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Prevalence of Parasites Infection of Resident Fish Species in a Tropical Reservoir

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Authors' contributions

This research work was jointly carried out by all the authors. Author JAO designed the study and wrote the first draft of the manuscript. Authors EOI and AAA managed the experiment and the analyses of the study. Author DOL executed the experiment and also carried out literature searches. The final manuscript was read by all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study detected, identified and determined the incidence of parasites present in and on *Clarias gariepinus*, *Sarotherodon galilaeus*, *Oreochromis niloticus* and *Tilapia zillii* in *Ero reservoir*, a tropical reservoir situated in Ikun-Ekiti, Nigeria. Fish species were randomly obtained from fishermen at the reservoir during the rainy season. Out of 55 fish samples examined, 17 (30.9%) fishes were invaded. 11(20.0%) were infected by Protozoans (Ciliates and Flagellates) and 6(10.9%) were infected by Metazoans (Myxosporean and Nematode). Parasitological examination of the 55 fish samples showed 41.2% incidence for *C. gariepinus*, 17.6% for *S. galilaeus*, 29.4% for *O. niloticus*, and 11.8% for *T. zillii*. A total of 59 parasites were recovered comprising 36 protozoans and 23 metazoans. Parasite infections were found on the skin, fins, gills, intestine, liver and kidney. Total number and percentage of parasites recovered were tabulated in relation to their host prevalence and location of specificity.

Keywords: Fish; parasites; identification; incidence; Ero-reservoir.

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1. INTRODUCTION

Fish, particularly fin-fish, is regarded as first-class protein providing 16% of the world population's protein requirements. It is an excellent and relatively cheap source of highly rich protein, and also contains lipids, vitamins, phosphorus and other essential elements that are important in body building, tissue repairs and maintenance of a healthy body [1]. Fish as a food is consumed by human and many species of animals. The word fish refers to both the animal and to the food prepared from it. Fish serve as a good source of animal protein for man and his livestock [2]. According to [3], more than half of the world's population depends on fish as a principal source of animal protein and represents nearly 50% of the animal protein intake of many on the continent of Africa. In Nigeria, fish accounts for about 40% of the total animal protein intake [1]. Although fish are a valuable source of food, their consumption may contribute to food poisoning and infections as they contain pathogenic bacteria and/or their toxins, parasites and chemical residues [4]. Parasites of fish are a concern since they often produce a weakening of the host's immune system thereby increasing their susceptibility to secondary infections by disease causing agents (such as bacteria, fungi and viruses), resulting in the nutritive devaluation of fish and subsequent economic losses [5].

One of the major factors hindering high productivity in fish farming is parasites and diseases infection [6]. Parasite infection on fish is often internal or external which can reduce fish productivity by affecting the normal physiology of fish [7] and can result in mass mortalities of fish, or in some cases infection of man and other invertebrates that consume them [8-10]. In cultured fishes, parasite infection often causes serious outbreak of disease. It is very common in swamps, lakes and rivers throughout Africa. Moreover, environmental circumstances (such as poor water quality, fluctuations in temperature, poor nutrition, overcrowding, poor handling and transportation) which are common in intensive fish farming poses stressful conditions to the fish making the fish more susceptible to a wide variety of pathogens.

With the increasing interests in aquaculture, parasitic infection is becoming threats to fish health management. It is essential therefore, that proper attention is given by scientists to this area for sustainable aquaculture production [11]. The study of fish parasites with a view to eliminating the disease they cause and prevent their transmission to man and other animals is of great importance. Information on occurrence, prevalence and pathogenicity of fish parasites and diseases is essential in aquaculture. Such information enables aqua-culturists to apply correct control measures for fish diseases which reduce production, increase production cost and the period of fish growth, thereby increasing the profit margins [12].

The main objective of this study is to investigate the prevalence of parasites infection in and on *Clarias gariepinus*, *Oreochromis niloticus*, *Sarotherodon galilaeus* and *Tilapia zillii* being the dominant species resident in Ero reservoir, Ikun-Ekiti, Nigeria in order to understand their adaptation for culture purpose as a result of their economic importance in the area.

2. MATERIALS AND METHODS

2.1 Study Area

This study was carried out in Ero reservoir which is located at Ikun-Ekiti in Moba Local Government of Ekiti State, Nigeria. The reservoir covers 4.5 kilometer square. The total fish sample count may be arguably small, but this was because obtaining fish was highly dependent on their availability in the study area, this is influenced by the construction of a new bridge by the government which disallowed the release of water from the reservoir to the downstream many times during the sampling period. This in turn decreased fishing efforts. Overall, it is believed that the present total sample count is adequate enough for an initial assessment of parasites invasion in the available fish species in Ero- reservoir.

2.2 Collection and Identification of Samples

Live fishes which were randomly caught by fishermen through the use of gill nets, cast nets, traps, hooks and lines were bought, kept in plastic containers and immediately transported to the laboratory in the Department of Zoology and Environmental Biology, Ekiti State University for identification and examination. A total of 55 fish samples which included *Clarias gariepinus*, *Oreochromis niloticus*, *Sarotherodon galilaeus* and *Tilapia zillii* were examined for parasites infection. Parasites were identified based on their observed morphology by [13]. After identification, parasites were counted and recorded per fish hosts. Locations on the host were noted on the data sheet.

3. RESULTS AND DISCUSSION

Out of 55 fish samples examined, 17 (30.9%) fishes were infected out of which 11(20.0%) were invaded by Protozoans (3 Ciliates and 3 Flagellates) and 6(10.9%) were infected by Metazoans (1 Myxosporean and 1 Nematode). Parasitological examination of the 55 fish samples as outlined in Table 1, showed 12.74% incidence for *C. gariepinus*, 5.46% for *S. galilaeus*, 9.10% for *O. niloticus* and 3.64% for *T. zillii.* A total of 59 parasites were recovered comprising 36 protozoans and 23 metazoans. Parasites invasion were found on the skin, fins and gills and also in intestine, liver and kidney. Prevalence of parasites recorded per host species in relation to the total sample population is shown in Table 2. The Protozoan parasites recorded from the fish samples include 3 Ciliates (*Chilodonella* spp., *Trichodina* sp. and *Ichthyophthirius multifiliis*) and 3 Flagellates (*Ichthyobodo* sp., *Cryptobia* sp. and *Hexamita* sp.).

Table 1. Parasites' prevalence in host species

Host species fish	No. of fish examined	No of fish infected
C. gariepinus	15	7(12.74)
S. galilaeus	10	3(5.46)
O. niloticus	20	5(9.10)
T. zillii	10	2(3.64)
Total	55	17(30.94)

Table 3 shows the overall prevalence of parasites per location. The protozoans recovered were 38.9% on the skin followed by intestine with 36.1% while fins, gills and liver had 11.1%, 8.3% and 5.6% respectively. No protozoan was recovered from the kidney. Metazoans were mostly found in the intestine with 60.9% rate followed by the gills with 30.4% while liver and kidney had 4.3% each.

Result obtained from this study shows a low infection rate of 30.94% in all fish genera examined, with all recorded parasites being ecto- and endo-parasitic protozoans (ciliates and flagellates) and metazoans (myxosporean and nematode). The four species of fish infected were *Clarias gariepinus*, *Sarotherodon galilaeus*, *Oreochromis niloticus* and *Tilapia zillii*. It was observed that *Oreochromis niloticus* was more susceptible to protozoans whereas *Sarotherodon galilaeus* was more susceptible to metazoans. The low infection rate in these fishes could be attributed to the location of the river from residential areas, number and class of people visiting the river and their purposes. Number of protozoans parasites isolated was higher than metazoans parasites. The ecto-parasitic ciliates recorded were of the genera: *Trichodina*, *Chilodonella* and *Ichthyophthirius* species and the flagellates recorded were *Ichthyobodo*, *cryptobia* and *Hexamita* species. The myxosporean recovered was *Myxobolus* species and the nematode recovered was *Ascaris* species. On the examined fish species: *Trichodina and Ichthyophthirius multifiliis* (white-spot) were found on skin and gills, *Chilodonella* spp. was found exclusively on the skin, *Ichthyobodo* was found only on the fins and skin of *Clarias gariepinus* indicating that they are all ecto-parasites of fish. Moreover, in the samples examined *Cryptobia* species was located in the intestines and liver, *Hexamita* and *Ascaris* were exclusively located in intestines. These indicate that they are all endo-parasites of fish. While *Myxobolus* was able to parasitize the gills, kidney, intestine and liver of the host samples; which means *Myxobolus* function both as ecto-parasites and endo-parasites of fish. *Myxobolus* sp. spores were often found encysted in white cysts in gills and sometimes they were sparse in intestine, kidney and liver.

In addition, different kinds of protozoan parasites were observed in different locations in *C. gariepinus*, *S. galilaeus*, *O. niloticus*, and *T. zillii*. *I. multifiliis* occurred on the gills and skin where infections of the fishes were observed, *Trichodina* sp. and *Ichthyobodo* sp. were found on the skin and fin, *Chilodonella* sp. were found on the skin, while *Cryptobia* sp. was found in the intestine and liver. Emere and Egbe 2006 had reported the infection of skin, fin and gills of fish by these protozoan parasites.

Furthermore, a higher number of parasites were found in the intestines than other organs which could be associated with the fact that most digestive activities take place in the intestine resulting in the release of parasite ova/cysts in food particles. Multiple infections were common due to the fact that the environment supports several parasites species thereby exposing the host to simultaneous infection with many of them. Host specificity of nematodes agrees with the findings of [14]. The presence of one parasite and its activity within the host weakens the resistance which makes concurrent infection feasible. Parasite infection affects palatability, productivity, market and aesthetic value of fish, it is necessary to eliminate all condition that favours parasitic infection.

Table 2. Prevalence of each protozoan and metazoan species in host species

Host species	Protozoan parasites				Metazoan parasites			
	Class	**No**	**%**	**Location**	**Class**	**No**	**%**	**Location**
C. gariepinus	**Ciliates:**				**Myxosporea:**			
	Chilodonella spp.	2	15.4	Skin, gills	*Myxobolus* spp.	3	42.9	Kidney
				Skin, fins				
	Trichodina spp.	3	23.1		**Nematode:**			
				Skin, gills	*Ascaris* sp.	4	57.1	Intestine
	Ichthyophthirius multifiliis	5	38.5					
				Skin, fin				
	Flagellates:							
	Ichthyobodo spp.	2	15.4	Intestine				
	Cryptobia spp.	1	7.7					
	Total	13	100		Total	7	100	
S. galilaeus	**Ciliates:** Not found				**Myxosporea:** *Myxobolus* spp.	3	37.5	Gills
	Flagellates:							
	Cryptobia spp.	2	66.7	Intestine	**Nematode:** *Ascaris* sp.			
	Hexamita spp.	1	33.3	Intestine		5	62.5	Intestine
	Total	3	100		Total	8	100	
O. niloticus	**Ciliates:**				**Myxosporea:**			
	Chilodonella spp.	3	18.8	Skin	*myxobolus* spp.	2	40.0	liver, Intestine
	Trichodina spp.	4	25.0	Skin,gills	**Nematode:**			
	Ichthyophthirius multifiliis	2	12.5	Skin,gills	*Ascaris* sp.	3	60.0	Intestine
	Flagellates:							
	Cryptobia spp.	5	31.3	Intestine, Liver				
	Hexamita sp.	2	12.5	Intestine				
	Total	16	100					
					Total	5	100	
T. zillii	**Ciliates:** Not found				**Myxosporea:**			
					Myxobolus sp.	2	66.7	Gill
	Flagellates:							
	Cryptobia sp.	3	75.0	Intestine				
	Hexamita sp.	1	25.0	Intestine	**Nematode:**			
					Ascaris sp.	1	33.3	Intestine
	Total	4	100		Total	3	100	

Table 3. Overall prevalence of parasites per location

Location	Total parasites per location		Protozoans per location		Metazoans per location	
	No.	%	No.	%	No.	%
Skin	14	23.7	14	38.9	0	0
Fins	4	6.8	4	11.1	0	0
Gills	10	16.9	3	8.3	7	30.4
Intestine	27	45.8	13	36.1	14	60.9
Liver	3	5.1	2	5.6	1	4.3
Kidney	1	1.7	0	0	1	4.3
Total	59	100	36	100	23	100

Ichthyophthirius multifiliis is one of the biggest parasites responsible for significant economic losses in fish farms worldwide [15]. [16] states that ecto-parasites such as *Trichodina* and *I. multifiliis* (white-spot) can be causative to skin or gills irritation. These findings associating ecto-parasites with the organs, skin and gills supports the findings in this study. *Ichthyobodo* spp. is a true ecto-parasite presenting a free-swimming stage alternating with an attached trophic stage. They are pathogenic to fish, having been implicated in causing fish kidney disease. They possess three pairs of flagellum and a pair of eye spots. The genus *Cryptobia* has a direct life cycle and fish-to-fish transmission is favored by conditions such as low water exchange, high organic load and high biomass density. The attack of the parasite through the flagella in general does not induce any cellular damage or pathological alterations.

Changes in the environment, both by anthropogenic and natural factors, may affect the variability of parasite burden by possibly promoting or hindering certain stages in the life cycle of each parasite species. Environmental changes have been documented to affect parasitism, regardless of whether the fish species are caged or in the wild, because they are both always exposed to intrinsic factors such as rainfall coupled with wind patterns and have the tendency to mix the water column, thereby increasing the possibility of ingesting preys that are intermediate hosts [17]. Limnological characteristics such as differences in water temperature [18,19] may potentially affect host susceptibility and parasite growth; because it may trigger the increased activities of the free-living larval stages of certain parasite species. The essence of constant surveillance of food-borne parasites and their epidemiological distribution can never be over emphasized in developing countries such as Nigeria because literacy level, awareness of basic hygiene and methods of limiting the spread of these food-borne parasites are low. The results of this study showed that fresh-water (such as reservoir) fishes are still suffering from infections from different species of parasites, which are documented in this paper. Effects of these parasites on the economically important fishes could lead to a huge economic loss. So the parasitic diseases of freshwater fishes deserve further investigations. Wild fish that are sometimes stocked or which may stray into rearing ponds could bring about incidence of transferred infection, fish mortalities and consequent loss of production. It will also attract public health concern when infected fish are improperly prepared for consumption.

4. CONCLUSION

Although low incidence of fish parasites was recorded in the reservoir, fish from this location should be properly cooked to avoid ingestion of parasites by fish consumers. Finally, with the increasing interest of people in aquaculture, it is essential to have facilities and services for diagnosis, treatment and control of fish parasites and diseases on ground. A total and comprehensive knowledge of the biology of host-parasite relationship within the culture system is therefore imperative. Fish parasitism can be reduced or controlled by avoiding overcrowding, eliminating intermediate/definitive host of the parasites through occasional surveillance and treatment.

5. RECOMMENDATIONS

It is recommended that this study be continued and widened for greater number of fish species as are found in many Nigeria diets. For the control of parasites in fish reservoir and culture system, the following recommendations are made:

- Early detection of signs of parasitic problems by constant surveillance and observation of the behavior in rivers and reservoirs.

- Removal of weeds and various types of vegetation to ensure that parasites such as snails and leeches (intermediate host) of some parasites are kept under control.
- Training of competent scientists to manage all commercial fish farms and reservoirs.
- Properly handle and cook fish before consuming it. Avoid eating raw or partially cooked fish, so as to reduce the risk of food borne illness and pathogens.
- Purchase fish from reputable sources and handle it properly to reduce potential health risk.
- Reduce pollution from urban area runoff, sewage outflows, agricultural pesticides and many other sources to avoid creating harmful conditions in aquatic environment. One important step in achieving such reductions is public education and aquatic-related educational campaigns, frequently focused on the impacts of pollution on fishes.
- People must also become more aware that food supplies and recreational areas are downstream. Education campaigns should also inform people of the potential risks from fish invaded with parasites.
- Better communication among the fisheries industry and state officials, recreational fishermen and consumers will also improve the effectiveness of fish safety programs and help prevent outbreaks of fish-related illnesses.
- States, territories, and tribes have a role in protecting their residents from the health risks associated with invaded fish caught outside the commercial industry by issuing Fish Consumption Advisories.
- Proactive control of parasites through reductions in point and nonpoint source water pollution and control of invasive species is needed to ensure a safe food supply.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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