

## Helminth Parasites of *Clarias gariepinus* (Burchell, 1822) and *Oreochromis niloticus* (Linnaeus, 1758) from Esa Odo Reservoir, Esa Odo, South-West Nigeria

Olugbotemi Caleb Ibronke<sup>1</sup>, Olajumoke Abimbola Morenikeji<sup>1</sup>

<sup>1</sup> Parasitology/Ecology and Environmental Biology Unit, Department of Zoology, University of Ibadan, Ibadan, Oyo State Nigeria

[jumokemorenikeji@yahoo.co.uk](mailto:jumokemorenikeji@yahoo.co.uk)

**Abstract:** The study was carried out to assess the prevalence of parasites, parasitic load and length-weight in relation to parasite infection in *Clarias gariepinus* and *Oreochromis niloticus* from Esa odo Reservoir in south-west Nigeria. A total of 254 randomly selected fish specimens consisting of 150 *C. gariepinus* and 104 *O. niloticus* were sampled between May – August 2017. The fish specimens were dissected to extract helminth parasites after determining their length, weight and sex. A total of 32 parasites were recovered. Parasite prevalence and parasitic load were higher in *C. gariepinus* than in *O. niloticus*. Overall parasite prevalence of 14% was recorded for *C. gariepinus* while 10.6% was recorded for *O. niloticus*. The helminths recovered included one trematode, *Clinostomum tilapiae*, one achantoccephalan, *Achantogyrus spp.* and one hirudinea, leech. Infection in males and females was not statistically different ( $P>0.05$ ). No significant difference was found in the prevalence of helminth parasitic infection in relation to size of the two species of fish examined. Bigger sizes of *C. gariepinus* and *O. niloticus* were however found to be more parasitized than smaller sizes. The infected *C. gariepinus* and *O. niloticus* had a lower condition factor than uninfected ones. The intestine of *C. gariepinus* and *O. niloticus* had the highest parasitic load of 76.2% and 63.6% respectively. There is a need to develop effective control measures against helminth parasites of fish and adopt good culinary practices to reduce the potential risks to human health.

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### 1. Introduction

Fishes are very important sources of protein with desirably low cholesterol levels in the diets of fish meat lovers. Economically, it is a source of income. With a nutrient profile superior to all other terrestrial meats, fish meat has a high digestible energy that can meet human nutritional requirements (Schonfeldt et al., 2013). Omega-3-fatty acids contained in fish oil has been shown to be necessary for proper brain, heart and immune system functioning (Hohn, 1999). Fish niches in the ecosystem influences the community structures of lakes, streams and estuaries. This according to Ashade et al. (2013), is because they are restricted to a particular mode of life related to their food source and reproductive requirements.

Interesting to note, is the vulnerability of fishes to parasitic infections. An observation that depends on species of fish and type of water inhabited as well as certain water quality parameters such as dissolved oxygen content, increased organic matter content etc. Poor environmental conditions is another influencing factor that enhances fish vulnerability to these parasitic infections (Ahmed-Hamid et al., 2012). This is of utmost importance as parasite presence (known to facilitate secondary infections and dangerous complications) and their disease causing activities in

fishes has been identified as a major constraint in aquaculture (Bondad-Reantaso et al., 2005), causing production and economic losses through direct fish mortality, reduction in fish growth, fecundity and stamina, increased susceptibility to predation and through high cost of treatment (Salawu et al., 2013).

The aquacultural production of *C. gariepinus* (African sharp-tooth catfish in the family Clariidae) and *O. niloticus* (Nile tilapia in the family Cichlidae) is no exception to the challenges in aquaculture brought about by fish parasitic infections. Both species are native to Africa, with *C. gariepinus* having a much wider geographical distribution extending through parts of Europe and Brazil in Southern America. Both are also omnivorous in nature, although, *O. niloticus* feeds mainly on phytoplanktons and benthic algae while *C. gariepinus* has an extremely varied range of diets, displaying both scavenging and predatory behavior and feeding on all types of aquatic invertebrates, small vertebrates, small mammals, aquatic plant parts and even planktons. Also, while *O. niloticus* have a preference for shallow waters, *C. gariepinus* are more benthopelagic (Skelton, 2001; Fish base, 2007).

With the importance of fish meat outlined earlier, there is need for extensive research into efficient fish

management practices. This must include studies of their parasites so as to ensure optimal production level (Burridge et al., 2010) which is necessary to satisfy the increasing worldwide demand for fish meat. Knowledge of fish parasites is also important not only to ensure fish health but to understanding ecological problems (Dudgeon et al., 2006). This and more justifies the recent shift in attention to studies on fish parasites, thereby making information available on parasites of cultured and wild fish (Shukerova et al., 2010). There is also an increasing knowledge on the helminth parasites of fishes in Nigeria (Morenikeji and Adepeju, 2009; Salawu et al., 2013; Domo and Ester, 2015; Kawe et al., 2016; Absalom et al., 2018), other parts of Africa (Barson et al., 2008; Bekele and Hussien, 2015; Abdel-Gaber et al., 2015, 2016), and elsewhere (Salgado-Maldonado, 2006). However, in Esa odo reservoir, there is paucity of information on the parasitic helminth status of resident *C. gariepinus* and *O. niloticus*. This study therefore sought to determine the helminth parasites of both species in Esa odo reservoir.

## 2. Materials and Methods

### 1.1. Study Area

Esa Odo reservoir ( $7^{\circ} 45' 0''\text{N}$ ;  $4^{\circ} 49' 0''\text{E}$ ), with a total surface area of about 192, 000 km<sup>3</sup>, is the result of an impoundment of Osun river at Esa Odo community of Obokun LGA of Osun State. The agrarian community has a generally high and uniform temperature and a mean annual rainfall of about 1400mm with the rainy season extending from April to November marked by torrential rains and thunderstorms at its beginning and end. Two maximal rainfall peaks are observed in July and September/October (Iloeje, 1978).

### 1.2. Fish Collection

A total of two hundred and fifty four (254) fish samples comprising of a hundred and fifty (150) samples of *C. gariepinus* and a hundred and four (104) samples of *O. niloticus* were collected fortnightly from May to August 2017 adopting methods by Olurin et al. (2012). Fishes obtained were taken alive to the Parasitology laboratory, Department of Zoology University of Ibadan, Ibadan, in plastic containers containing water. The fishes were anesthetized and killed with MS 222 (Jun et al., 2016). MS 222 was prepared by dissolving 400 mg tricaine mesylate in one (1) litre of water, and five (5) fishes were immersed in the prepared solution for ten minutes (IACUC, 2015). There was addition of sodium bicarbonate to the prepared solution so as to reduce the stress on the fishes due to the increased acidic level of the prepared solution caused by MS 222.

### 1.3. Fish Identification

Identification of the fishes were done using the atlas by Olaosebikkan and Raji (1998). The sex, length and weight of the fishes were all determined by previously adopted methods (Morenikeji and Adepeju, 2009; Salawu et al., 2013). Sex determination was by presence or absence of an intromittent organ on the ventral side with confirmation by presence of testes or ovaries observed during dissection. While lengths and weights measurements were done using a measuring board and a chemical balance respectively.

### 1.4. Examination for Parasites

Examination for fish helminth parasites was done macroscopically by inspection of fish skin surfaces, gills, eyes, internal organs (kidneys, liver and intestines), and sliced fish flesh portions exposing fish muscles. Dissecting microscopes were used for better observations where necessary. Each fish gill was teased apart, and fish eyes were cut open under water for easy examination of the lens and retina, and then were closely examined microscopically. The abdominal wall was cut laterally to expose the gut, and opened up into a specimen bottle containing normal saline solution and left for about 4 hours. Squash preparations of the liver, gonads and kidneys, the stomach and heart (dissected), the intestines teased open from the anterior to the posterior ends into petri dishes, and the walls and contents of the gall and swim bladders, were all thoroughly examined under a dissecting microscope for helminth parasites (Morenikeji and Adepeju, 2009).

### 1.5. Preservation and Identification of Parasites

The helminthes recovered were allowed to die and stretch fully in 0.09% normal saline. They were preserved in 70% alcohol with up to two drops of glycerine to prevent worm contraction and complete evaporation (MAFF, 1971). The parasites were viewed under a dissecting microscope for identification using the keys by Yamaguti (1959) and Juan and Windsore (2006).

### 1.6. Statistical Analysis

The prevalence and intensity of the parasites was calculated. The condition factor of the fish was calculated (Oniye et al., 2004). F-test of the condition factor was calculated using analysis of variance (ANOVA) to determine the significant levels between the condition factor of infected and uninfected ones. Chi-square was used to calculate the significant difference of the levels of infection and to compare the parasitic load between fish hosts in the study sites. Chi-squared goodness of fit was employed in order to statistically determine if there was any significant difference between prevalence of infection and sex, standard length and weight of fish samples (Morenikeji and Adepeju, 2009).

### 1.7. Ethical Consideration and Approval

Ethical approval was gotten from Animal Care and Use Research Ethics Committee (ACUREC) University of Ibadan Oyo State, Nigeria.

A total of 32 helminth parasites including one trematode (*Clinostomum tilapiae*), one achantocephalan (*Achantogyrus spp.*), and one hirudinea (leech) were recovered from the two fish species examined (Table 1).

### 3. Results

Table 1: Types of helminth parasites in fish hosts from Esa odo reservoir

Fish Host	Type of Parasite	Class of Parasite
<i>Clarias gariepinus</i>	<i>Clinostomum tilapiae</i>	(Trematode)
	<i>Achantogyrus spp.</i>	(Achantocephalan)
<i>Oreochromis niloticus</i>	<i>Clinostomum tilapiae</i>	(Trematode)
	Leech	(Hirudinea)

No cestodes and nematodes were found. The overall parasite prevalence observed was 12.6%, and by fish host species, *C. gariepinus* had a parasite prevalence of 14.0% while *O. niloticus* was at 10.6% (Table 2).

Table 2: Overall parasite prevalence in fishes from Esa odo reservoir

Fish Host	No. Examined	No. infected	Prevalence (%)	Total Parasites recovered
<i>C. gariepinus</i>	150	21	14.0	21
<i>O. niloticus</i>	104	11	10.6	11
<b>Total</b>	<b>254</b>	<b>32</b>	<b>12.6</b>	<b>32</b>

The relationship between the level of infection and the sizes of the fish hosts were not statistically significant ( $P > 0.05$ ) although there were observed differences (Tables 3 - 6).

Table 3: Prevalence of helminth infection in relation to length of *Clarias gariepinus*

Length Range (cm)	No. Examined	No. Infected	Prevalence (%)
13.0 – 16.9 (15.7±0.8)	44	5	11.4
17.0 – 20.9 (18.7±1.0)	80	12	15.0
21.0 – 24.9 (22.1±0.9)	21	4	19.0
25.0 – 28.9 (22.1±0.9)	5	0	0
<b>Total</b>	<b>150</b>	<b>21</b>	<b>14.0</b>

Chi squared  $\chi^2 = 1.21$ ,  $df = 3$ ,  $P > 0.05$

Table 4: Prevalence of helminth infection in relation to length of *Oreochromis niloticus*

Length Range (cm)	No. Examined	No. Infected	Prevalence (%)
6.0 – 8.9 (7.8 ± 0.7)	25	3	12.0
9.0 – 11.9 (9.9 ± 0.8)	69	5	7.2
12.0 – 14.9 (12.1 ± 0.2)	8	2	25.0
15.0 – 17.9 (16.5 ± 0.7)	2	1	50.0
<b>Total</b>	<b>104</b>	<b>11</b>	<b>10.6</b>

Chi squared  $\chi^2 = 3.78$ ,  $df = 3$ ,  $P > 0.05$

Table 5: Prevalence of helminth infection in relation to weight of *Clarias gariepinus*

Weight Range (g)	No. Examined	No. Infected	Prevalence (%)
20.0 – 52.9 (42.8 ± 8.3)	51	9	17.6
53.0 – 85.9 (67.0 ± 8.8)	62	6	9.7
86.0 – 118.9 (98.1 ± 6.7)	28	6	21.4
119.0 – 151.9 (132.7 ± 13.4)	9	0	0
<b>Total</b>	<b>150</b>	<b>21</b>	<b>14.0</b>

Chi squared  $\chi^2 = 3.32$ ,  $df = 3$ ,  $P > 0.05$

Table 6: Prevalence of helminth infection in relation to weight of *Oreochromis niloticus*

Weight Range (g)	No. Examined	No. Infected	Prevalence (%)
0 – 49.9 (33.6 ± 7.6)	88	7	8.0
50.0 – 99.9 (55.7 ± 4.6)	14	3	21.4
100.0 – 149.9 (124.95 ± 0.00)	0	0	0
150.0 – 199.9 (171.4 ± 29.9)	2	1	50
Total	104	11	10.6

Chi squared  $\chi^2 = 3.70$ ,  $df = 3$ ,  $P > 0.05$

There was also no significant difference ( $P > 0.05$ ) in the level of infection among the different fish host sexes, although, the females for *C. gariepinus* had higher percentage parasite prevalence, while the opposite was the case in *O. niloticus* (Table 7).

Table 7: Prevalence of helminth infection in relation to host sex

Fish Host	<i>C. gariepinus</i>		<i>O. niloticus</i>	
	Male	Female	Male	Female
No. Examined	76	74	35	69
No. infected	10	11	4	7
Infection rate (%)	13.2	14.7	11.4	10.1

\*Chi squared: *C. gariepinus* -  $\chi^2 = 0.079$ ,  $df = 1$ ,  $P > 0.05$ ; *O. niloticus* -  $\chi^2 = 0.040$ ,  $df = 1$ ,  $P > 0.05$

The parasitic load was higher in *C. gariepinus* than in *O. niloticus* (Table 8).

Table 8: Comparison of parasitic load between fish hosts from Esa odo reservoir

Fish Host	Observed	Expected
<i>C. gariepinus</i>	14	50
<i>O. niloticus</i>	10.6	50

Chi squared  $\chi^2 = 56.97$ ,  $df = 1$ ,  $P < 0.05$

And the statistical comparison between the two fish host species showed a significant difference ( $P < 0.05$ ). The condition factor analysis showed higher values for *O. niloticus* compared to *C. gariepinus*, however, for both fish host species, it showed lower values for the infected fish hosts than it was for the uninfected group (Tables 9 and 10).

Table 9: Comparison of condition factor (mean) of infected and uninfected *Clarias gariepinus* from Esa odo reservoir

Sex	Male		Female	
	Infected	Uninfected	Infected	Uninfected
Length range				
13 – 16.9	0.99 (±0.04)	1.10 (±0.24)	0.91 (±0.08)	1.26 (±0.53)
17 – 20.9	0.89 (±0.08)	1.06 (±0.33)	1.12 (±0.21)	1.09 (±0.28)
21 – 24.9	0.83 (±0.04)	0.93 (±0.18)	0.00 (±0.00)	0.97 (±0.04)
25 – 28.9	0.00 (±0.00)	0.79 (±0.16)	0.00 (±0.00)	0.87 (±0.11)
Total	0.88 (±0.08)	1.03 (±0.29)	1.06 (±0.21)	1.13 (±0.31)

F = 1.28,  $df = (1,74)$  F = 0.55,  $df = (1,72)$

P > 0.05 P > 0.05

Table 10: Comparison of condition factor (mean) of infected and uninfected *Oreochromis niloticus* from Esa odo reservoir

Sex	Male		Female	
	Infected	Uninfected	Infected	Uninfected
Length range				
6 – 8.9	4.81 (±0.02)	5.14 (±0.18)	4.80 (±0.00)	5.23 (±0.79)
9 – 11.9	0.00 (±0.00)	4.15 (±0.63)	3.97 (±0.17)	4.08 (±0.74)
12 – 14.9	2.71 (±0.00)	3.12 (±0.38)	2.96 (±0.00)	3.06 (±0.21)
15 – 17.9	3.67 (±0.00)	0.00 (±0.00)	0.00 (±0.00)	3.91 (±0.00)
Total	4.00 (±1.01)	4.10 (±2.05)	3.95 (±0.56)	4.38 (±0.94)

F = 0.01,  $df = (1,33)$ ,  $P > 0.05$ ; F = 1.39,  $df = (1,67)$ ,  $P > 0.05$

However, the statistical comparison between infected and uninfected fish host species showed no significant difference ( $P>0.05$ ). The preferred location of infection observed for both fish host species was the intestine with parasitic loads of 76.2% in *C. gariepinus* and 63.6% in *O. niloticus* (Figures 1 and 2).

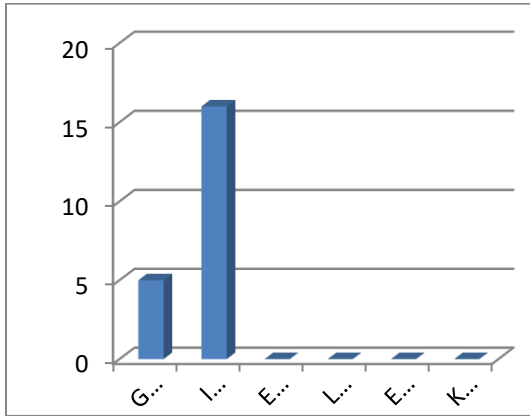


Figure 1: Helminth infection in relation to site in *C. gariepinus* from Esa Odo Reservoir

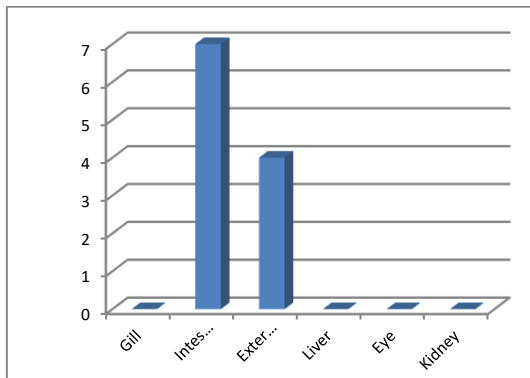


Figure 2: Helminth infection in relation to site in *O. niloticus* from Esa odo reservoir

#### 4. Discussion

The study showed a low overall parasite prevalence (12.6%), with only trematodes (*Clinostomum tilapiae*), achantocephalans (*Achantogyrus spp*) and hirudinea (Leech) as the parasite taxa recovered, suggesting a low parasite species diversity in the reservoir. Edeh and Solomon (2016) equally found a low parasite species diversity (with only cestodes and nematodes) for both *C. gariepinus* and *O. niloticus* from Utako flowing gutter in Abuja, Nigeria. Similarly, Amaechi (2014) and Absalom et al. (2018) also recorded low parasite species diversities for *O. niloticus* (with a relatively higher parasite prevalence of 56.4%) from Asa Dam, Ilorin, Nigeria and *C. gariepinus* (with a relatively higher parasite prevalence of 63%) from River Gudi in Nasarawa State respectively. However, in contrast to

the present study, Goselle et al. (2008) and Iboh et al. (2016) both observed a richer parasite species diversity including not less than two parasite species from each parasite taxa identified for *C. gariepinus* from Lamingo Dam, Jos Nigeria and Great kwa River in Cross River State respectively, and interestingly without a record of the presence of acanthocephalans and particularly hirudinae (Leech) which is rarely reported among parasite species found in freshwater fishes. Leeches are generally rarely reported among Nigerian freshwater fishes, although a few workers have reported their presence among some freshwater fish species (Okpasuo et al., 2016). Also worthy of note, is the record of the presence of *Achantogyrus spp.* in *C. gariepinus* and *O. niloticus* from Esa Odo reservoir, an acanthocephalan that has not been reported among freshwater fishes in Nigeria. Although, this study recovered acanthocephalans from freshwater fishes in Esa Odo reservoir, it is nothing like the high prevalence reports for the same group of parasites from earlier studies (Mgbemena, 1983) carried out during the dry season. From the observation on the absence of acanthocephalans in their studies, Goselle et al. (2008) and Edeh and Solomin (2016) suggested that a determining factor for presence of acanthocephalans could be seasonal variation, although, the study by Akinsanya and Otubanjo (2006) which covered different seasons in a southwestern freshwater body recorded the absence of acanthocephalans indicating the relevance of other factors in acanthocephalan distribution. Another contrasting study by Domo and Ester (2015), have reported a richer parasite species diversity (with much higher parasite prevalence of 40%) for both fish host species from Lake Geriyo in Yola, Adamawa state. Although, in line with this study, they also reported *Clinostomum spp.* among the parasite found in both fish host types. An Ethiopian study (Bekele and Hussien, 2015) similar to this study has reported a low species richness, low parasite prevalence (20.83%) and also the presence of the trematode *Clinostomum spp.* in both fish hosts types, although, observed during the dryer months of the year. The report of *Clinostomum spp.* from these studies confirms the assertion by Gebremedhn and Tsegay (2017) that *Clinostomum spp.* are among the major trematode species found affecting *C. gariepinus* and *O. niloticus*. In addition, the presence of *C. tilapiae* (metacercariae) suggests that *C. gariepinus* and *O. niloticus* are intermediate hosts in the local trophic web. *C. tilapiae* is known to use fish as an intermediate host, while the piscivorous bird, like cattle egret is the definitive host (Ukoli, 1966; Bonett et al., 2011). *Clinostomum* is known to damage the muscles of fish making it disgusting and unmarketable (Coulibaly et al., 1995). Akinsanya and Otubanjo (2006) opined that geo-climatic differences might be a leading factor in



determining, not just the prevalence of parasites in freshwater bodies, but also the parasite communities found in freshwater fishes. Other important factors that contribute to parasite prevalence, intensity and diversity include: parasite species and their biology including presence of suitable intermediate hosts, fish host habitat, migratory and feeding behavior, host diet and age (Shukerova et al., 2010; Hussen et al., 2012). Previous studies have attached similar observations on low parasite prevalence in Nigerian freshwater bodies to the absence of pollution (Salawu et al., 2013), the presence of certain environmental conditions that particularly strengthen the physiological statuses of freshwater fishes making them resistant to parasite invasion and establishment (Oswald and Hulse, 1982), the appropriateness of water quality parameters (Adegrooye et al., *accepted for publication*) etc. The observation on low parasite prevalence in Esa Odo reservoir could be suggestive of any one of the above factors.

The study also showed variation in parasite prevalence with respect to fish size with higher parasite prevalence observed among larger sized fishes than smaller ones. Although, Chi-square analysis showed a non-significant relationship ( $P>0.05$ ) similar to what was reported by Abdel-Gaber et al. (2015). The observation of higher prevalence among larger sized fishes is similar to that obtained in previous studies by Mohammed et al. (2009), and Omeji et al. (2010) that attributed the observation to longer time of exposure among older fishes compared to younger ones. The high incidence of infection obtained in longer fishes is an indication of the importance of fish size in determining parasitic load. Contrary to this observation is the report by Tasawar et al. (2007) and Kawe et al. (2016) where the prevalence of infection was relatively higher in smaller and shorter fishes respectively. This is attributable to random selection and low level of immunity in the small sized fish. In agreement with this study, Ayanda (2009) also reported higher parasitic load in bigger fishes. Another possible reason for increased parasitism with increase in size could be due to the fact that bigger fish cover wider areas in search of food than the smaller ones and as a result, take in more food than the smaller ones, and so could expose them more to infection by parasites.

As regards the relationship between infection rate and fish host sex, higher infection rates were recorded for females (14.7%) than in males (13.2%) in *C. gariepinus*. Emere and Egbe (2006), Ayanda (2009), Omeji et al. (2010) and Abdel-Gaber et al. (2015) all made similar observations. This could be due to the quest for survival by females and also due to their physiological state. Contrary findings are those by Emere (2000) and Kawe et al. (2016) where higher parasitic infection rates were obtained for males than

females. In *O. niloticus* on the other hand, the higher infection rates in males (11.1%) than females (10.1%) could be suggestive of a marked difference in fish feeding behaviours by sex. Kawe et al. (2016) reported a similar result.

In this study, the comparison of parasitic load between both species of fish using Chi-Square revealed that there was significant difference ( $P<0.05$ ) between the helminth parasitic loads in the two species of fish. Also, the distribution of helminth parasites in the fishes showed a clear preference for the intestine as sites of attachment attributable to the availability of food in these regions. The highest prevalence of parasites in the intestine implies that it is a more preferred predilection site; this could be due to the favourable conditions that enhance their survival (Owolabi, 2008). Similar findings were reported by Auta et al. (1999) and Emere (2000), Aliyu and Solomon (2012).

The condition factor which is an indication of the well-being or robustness of a fish in relation to its environment, proved to be lower among the infected fishes in Esa Odo reservoir compared to the uninfected ones, thereby, highlighting the negative effects of parasitism on the general well-being of parasitized fishes. This disagrees with the results gotten by Okpasuo et al. (2016) for *Bagrus bayad* fishes in Anambra River basin, Nigeria, although, it is similar to that gotten for all the other species investigated by the group. It is also similar to the earlier report of lower condition factor for parasitized male *C. gariepinus* fishes from Sabon-gari market Zaria by Oniye et al. (2004). The study also showed clearly that *O. niloticus* are in a far better condition than *C. gariepinus* in the reservoir. This may have been due to a variety of factors including the level of pollution and parasitism of the reservoir, the availability of food and the differential feeding habits of different species present, favouring *O. niloticus* more than *C. gariepinus* fishes. This is not unreasonable as generalist feeders tend to be more prone to parasitic infection especially from their predatory feeding activities. The better condition of *O. niloticus* compared to *C. gariepinus* in the reservoir suggests the favourableness of Esa Odo reservoir for the survival of *O. niloticus* and not for *C. gariepinus*.

The present study shows the prevalence and burden of parasitic helminths in *C. gariepinus* and *O. niloticus* sampled from Esa odo reservoir. The study revealed low parasitic helminth prevalence in the sampled fishes, suggesting that the fishes from Esa odo reservoir are safe for human consumption and that there is little or no pollution in the reservoir since pollution has been associated with higher parasitic prevalence. However, because the presence of helminth parasite infection in fishes affects their productivity, marketability, palatability and also bringing about the death of a good number, not to mention the potential

zoonotic effects on fish consumers, it is therefore necessary to develop effective control measures against helminth parasites of fish and adopt good culinary practices to reduce the potential risk to human health.

In addition, the increased demand for fish as a source of protein should trigger further studies on fish species and their parasites to determine the risks to humans feeding on them. Further studies on the level of pollution highlighting the current water condition (physicochemical status) of Esa Odo reservoir is recommended so as to ascertain the exact relationship between pollution and parasitism in the reservoir.

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