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Prevalence of Internal Parasites of *Oreochromis niloticus* and *Clarias gariepinus* Fish Species in Lake Ziway, Ethiopia

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Abstract

A cross sectional study was conducted from November 2013 to March 2014 in Lake Ziway to determine the prevalence of internal parasites and identify the most common genera infecting fish. A total of 384 randomly selected fish species comprising of 221 Oreochromis niloticus and 163 Clarias gariepinus were sampled. All the sampled fish were eviscerated in laboratory to investigate the internal parasites. Chi-square statistic and comparison of proportion were used to analyse the data. The overall prevalence of internal parasites of fish was 20.83% (80/384). The major internal parasite genera identified in the body of fish were Contracaecum (62.50%), Clinostomum (31.25%) and Eustrongylides (6.25%). The distribution of parasite genera was significantly affected by fish species (p=0.022). However, the difference between sexes was not seemed to be statistically significant (p=0.362) despite the prevalence was slightly higher in male (22.75%) than female (18.97%) fish. In conclusion, fishermen and other people who have developed the habit of consuming raw fish are at higher risk of becoming infected by the zoonotic parasites. Therefore, awareness creation activities and control of fish parasites should be conducted in the study Lake.

Keywords: Fish; Internal parasite; Lake ziway; Prevalence

Introduction

Ethiopia depends on its inland water bodies for fish supply for its population as a low cost protein source. The country's water bodies have a surface area estimated at 7334 km^2 of major lakes and reservoirs, and 275 km^2 of small water bodies with 7185 km of rivers within the country [1]. Several of these water bodies serve as sources of fish for the country. Commercial production of fish, however; is widely practiced on Lake Tana, Lake Lugo, Lake Chamo, Lake Awassa and Lake Ziway [2].

In Ethiopia, there are about 168 to 183 different species of fish and 37-57 of them are native to the country [3]. The tilapia *Oreochromis niloticus* and several species of the genera Clarias, Lates, Barbus and Bagrus, however; are the country's commercially most valuable fish species [4,5].

Lake Ziway serves as a home for several species of fish including *Oreochromis niloticus*, Tilapia zillii, Barbus species, *Clarias gariepinus* and Carp species, in which some are native and others exotic that were introduced into the Lake by the Ministry of Agriculture with the aim of fishery development [6-8]. The potential yield of all species of fish in Lake Ziway has been assessed by empirical modelling and is estimated to range between 2,500 to 6,680 tons/yr depending on the surface of the Lake [7].

Like other animals, fish are affected by parasites and other diseases causing pathogens. Fish parasites cause fish diseases and spoil the appearance of fish thus resulting in consumer rejection [9]. Several groups of parasites belonging to helminths, arthropods, protozoans and other groups of miscellaneous taxa are known to infect fish and produce harmful effects on their hosts [10]. However, only few studies on internal parasites of fish have been so far conducted in different Lakes and reservoirs of Ethiopia, including Lake Tana [11], Lake Lugo [12] and Koka reservoir [9]. There was previous report on prevalence of internal parasites of fish in Lake Ziway [8]. Since this study was conducted nearly two decades ago, recent data on the current status of internal parasites of fish in the Lake was required. The present study was, therefore, undertaken to determine the prevalence of internal parasites and identify the most common genera infecting *Oreochromis niloticus* and *Clarias gariepinus* in Lake Ziway.

Materials and Methods

Study area

The present study was conducted in Lake Ziway. Ziway is found in Adami Tulu Jido Kombolcha district which is a part of Rift Valley that lies 165 km South of Addis Ababa at an altitude of 500-1800 m.a.s.l. The area has an average annual rain fall of 700 mm. The rain fall is bimodal with short rainy season from March to May and long rainy season from June to September, followed by the dry season from October to February. The area has maximum and minimum temperatures of 27.2°C and 12.7°C, respectively and relative humidity of 60% [13].

Lake Ziway is found in the Great East African Rift Valley Lakes of Ethiopia. It has open water area of 422 km^2 and shoreline length of 137 km, a minimum and maximum depth of 2.5 m and 9 m, respectively, and an elevation of 1636 m.a.s.l. The Ziway watershed falls in between 7°15'N to 8°30'N latitude and 38°E to 39°30'E longitude covering a total area of about 7300 km^2. The Lake is fed by two major rivers, Ketar and Meki Rivers, and has one outflow in the South, the Bulbula River which flows into Lake Abiyata [14]. Five bigger islands are situated in Lake Ziway: Tulu Gudo (4.8 km^2), Tsedecha (2.1 km^2), Funduro (0.4 km^2), Debre Sina (0.3 km^2) and Galila (0.2 km^2). While the latter two have only a few inhabitants, the three bigger ones are populated with several hundreds of people [15]. The lake has a large littoral zone, containing emergent and submergent vegetation, which provides feeding, and breeding and nursery habitats for fish. It is highly influenced by rural,

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urban and other economic activities as it is situated to the Ziway town and hinterlands [16].

Study population

The fish that inhabit Ziway Lake are Nile tilapia (*Oreochromis niloticus*), Tilapia zillii, Barbus species, Cat fish (*Clarias gariepinus*) and Carp species [8]. The fish species included in the current study were *O. niloticus* and *C. gariepinus* of the Lake Ziway. The other species were not included because their numbers were very small and hence, it was not allowed by the concerned bodies to catch them during study periods.

Study design and Sample size determination

A cross sectional study was conducted from November 2013 to March 2014 at Lake Ziway to determine and identify the prevalent helimnth parasites on randomly selected *O. niloticus* and *C. gariepinus* fish species.

The sample size was determined by using the formula previously described by Thrusfield [17] using 95% confidence interval and 5% absolute precision and at 50% expected prevalence of internal parasites as the previous data in the same Lake was nearly two decades old [8]. Accordingly, 384 fish were included in the current study.

Sample collection and parasite identification

A total of 384 randomly selected fish of 221 *Oreochromis niloticus* and 163 *Clarias gariepinus* were sampled and examined. All the fish were caught using different centimeter mesh sizes of gillnets (6 cm, 8 cm, 10 cm, 12 cm and 14 cm stretched mesh) that were used for the fishing practice at the Lake Ziway.

All fish samples were transported immediately in ice box to Ziway Fishery Research Center Laboratory. In the laboratory, the species, sex and site of infection of the fish were indentified and recorded. Then, each sample of fish was evaluated visually and postmortem examination was done using appropriate postmortem kits using standard evisceration technique previously described by Zhokhov and Mironovsky [18]. Briefly, the whole body cavity was cut opened and examined for parasites. The gill filaments and various organs including stomach, intestine, liver, heart, gall bladder and gonads were removed and placed separately in petri dishes containing 0.75% saline solution. First the external surface of each organ was examined and then each organ was cut opened for examination of parasites. All the collected parasites were preserved in 70% ethanol and fixed in glycerine for further identification. The parasites were identified under stereo microscope using the identification guideline of Paperna [19].

Data Analysis

The data collected from the study area was analyzed using STATA software (version 11). Descriptive statistics was applied for the analysis of the data obtained. Chi-square test was used to examine whether the species and sex of fish were associated with prevalence of internal parasites. For all statistical analysis, a significant level (p-value) of less than 0.05 was considered as statistically significant. Odds ratio (OR) was calculated for the variable with a chi-square ($\chi 2$) >3.84 and P-value <0.05 to assess the strength of association of infection by internal parasites with explanatory variables.

Results

Of the examined 384 fish species, 80 were affected by internal parasites, giving the overall prevalence of 20.83%. Out of the examined 221 *Oreochromis niloticus*, 37 (16.74%) were affected by the parasites. However, of the examined 163 *Clarias gariepinus*, 43 (26.38%) were affected by the parasites. There was statistically significant difference ($\chi 2$=5.2838; p=0.022) in the distribution of internal parasites between the two species of fish. *C. gariepinus* was found 1.78 times (p=0.022, OR=1.78, CI=1.0851-2.9264) more at risk of infection by internal parasites than *O. niloticus* (Table 1).

Table 1 depicts the occurrence of internal parasites in male and female fish. Out of the examined 189 male fish, 43(22.75%) were infected by internal parasites. On the other hand, of the examined 195 female fish, 37(18.97%) were affected by internal parasites of fish. The occurrence of the internal parasites did not show any statistical significant difference between male and female fish ($\chi 2$=0.8301; p=0.362).

The genus Contracaecum was the most prevalent parasite affecting both species and sexes of fish in Lake Ziway. The nematode parasites were recovered from 19(8.60%) of *O. niloticus* and 31(19.02%) of *C. gariepinus* in the gastrointestinal tract of the fish. The parasites were identified from 30(15.87%) male and 20(10.26%) female fish. The second most prevalent internal parasites of fish in both species and sexes of fish were Clinostomum. The trematode parasites were identified from *O. niloticus* 16(7.24%) and *C. gariepinus* 9(5.52%) in gill filaments and thoracic cavity. The parasites were recovered from 11(5.82%) male and 14(7.18%) female fish. The least encountered parasite genus in the current study was Eustrongylides. The nematode parasites were encountered from 2(0.90%) of *O. niloticus* and 3(1.84%) of *C. gariepinus* in the thoracic cavity. The parasites were identified from 2(1.06%) male and 3(1.54%) fish (Table 2).

Discussion

The overall prevalence of internal parasites of fish in Lake Ziway was found to be 20.83%. The result of the current study was comparable to the prevalence of 29.00% in Lake Tana, Ethiopia [11], 17.9% reported in Karachi Fish Harbour, Pakistan [20], 18.5% in a Niger Delta Tidal Creek, Nigeria [21] and 22.22% in Mehran River, Iran [22]. However, it was higher than the prevalence of 6.94% reported in Okhuo River, Nigeria [23]. On the other hand, the overall prevalence (20.83%) of internal parasites of fish recorded in the current study was lower than the prevalence of 66.3% reported in Koka Reservoir, Ethiopia [9], 59.5% in Agulu Lake, Nigeria [24] and 47.8% in Lake Lugo, Ethiopia [12]. This shows that parasitic infection rates vary greatly from one area to another and this depends on a number of factors which include differences in physical and chemical conditions of the water (dissolved oxygen, temperature, salt content and pH), climatic conditions of the areas, season and host parasite relationship [12,20,23,25]. The prevalence rate obtained in the current study was almost similar to the

Variables	No. examined fish (%)	No. fish affected (%)	χ^2 (p-value) OR (95% CI)
Fish species			
Oreochromis niloticus	221 (57.55)	37 (16.74)	**1**
Clarias gariepinus	163 (42.45)	43 (26.38)	**5.2838 (0.022*)**
Sex			
Male	189 (49.22)	43 (22.75)	**1.78 (1.0851-2.9264)**
Female	195 (50.78)	37 (18.97)	**0.8301 (0.362)**
Total	**384 (100%)**	**80 (20.83%)**	

*Statistically significant

Table 1: Association of species and sex of fish to prevalence of internal parasites in Lake Ziway

	Number of fish infested (%)				
Parasite genera	***Oreochromis niloticus***	***Clarias gariepinus***	**Male**	**Female**	**Total Parasites Distribution (%)**
Clinostomum	16 (7.24)	9 (5.52)	11 (5.82)	14 (7.18)	25 (31.25)
Contracaecum	19 (8.60)	31 (19.02)	30 (15.87)	25 (31.25)	50 (62.50)
Eustrongylides	2 (0.90)	3 (1.84)	2 (1.06)	3 (1.54)	5 (6.25)
Total	**37 (46.25)**	**43 (53.75)**	**43 (53.75)**	**37 (46.25)**	**80 (100)**

Table 2: Frequency distribution of parasite genera on the two examined fish species at Lake Ziway

prevalence rate of 24.63% recorded in the previous study conducted before two decades in the same Lake [8]. Moreover, the major parasite genera identified in the two studies in the Lake were Contracaecum and Clinostomum. In the earlier study, despite in very few fish, Euclinostomum, Bothriocephalus and Amplicaecum were identified, and Eustrongylides was obtained in the present study. This shows that no measures have still been taken to control the parasites in the Lake and, among others, parasitic infection of the fish is still affecting the potential yield of fish of the Lake.

The most common parasite genera encountered in the present study were 62.50% Contracaecum followed by 31.25% Clinostomum and 6.25% Eustrongylides. Similarly, Amare et al. [12] encountered Contracecum (42.6%) most frequently followed by Clinostomum (38.6%) and Eustrongylides (2.7%) in Lake Lugo. Moreover, Contracecum was the dominant in all species of fish examined [8,9]. The higher prevalence of Contracecum might be due to the fact that the parasite infests wide range of aquatic birds that can serve as final and intermediate hosts (cormorants and pelicans) and larval stages are known to occur in most African fresh water fish, including Carp and related species, channel catfish and tilapia [8,19,26].

In the present study, fish species and sex have been described as risk factors predisposing fish to helminth parasites infection. Therefore, comparisons of prevalence of internal parasites of fish were carried out between species and sexes of fish. The prevalence of endoparasite infection was higher in *C. gariepinus* (26.38%) than O. niloticus (16.74%). Statistical analysis of the data showed that there was significant difference in infection rate between *O. niloticus* and *C. gariepinus* (p=0.022). In the current study, *C. gariepinus* was found 1.78 times (p=0.022, OR=1.78, CI=1.0851-2.9264) more at risk of infection by internal parasites than O. niloticus. Similar results have been reported by Gulelat et al. [9], Amare et al. [12] and Imam and Dewu [27]. In all these studies, *C. gariepinus* was found to be the most susceptibility species to helminth infections. This might be due to the fact that *C. gariepinus* has less selective or omnivorous behaviour [28,29]. The problem of parasitic infections is associated with feeding behaviour of fish [30]. This behaviour of the fish could expose it for easy transmission of parasites from invertebrate intermediate hosts and fish intermediate hosts [9]. The prevalence of internal parasites of fish in the present study was not seemed to be affected by sex (p=0.362) although the prevalence was slightly higher in male (22.75%) than female (18.97%) fish. Similar results have been reported by Allumma and Idowu [31] and Akinsanya et al. [32], where a higher rate of internal parasite infection was obtained in male fish. In other studies, despite sex of fish did not affect the prevalence of internal parasites, a higher prevalence rate was encountered in female fish [12,20]. The difference in infection rate of male and female fish recorded in these studies could be attributed to genetic predisposition and differential susceptibility owing to the difference of their physiological condition. Female fish especially gravid ones are susceptible to helminth infections as this physiological state could reduce the resistance of the fish to infection by the parasites [33,34].

In conclusion, the parasite genera encountered in the present study were those genera identified two decades ago by another author in the same Lake. The infection rates of fish by the helminth parasites in both studies were almost similar. This clearly shows that fish parasites have not attracted the attention of the concerned bodies in the Lake. That is why, fish parasites control attempt was not made in the Lake. The finding of Clinostomum, Contracaecum and Eustrongylides species represents the potential public health risks, as these parasites are recognized to infect humans from consumption of raw or inadequately cooked fish. Therefore, appropriate control measures should be put in place in the Lake so as to avoid infection of the fish. Moreover, public awareness creation activities should be conducted on zoonotic nature of fish parasites and danger of consumption of raw or undercooked fish.

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