



Original article

Distribution and prevalence of gastrointestinal helminth parasites of African catfish *Clarias gariepinus* in Ajiwa, Katsina Nigeria

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ABSTRACT

Introduction: The distribution and prevalence of gastrointestinal helminths in African catfish (*Clarias gariepinus*) from Ajiwa reservoir, Katsina State, Nigeria was investigated between March and August 2021, to understand the health status of the fish, potential risk to their existence and safety of consumption of fish from the water body.

Methods: A total of 162 live African catfish species were collected from artisanal fishermen from three major landing sites on the reservoir. The fish were identified and separated based on sex before being transferred live to the Fish Biology laboratory, Federal University Dutsin-Ma, Katsina State for further evaluation. The fish were dissected and the guts were removed for examination of the gastrointestinal helminths.

Results: A total of 149 helminths were collected from the 132 infected fish. The helminths belong to nematode and cestode groups with nematode dominating with three species and 59.06% abundance. *Capillaria* species, a nematode was the dominant species representing 29.53% of the helminths from the water body. A higher amount (57.72%) of the helminths were recovered from the intestine. The prevalence of the parasitic worms was affected by sex ($p=0.001$) with females having a higher prevalence (91.76%). There was no significant difference due to the sampling location ($p=0.076$) and length of the fish ($p=0.298$). However, weight showed a significant association with the prevalence ($p=0.019$) and the prevalence decreased with an increase in the size of the fish.

Significance: Although the distribution and abundance of the gastrointestinal helminths in the Ajiwa reservoir can be said to be low relative to the number of fish examined, however, the prevalence is high and something of concern. Sex and weight are important factors strongly associated with the prevalence of parasitic helminths in the reservoir.

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Introduction

Fish and its products remain crucial sources of inexpensive animal protein, omega-3 fatty acids, and many other important macro and micronutrients. They are relatively inexpensive and they are within the affordability of the common citizens especially in developing countries, where purchasing power is rather low (Dauda *et al.*, 2016). Demand for fish is constantly growing, this is due to the continuous increase in population and the high cost of other sources of animal protein like beef and egg (Tavares-Dias and Martins, 2017). The derivatives obtained from fish could be useful in the feedstuff of animals such as poultry and livestock, so there are so many uses of fish either directly for human consumption, agro-allied uses, or raw material in the industry. Amongst the majority of common fish obtainable and accessible in Nigerian aquatic bodies is the *Clarias gariepinus* locally known as the African catfish (Dauda *et al.*, 2018). The African catfish species are found largely in stagnant aquatic environments such as reservoirs, lakes, ponds and pools and they could also be found in shallow parts of lotic

water bodies such as creeks, rivers and streams (Abd El Hafez *et al.*, 2013). Although, African catfish are obtained from natural water bodies (capture) as well as aquaculture (culture) in Nigeria, however, capture from natural water bodies (inland waters) remains a very important source of the fish (Dauda *et al.*, 2021). Hence, the need for continuous monitoring and managing the existence and abundance of fish in inland waters.

Clarias gariepinus (African catfish) belongs to the family *Clariidae* and it is one of the most important commercial fish species accepted and admired by consumers in Nigeria (Froese and Pouly, 2014). The fish are noted to be omnivorous (feed on insects, phytoplankton and zooplankton, macro-invertebrates, etc) and live in wide-ranging water environments, from uncontaminated to turbid, not transparent, and extremely contaminated aquatic environments, therefore may come in contact with varieties of parasitic organisms. It is greatly appreciated in Nigeria either as smoked, dried, or fresh. Economically, African catfish is noted to be a source of income for a good number of actors along the value chain (Eyo and Effanga, 2018) and more recently a major fish product for export from Nigeria (Dauda *et al.*, 2018). Abdel-Gaber *et al.*, (2015)

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stated that African catfish from freshwater were diseased (infected/infested) by a variety of mature parasitic worms ranging from monogenean, digenean, cestodes, nematodes, *acanthocephalans*, and *aspidogastrea*n. The infestation of African catfish by parasitic worms could have negative consequences on their feeding and growth and, hence, affect their diversity and abundance in natural water bodies. Aquaculturists are also disturbed by the massive loss of fish seeds (fry and fingerling), mostly in nurseries due to the susceptible attacks from parasitic worms (Abdel-Gaber *et al.*, 2015). Parasitic worms frequently wound their hosts by splitting down the hosts' fleshy tissue, given that location for the growth of additional invasion or taking body fluid from the organism (Omeji *et al.*, 2010; Omeji *et al.*, 2015; Onyishi and Aguzie, 2018). In fish farming, certain parasites are extremely pathogenic and contribute to high mortalities of fish leading to monetary loss. Whereas, in a natural environment, they can threaten the abundance and distributions (richness and diversity) of commercially important fish species like African catfish (Ogonna *et al.*, 2017). Under usual or normal conditions, 50-90% of lakes, reservoirs, rivers and ponds fishes such as African catfish and *Bagrus bayad*, harbour one parasite species or another (Ali *et al.*, 2020).

African catfish and other aquatic organisms are disturbed by dissimilar parasitic worms, while some of them serve as intermediary hosts for numerous digeneans and cestodes, some of them serve as definitive hosts for several parasites. Fish helminthology is not as largely studied as other sectors of aquatic parasitology and the biology of fish. This may be because parasitic worms are predominantly inner diseases affecting internal organs, primarily the abdominal area. For most individuals, the stomach and intestinal region does not comprise the eatable portion of the fishes (Ali *et al.*, 2020) so many do not consider them as something of great risk. Unfortunately, this may not be valid as some of the parasitic worms can still be transferred to fish consumers and constitute health risk to human being. Ajiwa reservoir is one of the biggest and most important reservoirs in Katsina State, Nigeria, it serves as a source of water for domestic use, irrigation of farmland, and fishing activities among others (Sadauki *et al.*, 2022a). However, like other reservoirs, it is at the receiving end of a lot of anthropogenic activities around it, including farming and taking cattle for drinking water through which organic and inorganic pollutants can be transferred to the water bodies. Some of which may encourage the availability of undesirable organisms including parasites that could infect the fish species in the water body. It is therefore essential to continue to monitor the incidence and prevalence of pathogenic organisms in fishes from the water body especially commercially important species like African catfish. This will not only help to provide information on the health status of the fish and the water body but also help with information on how safe it is to consume the fishes caught from the reservoir. This study, therefore, examined the distribution and prevalence of gastrointestinal helminths of African catfish from Ajiwa reservoir, Katsina State, Nigeria, intending to understand the health status of the fish, potential risk

to their existence and safety of consumption of fish from the water body.

Materials and methods

Study Area

This study was carried out at Ajiwa man-made lake, which is positioned at Latitude 12°, 98'N, and Longitude 7, °75'E, in Batagarawa Local Government area of Katsina State, Nigeria. It is one of the biggest reservoirs in the state and it is being used for domestic water supply, irrigation of farmlands, and fishing. The capacity of the reservoir is nearly 22,730,000m³; and it has been a source of income to the bordering populations (Sadauki *et al.*, 2022a).

Sample collection and identification

Fish samples were collected between March 2021 to August 2021 from the three major landing sites on the dam (Kadaji, Kundu waje and Gajerar giwa). The six months cut partially across the two seasons experienced in the area, dry and rainy seasons. A total of 162 live fish was obtained from fishermen using different fishing gears to collect fish of different sizes. The fish were identified on the site using an identification guide for freshwater fishes (Olaosebikan and Raji, 2013). After which they were transported in an ice chest cooler to the Fish Biology laboratory of the Department of Fisheries and Aquaculture, Federal University Dutsin-Ma, Katsina State, Nigeria.

Measurement and sexing of experimental fish

The fish were measured for total length in centimetres with a metre rule and weight in grams with a sensitive weighing balance (GT4100 model). The sex was assessed using the urogenital organ following the description of Sadauki *et al.* (2022b). The males were identified by their elongated papillae while the females were identified by the round opening genital organ

Examination of gastrointestinal helminths

Examination of the gastrointestinal parasites was done using a light microscope, the different experimental fish samples were carefully dissected and the gastrointestinal part was processed for examination. The gastrointestinal tract was cut off and divided into two portions comprising the intestine and stomach. Each part was put individually in Petri dishes containing 0.9% normal saline (Sadauki *et al.*, 2022b). Each lone section was cut longitudinally and looked at for parasitic worms under a light microscope between x 10 and x 40 magnifications (Sadauki *et al.*, 2022b). The presence of every single parasite was noted through its wriggling movement in the saline solution under a light microscope. Parasitic worms revealed were counted, and after that conserved in 10% formalin. A typical parasite was stained overnight using a weak solution of Erlich's haematoxylin (Sadauki *et al.*, 2022b).

Identification of parasite

The parasitic worms were identified morphologically using standard documentation keys and graphic guides (Scholz *et al.*, 2004; Pouder *et al.*, 2005).

Parasite intensity of infection and prevalence

The prevalence of parasitic infestation was calculated for sex, location, length and weight. The percentage of infection and prevalence of parasites were calculated using the formulae described by Sadauki *et al.* (2022b):

$$\text{Percentage of infection (\%)} = \frac{\text{Number of a specific parasite in the sample} \times 100}{\text{Total number of parasites in the sample}}$$

$$\text{Prevalence (\%)} = \frac{\text{Number of fish host infected}}{\text{Total number of fish host examined}} \times 100$$

Data analyses

Data for the parasite distribution and prevalence were presented using frequency and percentage while the Chi-square test of independence was used to test the relationship between infection prevalence and the risk parameters (sex, location of sampling, length and weight of the fish). All analyses were done using IBM SPSS version 23.

Results

The result of the distribution of the parasitic worms is shown in Table 1, a total of 149 individual gastrointestinal helminths from two groups (Nematode and Cestode) were observed. Nematodes dominated with 59.06% and three species namely, *Contracaecum sp.*, *Capillaria sp.*, and *Camallanus sp.* While the cestodes had one species (*Monibothrium sp.*) although of different statuses in the lifecycle, hence, separated into two, species and larvae. The most abundant gastrointestinal helminth observed was *Capillaria sp.* representing 29.53% of the total parasitic worms. The distribution based on the site of infection revealed that the intestine had more infestation with 57.72% compared to 42.28% in the stomach (Table 2). Nonetheless, *Capillaria sp.* which was the most abundant gastrointestinal helminth observed seems to have more affinity for the stomach than the intestine with 30 of the 44 observed found in the stomach and the remaining in the intestine.

The prevalence of the parasitic worms in relation to sex showed that females are more susceptible to infection, with 91.76% infected compared to 70.13% in males (Table 3). There was a significant association ($p=0.001$) between the sex of the examined fish and the prevalence of infection. Table 4 showed the result of the prevalence of the infection in relation to sample location. The highest prevalence of infection (90.74%) was observed at Gajerar giwa while the lowest (74.07%) was observed at Kadaji. The Chi-square test of independence had a

p -value of 0.076, indicating no significant association between the prevalence of infection and sampling location. The highest prevalence in relation to fish length was 86.66% and it was observed in the *C. gariepinus* with length between 15.1 to 20.0 cm while the lowest 57.14% was found in the length range 30.1 – 35.0 cm (Table 5). There was no significant relationship ($p = 0.298$) between the prevalence of infection and the length of fish. The weight of the fish showed a relatively similar pattern with the length, the bigger fish tends to have lower prevalence. The least prevalence in relation to weight 55.55%, was observed in the weight range 111-140.9 g while the highest 88.37% was found in the weight range 21 – 50.9 g (Table 6). However, unlike the length, Chi-square showed a significant association between the prevalence of infection ($p = 0.019$) and the weight of the fish.

Discussion

Researches have shown that helminths habitually occur in all freshwater such as rivers, reservoirs, lakes, pond and streams (Ajala *et al.*, 2019; Sadauki *et al.*, 2022b). While water quality can show the instantaneous condition of a water body, biological agents including the prevalence of parasitic helminths can give better information about occurrences over time Ani *et al.* (2016). As for the Ajiwa reservoir, the results of water quality documented more recently (Sadauki *et al.*, 2022a) didn't show the water is under pollution stress. Although the total-ammonia nitrogen content of the water was slightly high which might be due to the decomposition of organic contaminants or pollutants and some of these contaminants may come into the water body with parasitic worms. As noted by Ito (2017) African catfish could serve as definitive or intermediate hosts in the development cycle of many of the worms including parasitic helminths since they are omnivorous and feed on varieties of flora and fauna. In this study, two groups of helminths, nematode and cestode were observed with nematode as the dominant group. This is in line with the observation of Sadauki *et al.*, (2022b), Kawe *et al.* (2016), and Abdel-Gaber *et al.* (2015) all in *C. gariepinus*. Sadauki *et al.* (2022b) reported trematode in addition to the groups observed in this study at Zobe reservoir in Katsina State, Nigeria. Kawe *et al.* (2016) also reported trematode in addition to the nematode and cestode observed in African catfish collected from the area councils in Abuja, Nigeria. In contrary, digenean was the additional parasitic worm reported by Abdel-Gaber *et al.* (2015) in *C. gariepinus* collected from Lake, Manzala in Egypt. *Camallanus sp.* and *Contracaecum sp.* have been previously reported by several researchers as important parasitic helminths of *C. gariepinus* (Ito *et al.*, 2017). Except for *Capillaria sp.*, a nematode, all other species of nematode and cestode were more abundant in the intestine compared to stomach. Abdel Gaber *et al.* (2015) and Ali *et al.* (2020) also reported a higher percentage of infection in the intestine compared to the stomach of *C. gariepinus* collected from different water bodies in Egypt. The highest amount of helminths was also documented by Ito (2017) in the intestine compared to the gills or skin of *C. gariepinus* and *Tilapia Zillii* collected from the Ase River Catchment in Delta State, Nigeria.

Capillaria sp dominating the observed parasitic helminths observed in this study has been reported to be the cause of *Capillariasis*, a zoonotic disease believed to be transmitted through consumption of raw or poorly prepared fish (Betson *et al.*, 2020).

Among the fish sampled in this study, infestation was higher in females than males. The disease prevalence is generally higher in the water body and the observed higher prevalence in females is in line with previously documented reports (Abdel-Gaber *et al.*, 2015; Ratnabir *et al.*, 2015; Ogonna *et al.*, 2017; Ukuru and Adikwu, 2017; Omoniyi and Ojelade, 2017; Sogbesan *et al.*, 2018; Ajala *et al.*, 2019; Sadauki *et al.*, 2022b). However, contrary report was documented by Ito, (2017); Oladipo *et al.* (2019); Ali *et al.* (2020) who indicated more parasitic worm invasion in sampled male fish than females. According to Omeji *et al.* (2010) and Emere and Egbe (2006), higher parasitic infection in females could be due to their physiological states as gravid females could have immune-compromised and reduction in resistance to parasitic infection.

The prevalence of gastrointestinal helminth infection was slightly different though not significant among the sampling stations with the highest being from Gajerar giwa. The observed differences due to sampling location could be due to endemicity, ease of access to intermediary hosts and vulnerability of the fish to infestation (Ogonna *et al.*, 2017). Sadauki *et al.* (2022b) and Kawe *et al.* (2016) also reported differences in parasitic infestation of *C. gariepinus* collected from different locations on the same water body. Size of the fish, length, and weight are usual traits of the age of the fish with bigger fish of the same species tending to be older than smaller ones (Dambatta *et al.*, 2021). Researchers have reported variation in parasitic infestation due to the size of the fish (Abdel-Gaber *et al.*, 2015; Uruku and Adikwo, 2017). In this study, there is a general trend for a decrease in parasitic infestation as the size increase, for both length and weight. While the difference was significant for weight, it was not for length. The observed decrease in parasitic worm infestation with an increase in size is similar to that of Tasawar *et al.* (2007); Uruku and Adikwo, (2017); Shehata *et al.*, (2018) and Sogbesan *et al.* (2018) among others. This observation could be associated with improved immune response and increased resistance to parasites and disease as the fish grows bigger and tends towards maturity, unlike small size (fingerlings and juveniles) with poor defence mechanisms. High mortality due to disease and parasitic infestation in cultured fish is usually documented in nurseries with fish that are yet to attain maturity (Tasawar *et al.*, 2007). However, contrary reports to the above have been documented by Abdel-Gaber *et al.*, 2015 and Omotoyi and Ojelade, (2017), who reported increased parasitic prevalence with an increased size of the sampled fish. This observation may require further efforts to document what is regarded as small or

big fish for proper context. Adebambo (2020) noted that the lower occurrence level of parasitic infestation in matured fish sample fish may be due to long time exposure to parasites and over time development of immune response and resistance to the infection. It is a plausible position that fish like other organisms get used to certain parasites over time and less affected by them as they grow up.

Conclusion

The *C. gariepinus* species in Ajiwa reservoir are highly infected with parasitic worms mainly from nematode and cestode groups, although the intensity is low considering the number of species sampled as against the abundance of the parasitic helminths observed. The prevalence of the parasitic gastrointestinal helminths in *C. gariepinus* from Ajiwa reservoir is affected by sex and size, especially weight. While previous research on the water quality did not show a water body under pollution stress, it is important to seek information on what could be responsible for the high prevalence of the infestation, as well as parasitic infestation status of other commercial fish species in the water body. This is essential to put in place appropriate management practices to reduce it. This will help in managing the fish diversity and abundance in the water body as well as reducing the risk of parasitic worms being transferred to the fish consumers who largely depend on the water body for cheap quality protein source.

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Conflict of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Table 1: Distribution of gastrointestinal helminths of African catfish (*Clarias gariepinus*) from Ajiwa reservoir, Katsina State, Nigeria

Parasitic worms	Number of parasites	Per cent of infection
Nematode		
<i>Contracaecum</i> sp	23	15.44
<i>Capillaria</i> sp	44	29.53
<i>Camallanus</i> sp.	21	14.09
Cestode		
<i>Monibothrium</i> sp	35	23.49
<i>Monibothrium</i> larvae.	26	17.45
TOTAL	149	(100)

Table 2: Distribution of gastrointestinal helminths of African catfish (*Clarias gariepinus*) from Ajiwa reservoir, Katsina State, Nigeria in relation to the site of infection

Parasite	Site of infection	
	INTESTINE	STOMACH
Nematode		
	No (%)	No (%)
<i>Contracaecum</i> sp	14 (9.40)	9 (6.04)
<i>Capillaria</i> sp	14 (9.40)	30 (20.13)
<i>Camallanus</i> sp	12 (8.05)	9 (6.04)
Cestode		
<i>Monibothrium</i> sp	27 (18.12)	8 (5.37)
<i>Monibothrium</i> larvae	19 (12.75)	7 (4.70)
TOTAL	86 (57.72)	63 (42.28)

Table 3: Prevalence of gastrointestinal helminths of African catfish (*Clarias gariepinus*) based on the sex of the species from the Ajiwa reservoir, Katsina State, Nigeria

SEX	Number examined	Number infected	Prevalence (%)
Male	77	54	70.13
Female	85	78	91.76
Total	162	132	81.48

χ^2 (df =1, n = 162) = 12.532, p =0.001

Table 4: Prevalence of gastrointestinal helminths of African catfish (*Clarias gariepinus*) from Ajiwa reservoir, Katsina State, Nigeria in relation to sample location

Locations	Number examined	Number Infected	Prevalence (%)
Kadaji	54	40	74.07
Kunduwaje	54	43	79.63
Gajerar giwa	54	49	90.74
TOTAL	162	132	81.48

χ^2 (df = 2, n = 162) = 5.155, p = 0.076

Table 5: Prevalence of gastrointestinal helminths of African catfish (*Clarias gariepinus*) from Ajiwa reservoir, Katsina State, Nigeria in relation to the length of the fish

Fish length (cm)	Number examined	Number Infected	Prevalence (%)
10.0-15.0	67	57	85.07
15.1-20.0	45	39	86.66
20.1-25.0	27	20	74.07
25.1-30.0	16	12	75.00
30.1-35.0	7	4	57.14
TOTAL	162	132	81.48

χ^2 (df = 4, n = 162) = 4.901, p = 0.298

Table 6: Prevalence of gastrointestinal helminths of African catfish (*Clarias gariepinus*) from Ajiwa reservoir, Katsina State, Nigeria in relation to the weight of the fish

Fish weight (g)	Number examined	Number of Infected	Prevalence (%)
10-20.9	68	60	88.23
21-50.9	43	38	88.37
51-80.9	30	21	70.00
81-110.9	12	8	66.66
111-140.9	9	5	55.55
TOTAL	162	132	81.48

χ^2 (df = 4, n = 162) = 11.784, p = 0.019

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