. To recover helminths, each gut was longitudinally opened and examined section by section: Oesophagus, stomach, intestine, and rectum. The contents were emptied into separate Petri dishes containing normal saline. The mucosal lining of each section was also scraped and mounted on microscope slides for observation. The gill arches were also dissected and examined separately for the presence of encysted or attached trematodes. All parasites found were isolated under a dissecting microscope, counted, recorded, and preserved[4,6].

Parasite preservation and staining: Parasites were carefully removed using a fine brush to avoid mechanical damage. Specimens were initially washed in normal saline to remove mucus and debris. Trematodes were killed in hot saline and then fixed in cold 4% formaldehyde, while cestodes were

Fig. 1: *Bayan Gari Pond* (Pond A)

Fig. 2: *Kunkuba Pond* (Pond B)

flattened under a glass coverslip and fixed in AFA solution (Alcohol-Formalin-Acetic acid). After fixation, all helminths were stained with acetocarmine, dehydrated in an ethanol series, cleared in xylene, and mounted for microscopic identification.

Identification of parasites: Parasites were identified based on morphological features, including body shape, attachment organs, and internal anatomy, using taxonomic keys and identification guides[9,10]. Identification was conducted using both stereomicroscopes and compound microscopes.

Data analysis: Prevalence, mean intensity, and abundance of infection were calculated using descriptive statistics. Differences in prevalence between the two ponds were analyzed using the Chi-square (χ^2) test. Statistical significance was set at $p<0.05$. Data analysis was performed using SPSS version 25.0.

Ethical statement: The ethical approval for this study was obtained from the Research Ethics Committee, Northwest University, Kano. Also, all procedures were conducted in accordance with the guidelines for the care and use of animals in research.

RESULTS

Overall prevalence of helminth parasites: The results indicate that the prevalence of helminth infection was higher in Pond A (35.4%) compared to Pond B (23.44%). The overall prevalence across both ponds

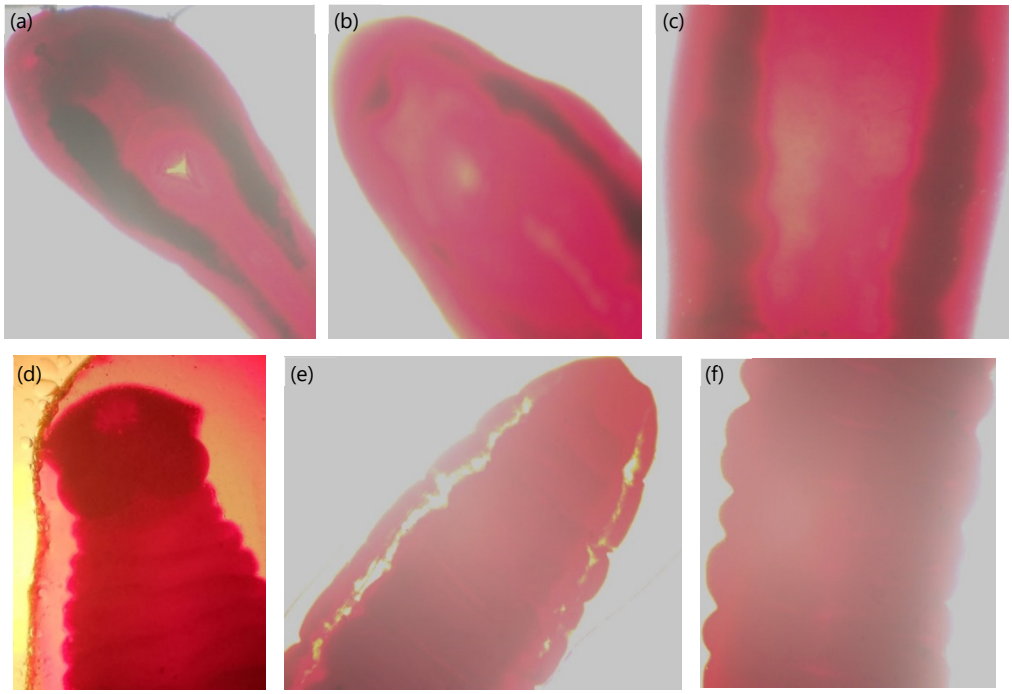

Fig. 3(a-f): Photomicrograph of the identified parasites, Fig. 3a-b: *Clinostomum* sp. (Trematoda: *Clinostomidae*), (a) Ventral sucker, (b) Oral sucker, (c) *Euclinostomum* sp. (Trematoda: *Clinostomidae*) (Prominent intestine), Fig. 3d-f: *Proteocephalus polyepiteri* (Cestoda: *Proteocephalidae*), (d) Scolex, (e) Posterior end and (f) Strobila (mid part)

Table 1: Prevalence of helminth parasites of tilapia fish (*Oreochromis niloticus*) in the studied sites

Site	Number examined	Number non-infected	Number of infected	Prevalence (%)
Pond A	257	166	91	35.4
Pond B	128	98	30	23.44
Total	385	264	121	31.43

χ^2 = 5.62, df = 1 and p<0.05

Table 2: Helminth parasite species recovered from *Oreochromis niloticus,* their microhabitats, and frequency of occurrence

Taxonomic group	Species	Microhabitat	Frequency
Trematodes	*Clinostomum* spp.	Gills	72
	Euclinostomum sp.	Body cavity/gills	8
	Immature	GIT	228
Cestodes	*P. Polyepiteri*	GIT	12
	Immature	GIT/body cavity	43
Total			363

was 31.43% (Table 1). Chi-square test revealed a significant difference in the prevalence of helminth parasites between Pond A and Pond B (χ^2 = 5.62), (df = 1), (p<0.05).

Identified helminth parasite species: Three helminth parasite taxa were identified: Trematodes *Clinostomum* spp. (Fig. 3a-b) from gills, and *Euclinostomum* sp. (Fig. 3c) from intestines, Cestode; *Polyonchobothrium polyepiteri* (Fig. 3d-f) from intestines. Trematodes were the most abundant group, accounting for 308 (84.8%) of the total parasites recovered, while cestodes accounted for 55 (15.2%). Among the species, immature trematodes in the gastrointestinal tract (GIT) were the most prevalent (228, 62.8%), followed by *Clinostomum* spp., in the gills (72, 19.8%) (Table 2).

Distribution of helminth parasite groups, their frequency, and prevalence: A total of 363 parasites were recovered, with 274 from Pond A and 89 from Pond B. As shown in Table 3, Trematodes were the

Table 3: Distribution of helminth parasite groups in *Oreochromis niloticus* from two sewage ponds, their frequency, and prevalence

Site	Taxonomic group	Frequency	Prevalence
Pond A	Trematodes	227	82.9
	Cestodes	47	17.1
	Total	274	100
Pond B	Trematodes	81	91.0
	Cestodes	8	8.9
	Total	89	100

Table 4: Parasite load metrics

Parameter	Pond A (n = 257)	Pond B (n = 128)	Combined (n = 385)
Infected fish (N)	91	30	121
Parasites recovered	274	89	363
Mean intensity	3.01±0.21	2.97±0.25	3.00±0.16
Mean abundance	1.07±0.08	0.70±0.06	0.94±0.05
Intensity range	1-14	1-10	-
Abundance range	0-14	0-10	-

dominant group in both ponds, accounting for 82.9% of parasites in Pond A and 91.0% in Pond B. Cestodes were less prevalent, representing 17.1% of parasites in Pond A and 8.9% in Pond B.

Parasite load metrics: The mean intensity and abundance of helminth parasites were calculated for each study site (Table 4). Mean intensity, representing the average parasite burden per infected host, showed minimal variation between sites (Pond A: 3.01; Pond B: 2.97). Mean abundance, indicating the average parasite load across all examined hosts, was 53% higher in Pond A (1.07) compared to Pond B (0.70).

DISCUSSION

The findings of this study provide important insights into the helminth parasitism of *Oreochromis niloticus* in sewage-impacted aquatic systems. The observed overall prevalence of 31.43% is consistent with previous reports from similar environments in Nigeria and Sub-Saharan Africa, where helminth infections in freshwater fish tend to range between 25-60%[11]. The higher infection rate in Pond A (35.4%) compared to Pond B (23.44%) may be attributed to differences in organic load, water quality, and the density of intermediate hosts, such as aquatic snails that facilitate parasite life cycles.

Trematodes were the most dominant group, accounting for 84.8% of total infections. This aligns with previous studies which emphasize the ubiquity of digenetic trematodes in polluted or eutrophic water bodies[12]. Specifically, the high prevalence of *Euclinostomum* sp. and *Clinostomum* spp., suggests a well-established transmission cycle involving snails and fish. The cestode *Polyonchobothrium polyepiteri*, though less frequent, was exclusively found in the intestines. Cestodes generally require intermediate hosts such as copepods, suggesting a complex aquatic food web that supports multiple parasite life cycles even in such degraded systems[5]. To mitigate the risks associated with helminth infections in Tilapia from sewage-fed ponds, several measures are recommended. Relevant authorities should regulate and monitor fish harvesting from such environments to minimize exposure to parasites and other contaminants. In addition, routine screening of fish sourced from high-risk ponds is essential for tracking parasite prevalence and species composition. Implementing targeted snail control measures in and around sewage ponds may also reduce trematode transmission, given that snails act as intermediate hosts. Furthermore, longitudinal studies conducted across different seasons and fish species are necessary to provide deeper insights into the dynamics of helminth transmission and the ecological factors that drive infection patterns.

CONCLUSION

This study demonstrates that *Oreochromis niloticus* inhabiting sewage-fed ponds in Gwale Local Government Area, Kano State, are significantly infected with helminth parasites, particularly trematodes and cestodes. The overall prevalence of 31.43% reflects a moderate but concerning level of

infection, with significantly higher rates observed in Pond A compared to Pond B. Trematodes, especially *Clinostomum* spp. and *Euclinostomum* sp., were the most dominant parasites, suggesting the presence of a stable parasite-host transmission cycle supported by polluted conditions and the abundance of intermediate hosts.

SIGNIFICANCE STATEMENT

This study discovered the occurrence, prevalence, and species diversity of helminth parasites infecting *Oreochromis niloticus* in sewage-fed ponds, which can be beneficial for understanding host-parasite interactions and developing targeted aquaculture management practices. By documenting the dominance of trematodes and the site-specific distribution of cestodes, the findings provide evidence of how environmental contamination shapes parasite ecology in fish. These insights are valuable for improving fish health, enhancing productivity, and ensuring food safety in aquaculture systems exposed to wastewater. Moreover, this study will help researchers to uncover the critical areas of parasite transmission dynamics and ecological risk factors that many researchers were not able to explore. Thus, a new theory on helminth ecology in aquaculture may be arrived at.

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