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COMPARATIVE ANALYSIS OF GASTROINTESTINAL PARASITES IN FISH FROM KADUNA RIVER AND SELECTED DOMESTIC PONDS IN KADUNA METROPOLIS

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ABSTRACT

Fish is a source of livelihood for fishermen and fish farmers especially in Nigeria and other developing countries. Fish from river and domestic ponds are widely consumed today, hence the need to conduct this study to enable monitoring and adopting control measures of parasites. The aim of this research to analyze the gastrointestinal parasites in fish from Kaduna River and selected domestic ponds in Kaduna metropolis. Results showed that 197 fishes out of the 350 examined were infected, giving an overall prevalence (56.3%) in fish from Kaduna River and selected domestic ponds. Infection was significantly higher in fishes from Kaduna River (68.0%) than in those from selected domestic ponds (27.0%). The male was 68.3% significantly higher ($p < 0.05$) than that of the female (23.1%) and there was significant association ($p < 0.05$) in the prevalence of gastrointestinal parasites and weight of fish sampled from Kaduna River and selected domestic ponds. Intestines harboured the highest number of parasites (168) than stomach and parasites identified comprised of three taxonomic groups, the nematodes were *Capillaria* species, *Paracamallanus* species, *Contracaecum* species and *Camallanus* species respectively. Cestode was *Diphyllobothrium latum* and Trematode was *Clinostomum* species. There was no significant difference ($p > 0.05$) of intensity and parasite load to the fish species of parasites identified from River Kaduna and selected domestic ponds. The study has revealed that different parasites in fresh water fish from Kaduna River constitutes a major threat to fish productivity than the selected domestic ponds. It is recommended that fishermen should be enlightened on fish parasites in order for them to handle it properly.

Keywords: Domestic ponds, Fish species, River

INTRODUCTION

Fish is a source of livelihood for fishermen and fish farmers especially in Nigeria and other developing countries (FAO, 1996). It contributes significantly to the economic development of countries that involve in aquaculture and fisheries' programme. Fish is one of the most important species of aquatic animal and is found in fresh water and salt water worldwide. It is among a class of aquatic vertebrates which is an important source of protein in human diet. It contains about 80% of water in its fresh state and it is a highly perishable food product with a very short shelf life. While living through the water, the fish takes a large number of parasites into its gut from water sediments and food (Adedeji *et al.*, 2011). In most part of the world, parasites of fish are very common all over, as the population grows, fish resources are being depleted at an increasing rate as a result of environmental degradation, over harvesting, pollution thus fish production could no longer meet the demand of the growing population. This had led to increase in the involvement of stakeholders in aquaculture. Poor environmental conditions and pollution often result in reduced immunity of fish and higher susceptibility to parasites and diseases (Murray, 2005 and Biu *et al.*, 2014). Fish parasites are posing health challenges by either serving as host of parasites that are harmful to man and animals. Series of factors such as habitat loss, pollution, invasive species, over exploitation, and climate change are responsible for this loss in the freshwater biodiversity and quality (Dudgeon *et al*., 2006 and Arthington *et al*., 2016). These factors affect the fish species biodiversity and parasite fauna of freshwater environments. Also, the spatial and temporal variability of intermittent rivers is likely to have a major influence on parasite diversity, abundance, and on the dynamics of parasitic diseases because of their direct effects on parasite free-living stages and indirect effects on freshwater fishes (Lymbery *et al*., 2020). In spite of their significance to man, fish species are known for harbouring parasitic organisms by either serving as intermediate or definitive host of parasites which are harmful to man and animals (Ravinchandran *et al*., 2010). Some of these parasites have been discovered to have zoonotic potential, thereby making them of public health importance and might be highly pathogenic while in natural systems and threaten the abundance and diversity of indigenous fish species (Mashego, 2001).

Fish provides more than 60% of the world's supply of protein, especially in developing countries (FAO, 2018). The importance of fish could be felt directly and indirectly among rural and urban residents in Nigeria. In Nigeria, fisheries, particularly has an important subsector which contributes about 3-5% to the agriculture share of the Gross Domestic Product (GDP). The relevance of the fisheries sector to the Nigeria economy and benefits derived by Nigerians from fish and other fish products led to the high consumption and hence the increased demand for fisheries products. In order to meet up with increasing demand for fisheries products, Nigerian Federal government have tremendously implemented a series of projects targeted at increasing the local supply of fish (Tiamiyu *et al.*, 2015). In spite of the tremendous progress, the potentials of fish parasite have increased research interests and concerns on the sustainability of fish. The aim of this

work is to analyze the gastrointestinal parasites in fish from Kaduna River and selected domestic ponds in Kaduna metropolis.

MATERIALS AND METHODS

Study Area

The study was conducted in Kaduna metropolis, Kaduna State. Kaduna metropolis has a total land area of about 3,080 km^2. It has an approximate landmass of about 431 km^2 and located between latitude 10º 52' N and 10º 30' N and longitude 7º 15' E and 7º 45' E. The area is situated on a relatively low plain liable to flood. The river divides the Kaduna metropolis into two major areas, Kaduna North and Kaduna South (BLSK, 2010).

Sample collection

A total of three hundred and fifty fishes (350) were collected comprising of 250 fish species from Kaduna River, in Kaduna metropolis from the local fishermen and 100 catfish was purchased directly from the domestic ponds of Abaji and Nuhu fish ponds which is located in Kaduna metropolis. They were transported live in clean 20litres plastic containing water to postgraduate laboratory, Department of Biological Sciences, Nigerian Defence Academy Kaduna.

Measurement of Weight and Sex Determination

The weight of each fish was determined with the aid of weighing balance (Biu *et al.,* 2013). The sex of the fish was determined by physical examination of the papillae which is long in males, while it is round and reddish in matured females. Sex was confirmed by internal examination for the presence of male gonads, testes and ovaries in females (Imam *et al.,* 2010).

Examination of Fish for Parasites

The fish was immobilized by cervical dislocation for easy handling prior to dissection on a dissecting board. Each fish was dissected through the abdomen by making a longitudinal slit on the ventral surface from the anus to the pectoral fins level with the aid of surgical blade. The gastrointestinal tract was isolated, stretched out and grouped into stomach and intestine. Each section was placed into separate Petri-dishes. The sections were slit longitudinal and washed in normal saline and parasites detected were fixed and preserved in 10% formalin (Salawu *et al.,* 2013).

Identification of parasites

Identification of parasites was carried out according to their distinctive body shape and morphological features using a stereomicroscope. Standard key for identification of fish parasites were used (Hoffman, 1998 and Pugachev *et al.,* 2010).

Data Analysis

The results obtained were presented in descriptive statistics, all data collected were analyzed using Statistical Package for Social Sciences (SPSS 19.0 software) to determine the association between the prevalence of the sex and weight. The Chi square test was used to establish statistical difference. Probability values of less than 0.05 (< 0.05) were considered as statistically significant.

RESULTS AND DISCUSSION

Of the total number of fishes screened from Kaduna River, 170 out of the 250 fish sampled from Kaduna River were infested with gastrointestinal parasites. The parasites identified include *Paracamallanus* species, *Camallanus* species, *Clinostomum* species, *Contracaecum* species and *Capillaria* species and *Diphyllobothrium latum*. Of the 100 fishes screened from selected domestic ponds, overall prevalence of gastrointestinal parasites in *Clarias gariepinus* grown in domestic ponds was 27.0%. The parasites identified include *Paracamallanus* species, *Camallanus* species and *Diphyllobothrium latum*.

A significantly higher ($p < 0.05$) prevalence of gastrointestinal parasites was recorded in fish from Kaduna River compared to those from selected domestic ponds. Of the species of fish sampled from Kaduna River, the highest prevalence with gastrointestinal parasites was recorded in *Labeo coubie* with a prevalence of 80.0% followed by *Barbus occidentalis* and *Labeo senegalensis* with prevalence values of 75.6% and 65.0%, respectively. Among *Oreochromis niloticus*, the prevalence of gastrointestinal parasites was 63.1% while the least prevalence of 60.0% was recorded in *Bagrus docmak* and *Clarias gariepinus* (Table 1).

The results showed that prevalence of gastrointestinal parasites was higher in male (68.3%) than female (67.7%) fishes that were sampled from either Kaduna River or selected domestic ponds. However, the difference was not significant ($p > 0.05$). The recorded prevalence of gastrointestinal parasites in male and female fish sampled from selected domestic ponds was 33.3% and 30.0%, respectively. Furthermore, the results indicated that the prevalence of gastrointestinal parasites among male fishes from Kaduna River was significantly higher ($p < 0.05$) than that recorded in male fishes sampled from selected domestic ponds. Similarly, significantly higher ($p < 0.05$) prevalence was recorded in female fishes sampled from Kaduna River than those from selected domestic ponds (Table 2).

There was significant association ($p < 0.05$) in the prevalence of gastrointestinal parasites and weight of fish sampled from Kaduna River with the highest prevalence of 78.3% recovered in fish weighing between 300-500g, followed by those weighing between 100-300g with a prevalence of 67.3%. In fish weighing 500-700g and those weighing 900-1100g, a prevalence of 66.7% was recorded each. Gastrointestinal parasites were not detected in fish weighing between 700g and 900g. Similarly, there was significant association ($p < 0.05$) between prevalence of gastrointestinal infection and body weight of fish species sampled from selected domestic ponds. The highest prevalence was 53.3% recorded among fish weighing between 300-500g while the least was recorded in fish weighing 900-1100g with prevalence of 14.3% respectively. In fish weighing 100-300g, the prevalence was 21.2% while in those weighing 500-700g and 700-900g the prevalence was 33.3% each (Table 3).

Table 1: Prevalence of gastrointestinal parasites in fish from Kaduna River and selected domestic ponds in Kaduna metropolis

Fish species	Location	Number examined	Number infected	Prevalence (%)
Clarias gariepinus	River	15	9	60.0
Bagrus docmak	River	40	24	60.0
Labeo coubie	River	45	36	80.0
Oreochromis niloticus	River	65	41	63.1
Barbus occidentalis	River	45	34	75.6
Labeo senegalensis	River	40	26	65.0
Subtotal		250	170	68.0
Clarias gariepinus	Pond A	50	16	32.0
	Pond B	50	11	22.0
Subtotal		100	27	27.0
Total		350	197	56.3

Table 2: Prevalence of gastrointestinal parasites in fish in relation to sex from Kaduna River and selected domestic ponds in Kaduna metropolis

Location	Sex	Number examined	Number infected	Prevalence (%)
River	Male	120	82	68.3
	Female	130	88	67.7
Pond A	Male	30	10	33.3
	Female	20	6	30.0
Pond B	Male	24	5	20.8
	Female	26	6	23.1
Total		350	197	56.3

Table 3: Prevalence of gastrointestinal parasites in fish in relation to weight from Kaduna River and selected domestic ponds in Kaduna metropolis

Weight (g)	Kaduna River			Pond A and B		
	Number examined	Number infected	Prevalence (%)	Number examined	Number infected	Prevalence (%)
100-300	220	148	67.3	66	14	21.2
300-500	3	18	78.3	15	8	53.3
500-700	3	2	66.7	9	3	33.3
700-900	1	0	0.0	3	1	33.3
900-1100	3	2	66.7	7	1	14.3
Total	250	170	68.0	100	27	27.0

Six species of gastrointestinal parasites of fish identified from Kaduna River include C*linostomum* species accounted for (20.3 %) of the parasites identified, 15.9% *Camallanus* species, 15.3% *Diphyllobothrium latum*, 17.3% *Contracaecum* species, 16.2% *Capillaria* species, and *Paracamallanus* species, 6.5%. *Capillaria* species, *Paracamallanus* species, and *Diphyllobothrium latum* were identified exclusively in the intestines of infected fish. *Contracaecum* species, *Clinostomum* species, and *Camallanus* species were found in both the stomach and intestines of infected fish: 20 of the infections due to *Contracaecum* species were stomach infestations, while 15 were intestinal; 26 of the *Clinostomum* species infestations were in the stomach while 19 were intestinal. In *Camallanus* species, the intestinal infestation (17) was higher than stomach infestation (12).

Similarly, three species of gastrointestinal parasites of fish were identified from selected domestic pond, *Paracamallanus* species accounted for 25.9%, 40.7% *Camallanus* species, and 33.3% *Diphyllobothrium latum*. *Paracamallanus* species, and *Diphyllobothrium latum* were identified exclusively in the intestines of infected fish and *Camallanus* species were found in both the stomach and intestines of infected fish: 7 of the *Camallanus* species were in the stomach while 4 were intestinal. The result showed that there was no significant difference ($p>0.05$) in the intensity of parasites from Kaduna River and selected domestic ponds (Table 4).

Nematodes accounted for the highest diversity gastrointestinal parasites in the fish examined, accounting for four of the six species of gastrointestinal parasites identified from Kaduna River and selected domestic ponds. They include *Capillaria* species, *Paracamallanus* species, *Contracaecum* species and *Camallanus* species. One species of Cestode and Trematode were identified, namely *Diphyllobothrium latum* and *Clinostomum* species respectively.

Table 4: Prevalence and intensity of gastrointestinal parasites in relation to the part of GIT from Kaduna River and selected domestic ponds in Kaduna metropolis

Parasites	Location	Number infected	Prevalence(%)	Region		Parasites recovered	Intensity
				Stomach	Intestine		
Capillaria species	River	32	18.8	0	40	40	1.3
Paracamallanus species	River	11	6.5	0	13	13	1.2
Diphyllobothrium latum	River	26	15.3	0	41	41	1.6
Contracaecum species	River	34	20.0	20	15	35	1.0
Clinostomum species	River	40	23.5	26	19	45	1.1
Camallanus species	River	27	15.9	12	17	29	1.1
Subtotal		170	100	58	145	203	1.2
D.latum	Pond	9	33.3	0	9	9	1.0
Paracamallanus species	Pond	7	25.9	0	7	7	1.0
Camallanus species	Pond	11	40.7	4	7	11	1.0
Subtotal		27	100	4	23	27	1.0
Total		197	100	62	168	230	1.2

The results further showed that there was no significant difference in the parasite load to the species of parasites identified. The highest parasitic load of 21.7% was Cestode *Diphyllobothrium latum* followed by the Trematode *Clinostomum* species (19.6%). *Camallanus* species and *Capillaria* species each accounted for 17.4% of the parasite load. The parasite loads due to *Contracaecum* species and *Paracamallanus* species were 15.2% and 8.7%, respectively (Table 5).

Two hundred and fifty (250) fish species, out of 350 fish species sampled from Kaduna River while 100 were from selected domestic ponds. The overall infection prevalence was 56.3% as 197 of the 350 fish were infected with gastrointestinal parasites. Infections were significantly higher ($p < 0.05$) in fish sourced from Kaduna River than in those sourced from selected domestic ponds: 68.0% of the fish species from Kaduna River were infected while 27.0% of the infections were detected in fish species from selected domestic ponds. Of the two domestic ponds sampled, infections were higher in fish sourced from Pond A than in those from Pond B with prevalence of 32.0% and 22.0% respectively (Figure 1).

Table 5: Prevalence and parasite load of gastrointestinal parasites in relation to parasite species from Kaduna River and selected domestic ponds in Kaduna metropolis

Location	Parasite species	Taxonomic group	Number of parasites	Parasite load (%)
River	Capillaria species	Nematode	40	19.7
	Paracamallanus species	Nematode	13	6.4
	Diphyllobothrium latum	Cestode	41	20.2
	Contracaecum species	Nematode	35	17.2
	Clinostomum species	Trematode	45	22.2
	Camallanus species	Nematode	29	14.3
Subtotal		203	100	
Pond	Diphyllobothrium latum	Cestode	9	33.3
	Paracamallanus species	Nematode	7	25.9
	Camallanus species	Nematode	11	40.7
Subtotal			27	100
Total			230	100

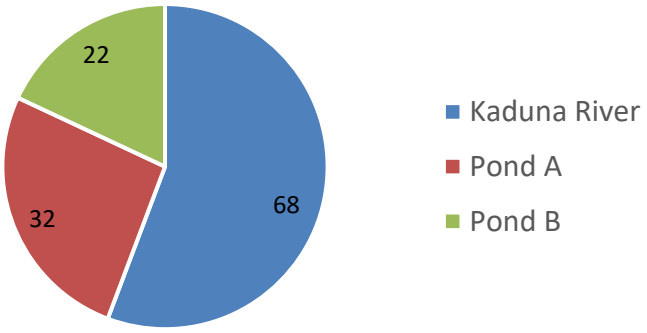

Figure 1: Comparative Analysis of Gastrointestinal Parasites in Fish from Kaduna River and Selected Domestic Ponds

Discussion

In this study, the higher prevalence of gastrointestinal parasites detected in fish sampled from Kaduna River than in the selected domestic ponds could be due to level of pollutants accumulation as a result of long distance travelled of river as well as the influx of pollutants from their several tributaries (Lae *et al.,* 2004; Kelly *et al.,* 2010). The prevalence was in consonance with earlier reported work of Yaro *et al.,* (2021) of freshwater fish species on *Clarias* species, *Tilapia zillii*, *Oreochromis niloticus*, *Synodontis schall* and *Megalops atlanticus* with 80%, 95.3%, 89.7%, 70.6% and 38.6% from Niger and Benue Rivers at Lokoja. Onyishi *et al.,* (2018) also reported 84.9 %, 61.8 % and 50.0 % on *Synodontis clarias, Labeo senegalensis and Distichodus engycephalus* from Ebonyi River, Eha-Amufu, Enugu State. This implies that the high infection rate in these fishes could be attributed to these factors such as its feeding habit, physical factors, hygienic of the water body, and presence of intermediate hosts contributes to their prevalence and intensity (Hussen *et al.,* 2012). The low prevalence of gastrointestinal parasites detected in fish species from domestic ponds could be attributed to the sanitary condition of the pond and proper way of handling the fish by the owners or rearers.

The male fishes recorded (from Kaduna River and selected domestic ponds) the highest prevalence than the female, the difference in the incidence of infestation between male and female fish might be due to differential feeding either by quantity or quality of food eaten or as a result of different degrees of resistance to infection (Emere, 2000). These findings are within the work of some authors; Absalom *et al.,* (2018) who documented 65.1% and 59.5% on sexes of *C. gariepinus* from River Gudi, Akwanga. Similarly, Kawe *et al.,* (2016) also reported 67.9% and 67.3% on sexes of *C. gariepinus* from FCT Abuja. However, Biu *et al.,* (2013) reported that variations in parasitic infection among the sexes of fish were by chance. Emere and Egbe, (2006) also reported that due to the physiological state of the female, most gravid females could have reduced resistance to infection by parasites.

The higher infection rate observed in smaller fish than the bigger ones could be by chance. The observation is in line with the prevalence of 75% and 62.5% in body weight 100-199 and 400-499 of *Auchinoglanis occidentalis* and *Heterotis niloticus* by Nwadike, (2018) from Anambra River. In terms of size, the findings of this study agreed with that of Uneke, (2015), who reported a higher prevalence rate in smaller fish sizes in terms of length and weight measurements. But Akinsanya, (2007) also reported that the low level of immunity in the smaller sized fish could explain the high prevalence but contradicted the reports of Ray, (2005); Olurin and Samorin, (2006) observed that the larger the fish, the greater the susceptibility to parasite infection as adult fish consumes a great variety of foods and exhibit a great variety of feeding styles.

The higher number of parasites harbored by the intestine compared with those in the stomach could be attributed that some of these intestines were dumped by the fishermen at the river side and such were washed off by surface run off water into the river and there is a likelihood that these fishes could just ingest this same parasite through those intestinal contents. These fish species are equally carnivorous in nature, once part of the fish is washed into the river, the fishes could eat those part together with all the intestinal contents including the parasites. This was in consonance with the works of Afolabi *et al.,* (2020) in their study who reported 128 and 140 parasites for intestine and stomach. According to Dankishiya and Oboh (2013) the preference of parasites for the intestines compared to the stomach might also be due to the presence of digested food present in the intestines and greater surface area of the intestines. However, Ajala and Fawole, (2014) argued that the presence of an acidic medium in the stomach might render the stomach unfavourable for these parasites. This agreed with the 1.11 intensity of infection reported by Anagha and Osimen, (2020) the life functions of a parasitic host are perturbed (due to factors such as longer duration of exposure and/ or high level of concentration of pollutants) such may lead to either mortality or reduction in the reproduction of the parasitic host. This resulted into rapid increase in the amount of host of other parasites due to relatively less competition.

The three taxonomic groups of the parasites identified in fish from Kaduna River and selected domestic ponds with no significant difference in the parasite load to the fish species of parasites identified from Kaduna and selected domestic ponds were similar to parasite species reported by Uneke and Jonah, (2017) in their study carried out from Ebonyi River. The authors encountered the presence of *Camallanus* species, *Capillaria* species and *Procamallanus* species. Also, Absalom *et al*., (2018) conducted a study on *Clarias gariepinus* from River Gudi, Nasarawa State, parasites recovered were *Camallanus*, *Diphyllobothrium latum* and *Capillaria.* In a study carried out on *Clarias gariepinus* from three fish farms in Uyo, Nigeria, the following parasite species were recovered *Paracamallanus* species, *Contraceacum* species and *Clinostomum* species (Usip *et al.,* 2014). The high nematode parasite in fish host from Kaduna River and selected domestic ponds indicated that the fish feed on algae and other debris in the water. Nematodes have relatively developed alimentary canal and could easily move around any area of the host alimentary canal to feed on digested and semi-digested food, whereas, cestodes lack alimentary system and are dependent on digested food of the host which is then absorbed through the body surfaces (Owolabi, 2008).

Omeji *et al.,* (2011) reported a prevalence of 37.08% of the total parasites encountered for fishes in the pond and 42.51% of fishes in the wild. The low prevalence recorded from selected domestic ponds may imply that there has been an improvement in management practices of domestic fish such as the reduction in overcrowding of fish ponds carried out by a fish farmer (Ayanda, 2009).

CONCLUSION

The study shows an overall prevalence (56.3%) of intestinal parasites detected from gastrointestinal tract of fish examined from Kaduna River and selected domestic ponds were significantly different. High prevalence (68.0%) of parasites were detected from fish sampled in Kaduna River compared to those sampled in selected domestic ponds. The parasites identified in fish sampled from Kaduna River were *Paracamallanus* species, *Camallanus* species, *Clinostomum* species, *Contracaecum* species and *Capillaria* species and *Diphyllobothrium latum* while *Paracamallanus* species, *Camallanus* species and *Diphyllobothrium latum* were identified from fish sampled from selected domestic ponds. The intensity and parasite load observed during the study showed no significant different ($P > 0.05$) from the Kaduna River and selected domestic ponds. It is recommended that fishermen should be enlightened on fish parasites in order for them to handle it properly.

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