PARASITIC AND BACTERIAL LOAD ASSOCIATED WITH *OREOCHROMIS NILOTICUS* HARVESTED FROM OYAN DAM UNDER OPEN WATER AND CAGE CULTURE SYSTEMS OF FISH MANAGEMENT

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ABSTRACT
Parasites co-habit with water organisms and infect host tissues to derive nutrients from them while an excessive load of bacteria can serve as an indicator of stress, contamination, low health status and an inadequate growth rate. This study, therefore, identified the bacteria and parasites associated with O. niloticus raised under extensive (open water ecosystem) and semi-intensive (cage-culture) systems of management. Six bacteria (Bacteria Spp, Klebsiella pneumoniae, Citrobacter freundii, Flavobacterium columnar, Pseudomonas aurenginosa, Staphylococcus aureus) were isolated in the samples of fish but no detection of S. aureus in the samples from cage cultured fish. Two nematodes (Ascaris and Trichuris) and Moniliformis dubius (Phyllum Acanthocephala) were identified. Management of water bodies should be more pro-active and proper cooking of fish with inclusion of pepper should be encouraged.

INTRODUCTION
The dominance of the family Claridae (mainly Clarias gariepinus), Cichlidae (mainly Tilapia Spp and *Oreochromis niloticus*) and Bagridae (*Chrysichthys nigrodigitatus)* in Oyan Lake has been reported by Ikenweiwe (2005). Hence, justified the secondary use as reservoir of fish which supplies Abeokuta plus Ibarapa-Central communities. Freshwater fishes available in this lake therefore become nutritional and economic valuables; apart from its recreational importance (Obisesan *et al*., 2020). Oyan Dam is owned and operated by the Ogun-Osun River Basin Development Authority (O-ORBDA). It is located on latitude 7^0 15 W and longitude 3^o 16 E at an elevation of 43.3m above sea level on the confluence of Oyan and Ofiki rivers. Its catchment areas is about 9,000 km, and covers 4000 hectares. The primary focus include water supply, provision of irrigational water and hydro-electricity.

The freshwater ecosystem (rivers, lakes, and streams) harbours a complex flora of microbes which can be attributed to the co-existence of aquatic fish with other components (living or non-living) that are introduced from land, animals, and plant sources (Obisesan *et al*., 2020). An occurrence of infectious and non-infectious biota is therefore employed in understanding status of fish health through parasitic and bacterial profile in samples. For example, parasites are microscopic organisms that infect other organisms, such as fish, and derive nutrients from them for survival. They have the ability to attack virtually every part of the organisms present in the water bodies through direct and indirect interactions. Hence, leading to a reduced body fitness or market value and financial loss to the managers and producers (Edema, 2014). Precisely, non-infectious diseases are recognized to be hereditary, nutritional or as a result of poor management. Consequently, the danger poised on the final consumer can be ascertained to inform policy makers in decision making towards public health and food safety .

Oreochromis niloticus is a deep-bodied fish with cycloid scale. Silver in colour with olive or grey or black body bars. *Oreochromis niloticus* often flashes red during the breeding season (Picker and Griffles, 2011). It can grow to a maximum length of 62 cm and body weight of 3.6 kg; at an estimated age of 9 years (FAO, 2012). It is a tropical freshwater and estuarine species which prefers shallow still waters on the edge of lakes and wide rivers with sufficient vegetation (FAO, 2012). *Oreochromis niloticus* are known to feed on phytoplankton, aquatic plants, invertebrates, benthic fauna, detritus, and bacterial films (Idodo-Umeh, 2003 ; FAO, 2012).

MATERIALS AND METHODS

A total of 260 fresh fish (*Oreochromis niloticus*) were purchased on harvesting days (Mondays and Thursdays) , over a period of eight (8) weeks, from Oyan Dam; using two deliveries (local fishermen and foreign investors in cage culture systems). Fish were later transported through an ice chamber to the Central Laboratory of the Oyo State College of Agriculture for analysis. The body weights were measured using an electronic weighing balance before a random selection and dissection to isolate the gastro-intestinal track, liver, and gill, apart from the skin samples. Tools used include surgical blades, knives and scissors from the dissecting set coupled with hand-gloves for protection against contaminants.

Parasitofauna were examined in the gastro-intestinal track by stripping content into petri-dish. A fraction of this shipped content was later introduced into a slide while the other fraction was put inside test tube and mixed with saline water. Mixture was shaken to achieve homogenization before placing a slide cover on the tube for contact and slide preparation followed by viewing under the light microscope (Sikoki*, et al.*, 2013). Standard procedures for the examination of the liver, gill, and skin samples as described by Zdenek (1977). Similarly, forty cultured and forty wild *O. niloticus* were investigated using random selection for bacterial load. Tissues from the gills, skin and intestine were removed by means of sterile scalpel and a pair of scissors and kept in sterile petri dishes. Four (4) gramme of each section was homogenized to get a uniform distribution of cell in the stock culture. The excised tissues were placed in Nutrients Broths (NB) followed by incubation at 37^0 C for 24 hours using a sterile Mac Conkey Agar. The identification of bacteria colonies and cells by physical characterization and staining were subsequently carried out; involving cell micro morphology, biochemical test of gram-reaction, catalase test and oxidase test for proper identification (Chessbrough, 2000; Cowan and Steel, 1999).

Results

Table 1 shows the variations in body weight of fish and group-prevalence. Thus, the interval of 601 – 800g, 401-600g, 201- 400g, 801 -1000g and 0-222g recorded a parasitic prevalence of 88.24, 73.58, 33.76,31.25 and 0.00%, respectively. However, a general prevalence of 55.56% was recorded as an indicator for infection in the sampled population of Oreochromis niloticus. Also, the descending order of occurrence of parasite in the four (4) organs investigated is expressed in this table as intestine (37.0%), stomach (31.0), Gill (19.0%), and liver (13.0%).

Table 1: Distribution and prevalence of endo-parasites in specific body size and organ of *Oreochromis niloticus* from Oyan Dam

Body weight of Fish (g)	Number examined	Gill		Liver		Stomach		Intestine		Total samples infected	Prevalence per group (%)
		C	W	C	W	C	W	C	W		
0 - 200	0	0	0	0	0	0	0	0	0	0	0.00
201- 400	77 (42.7%)	2	6	0	2	3	3	5	5	26	33.76
401- 600	53 (29.4%)	4	5	0	5	5	7	6	7	39	73.58
601 - 800	34 (18.89%)	0	2	1	5	5	7	4	6	30	88.24
801- 1000	16 (8.89%)	0	0	0	0	1	0	4	0	5	31.25
Total	180	6	13	1	12	14	17	19	18	100	
CI/ Organ		19		13		31		37			

The distribution of the specific parasite is represented in Table 2. Prevalence of parasites per group of body weight (size) in a descending order showed 601-800g, 401-600g, 801-1000g, 201-400g, and 0-200g to exhibit prevalent value of 85.3%, 73.6%, 31.3%, 27.3% and 0.0%, respectively. Sampled population with parasitic infection decreased from 100 (in Table 1) to 94 in Table2 due to human error during investigation.

A varied number of bacterial organisms were isolated and observed in O. niloticus from Oyan Dam in current study. Precisely, *Klebsiella pneumonae*, *Flavobacterium columnae*, *Citrobacter freundii*, *Pseudomonas aurenginosa* and Bacillus Spp with a corresponding cumulative prevalence of 139.5%, 63.0%, 46.0%, 33.0%, 13.5% and 8.5%, respectively.

Table 2: Identified parasites in the samples of *Oreochromis niloticus* during investigation in the laboratory

Body weight of Fish (g)	Number Examined	Cage culture system				Wild culture system					Prevalence Per group (%)
		Tr	Ce	Ac	Ne	Tr	Ce	Ac	Ne	Ti	
0 - 200	0	-	-	-	-	-	-	0	0	0	0
201 -400	77	-	-	-	7 (9.1%)	-	-	0	14	21	27.3
401 - 600	53	-	-	-	16 (30.2%)	-	-	08	15	39.0	73.6
601 - 800	34	-	-	-	12 (35.3%)	-	-	06	11	29	85.3
801-1000	16	-	-	-	05 (31.3%)	-	-	0	0	05	31.3
Total	180	-	-	-	40			14	40	94	

Keys:
TR : Trematodes.
CE: Cestoda. Ac: Acanthocephala.
Ne : Nematodes. Ti: Total infected samples.

Table3: Prevalence of bacteria organisms in *Oreochromis niloticus* under two (2) systems of management (cage culture and open water)

Organism from tissues		Prevalence in the specific organ investigated						
S/N		Gill		Skin		Intestine		Cum prevalence
		Culture	Wild	Culture	Wild	Culture	Wild	
1	*Bacillus Spp*	1.0	1.5	1.0	1.0	1.0	3.0	8.5
2	*Flavobacterium columnar*	2.0	6.0	5.0	8.0	10.0	15.0	46.0
3	*Klebsiella pneumoniae*	16.0	30.0	10.0	20.0	28.5	35.0	139.5
4	*Pseudomonas aurenginosa*	2.0	4.0	2.0	3.0	1.0	1.5	13.5
5	*Citrobacter freundii*	3.8	6.5	1.0	3.0	7.0	12.5	33.0
6	*Staphylococcus aureus*	0.0	12.0	0.0	10.0	0.0	15.0	63.0

Key (s): Cum: Cumulative. S/N: Serial Number.

DISCUSSION:

Parasitic infestation was highest in the intestine in the current study. This was followed by that in the stomach (31.0%), gill (19.0%) and liver (13.0%). However, population of fish with average weights (601-800g) and 401g – 800g) recorded the highest prevalence of 88.24% and 73.6%. Consequently, a general trend of increasing parasitic invasion of the organs as the size or age of fish increases; except at a terminal body size of 801-1000g. Sidney *et al*. (2014), similarly reported highest prevalence of 40.0% in the intestine of *Chrysichthys nigrodigitatus* sampled from Calabar River, Nigeria. However, this body weight distribution, among the sampled population of *O. niloticus* revealed a rapid drop in the size of fish from Oyan Dam because the smaller sizes (201-400g and 401-600g) recorded highest fractions (42.8% and 29.4%) of the randomly sampled population. This calls for a restrictive management technique, such as close seasons and close areas of water. Secondly, the phylum Nematode and Acanthocephala were identified during investigative procedures in the laboratory. The chief microbes were the Nematodes (42.6%) compared to their counterparts from Phyllum Acanthocephala (14.9%). Precisely, the Phyllum Nematodes captured Ascaris (Strongyloids) and Trichuris while the Acanthocephala revealed *Moniliformis dubius.* The infection of the intestine has been widely reported in beetles, rats, cats, dogs, cockroaches and human (especially children) and are associated with poor hygiene, dirty environment, and poor handling of foods (Wikipedia, 2024). Similarly, in the Northern Nigeria, gastrointestinal helminth worms have been reported in *Clarias*

gariepinus (Oniye *et al*., 2004). This report revealed Cestodes, Polyonchobothrium, Nematodes and Acanthocephala in *Clarias gariepinus*. Also, Aliyu and Solomon (2012) reported Nematode as the commonest infection of *Clarias gariepinus* at Usman Dam in Abuja., Nigeria. Additionally, Akinsanya and Otunbanjo (2005) similarly reported higher prevalence of helminth parasites in *Clarias gariepinus* at smaller size than bigger ones from Lekki Lagoon in Lagos.

The isolates of bacteria observed in the wild and culture fish from Oyan Dam include *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Flavobacterium columnaris*, *Citrobacter freundii, Pseudomonas aurenginosa* and Bacillus Spp in the current study. The dominance of *K. pneumonia*, *S. aureus* and *F. columnaris* has been expressed through the cumulative prevalence of 139.5%, 63.0% and 46.0%, respectively. Also, the poor existence or interaction of *C. freundii*, *P. aurenginosa* and Bacillus Spp was also observed as indicated through a corresponding cumulative prevalence of 33.0%, 13.5% and 8.5% in the current study. Similarly, the dominance of *S. aureus* (26,3%), *E. coli* (15.0%) and *Vibrio vulnificus* (42.4%) in three (3) fish farms within Ibarapa Central of Oyo State has been reported by Obisesan *et al*. (2020) and is in close proximity to the current study area. Other isolated microbes were in low degrees of occurrence; *K. pneumonia* (9.2%), Aeromonas Spp (9.2%), *C. freundii* (7.5%), *Pseudomonas aurenginosa* (2.5%), and *Streptococcus pyrogenes* (8.8%). However, sampled fish from the open water environment exhibited higher prevalence in bacterial load across the three organs investigated in the current study. Although, *S. aureus* was never observed in fish raised under the cage culture system practiced by the foreign investors at Oyan Dam. This implies that contamination of fish at the ecological site was increased by poor handling through the local fishermen and collectors at landing sites due to ignorance. Furthermore, comparing the load of bacteria in each organ, higher prevalence was recorded in the gill and intestine compared to the skin of *O. niloticus* . This could be partly explained in terms of a better accumulation or additive effect in the gill and intestine while strong variability expressed by the skin could be a result of washing-off of bacteria by flowing water.

The isolated bacteria were significantly gram negative with exception of Bacillus Spp and *Staphylococcus aureus* in the current study. These bacteria are pathogenic and have the ability to live in different ecological niches because of adaptation to different lifestyles (Qin *et al*., 2022: CaO *et al*., 2022). Pathogenic abilities of these bacteria apart from food spoilage or poisoning include localized and systemic infections (Bacillus Spp e.g. *B. cereus* and *B. anthracis*), attack of the mucosal surfaces of animals and gastro intestinal tract (*K. pneumonia*), infections of the respiratory and urinary systems (*C. freundii*), Staphylococcal food borne diseases (*S. aureus*) while severe infection, cystic fibriosis, burn wounds, immunodeficiency, cancer, and chronic obstructive pulmonary disorder are caused by *P. aurenginosa* (Heaton *et al*., 2020; Qin *et al*., 2020). Therefore, the importance of their presence in fish, animals and final consumers are varied, density-dependent, and combinational factor poise a threat to public health. Additionally, most bacteria are now developing resistance to popular antibiotics such as oxacillin, methicillin, penicillin, ampicillin, and so on (Smith *et al*., 2010; Heaton *et al*., 2020).

CONCLUSION

Excessive density of bacteria and parasites should be avoided in public waters to minimize concerns and infection of the final consumers of fish. This is achievable through the practice of bio-security, instead of treatment after full invasion of concern water bodies. Awareness concerning the significance and habits of these bacteria and parasites should be given to the public through media houses, workshops and seminars through appropriate ministries; such as Ministry of environment, Ministry of education, Ministry of health, and Ministry of water resources. Also, constant monitoring of activities of farmers plus other anthropogenic actions around water bodies should be enforced. Water managers should promptly and regularly discharge water to reduce microbial build up while fish handlers should be trained in the techniques of proper hygiene.

Pictorial representation (photomicrographs) of captured helminths in the specific organs *Of Oreochromis niloticus*.

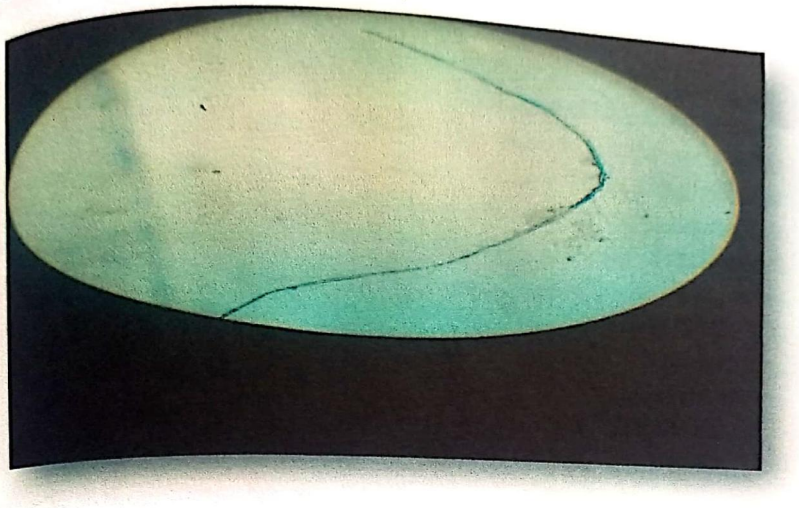

Plate1: Gill of *Oreochromis niloticus* source from the wild water of Oyan Dam capturing: *Monillformis dubius* (ACANTHOCEPHALLA) (M×10)

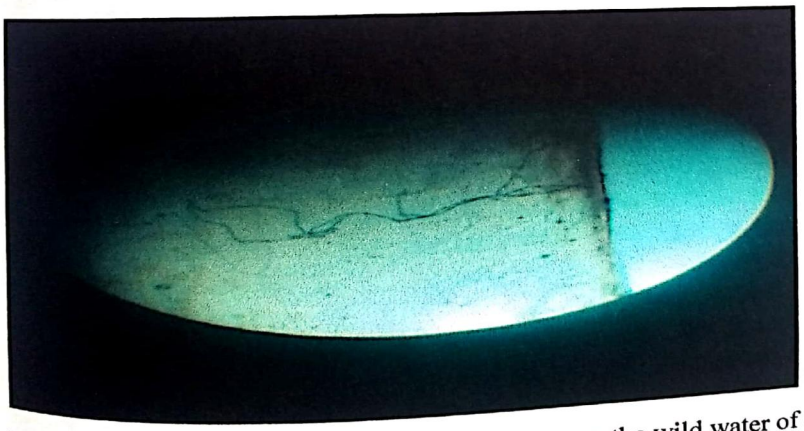

Plate2: Gill of *Oreochromis niloticus* source from the wild water of Oyan Dam capturing: *Filaria worm* (NEMATODE) (M×10)

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