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Monogenean parasites of the African catfish *Clarias gariepinus* from two fish farms in Calabar, Cross River State, Nigeria

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ABSTRACT

Objective: To determine the prevalence, mean intensity, and abundance of monogenean parasites in *Clarias gariepinus* (*C. gariepinus*) from two selected fish farms in Calabar, Cross River State, Nigeria.
Methods: Eighty specimens of *C. gariepinus* from the two farms (40 each) were necropsied for parasitological analysis. Skin, gill and fin biopsies were prepared from each specimen following standard methods for microscopic analysis. Parasitological indices including dominance (D), prevalence, mean intensity and abundance were calculated according to standard formulae. Data were analyzed using the Fisher's exact test.
Results: *C. gariepinus* from the two farms were infested with a total of ninety individuals of monogenean parasites belonging to three species including *Macrogyrodactylus clarii* (*M. clarii*), *Gyrodactylus* sp. and *Dactylogyrus* sp. D index showed that the three monogenean species were eudominant (*D*-value > 10%). *Gyrodactylus* sp. was more abundant (46) followed by *Dactylogyrus* sp. (23) while *M. clarii* was the lowest (21). Prevalence, meaning intensity and abundance of monogenean parasites in the two farms, varied insignificantly higher ($P > 0.05$). Prevalence in both farms were higher in female *C. gariepinus* than that in male. Monogenean parasites exhibited organ specificity as *M. clarii* and *Dactylogyrus* sp. were recovered from the gills while *Gyrodactylus* sp. colonized the skin and fin.
Conclusions: High abundance of these parasites may lead to poor growth performance and high mortality in *C. gariepinus*, leading to huge monetary loss and low profit margin by increasing production cost due to the cost of treatments.

1. Introduction

Monogenea is a parasite of marine and freshwater fishes that was first collected and described by Muller in 1776 from the skin of the halibut, *Hippoglossus hippoglossus*[1]. They also parasitize frogs and other aquatic animals throughout freshwater and marine habitats[2]. However, Muller considered the parasite as a leech and named it *Hirudo hippoglossi* not until 1858 when Van Beneden proved its status as a monogenean, publishing a detailed and accurate description of the parasite[1]. Monogeneans are a kind of flatworms that belong to the phylum Platyhelminthes. They are composed of two major groups, the monopisthocotyleans and the polyopisthocotyleans[2]. Three members of the monogenean family including Gyrodactylidae, Dactylogyridae and Ancyrocephalidae are the most reported parasites found in cultured and wild fish[2,3]. Monogenea, are known to exhibit both host and organ specificity as some species prefer to colonize the skin and fins while some are mostly restricted to gills of marine and freshwater fishes. The life cycle of monogeneans involves only one host and they spread by releasing eggs and free-swimming infective larvae[2]. All monogeneans are oviparous (egg layers) except gyrodactylids which are viviparous (live bearers) in nature[4]. According to Jalali and Barzegar and Tasawar *et al.*[5,6], the adult stage of parasite is more dangerous to fish health depending on factors such as modes of attachment, the size and weight of host. Attachment of ectoparasites

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such as monogeneans to gill and skin of fishes causes localized hyperplasia, disturbance of osmoregulation and mortality of the host[7,8]. This can also result in providing a pathway for secondary pathogens such as viruses, bacteria and fungi to invade the host[9].

The African catfish [*Clarias gariepinus* (*C. gariepinus*)] which belongs to the family Clariidae is the most cultivated fish species in Nigeria[10]. The dominance of this species in Nigerian aquaculture, compared to other species such as the Nile tilapia (*Oreochromis niloticus*), common carp (*Cyprinus carpio*), is attributed to several characteristics exhibited by this species. Such attributes include its ability to tolerate a varying range of environmental conditions, high stocking densities under culture conditions, fast growth rate, disease resistance, acceptability of artificial feed, high fecundity, nice taste, excellent meat quality, ease of artificial breeding, high market value, *etc*[10].

In Nigeria, infection problems caused by parasites are quite frequent in fish farms and can lead to poor growth performance, high mortalities and monetary losses. The profitability is reduced because the production cost is increased due to the treatment expenses. This indicates the significance of epidemiological studies in Nigerian fish farms so that proper management strategies should be adopted. In Cross River State, there have been numerous studies on fish parasites, especially parasites of landed fishes from the wild[11-14]. However, there is no report on the occurrence of monogenean parasites in farmed *C. gariepinus*. Therefore, the objective of this study is to determine the prevalence, mean intensity, and abundance of monogenean parasites in *C. gariepinus* from two selected fish farms in Calabar, Cross River State, Nigeria.

2. Materials and methods

2.1. Study site

Specimens of the African catfish *C. gariepinus* were collected from March 2014 to June 2014 in two fish farms located at Calabar South Local Government Area, Cross River State of Nigeria for parasitological analysis.

2.2. Collection and transportation of fish specimens

Specimens collected from the two farms were stored in a labelled transparent rectangular plastic container with cover and transported alive immediately to the Fish Pathology Laboratory of the University of Calabar for identification and examination. Collection of specimens was based on physical observable signs such as wounds, leisions, patches, fin rot and behavioral signs such as loss of appetite, erratic swimming, rubbing the skin against the walls of the tank, *etc*.

2.3. Parasitological analysis

All fish from the two farms were collected with hand net, weighed (g) and measured (cm). Fish weight was measured with METLAR MD-2000 electronic weighing balance to the nearest g while the length was measured using measuring board to the nearest cm. Thereafter, the fish specimens were necropsied for parasitological analysis. Collected fish specimens were examined externally for gross signs of monogenean parasities. For each specimen, the gills, skin and fins were examined. Skin biopsies were prepared from the entire length of the lateral body wall; gill biopsy was collected from the second arch and fin biopsy was collected from the caudal fin[15]. Wet mounts of all biopsied tissues were prepared for further analysis and examined under light microscopes for monogenean parasites. Collection, fixation, identification and quantification of monogenean parasites were done according to standard recommendations and literature[3,11,12,16-19].

2.4. Calculation of parasitological indices

Parasitological indices evaluated in this study included dominance, prevalence, mean intensity and abundance.

The dominance of monogenean parasite species was calculated according to Roohi *et al*. as follows[15]:

$$\text{Dominance} = \frac{N}{N\ \text{sum}} \times 100$$

Where N = abundance of monogenean parasite species and N sum = sum of the abundance of all monogenean parasite species found. The monogenean parasites were classified based on their dominance values according to Niedbala and Kasprzak as follows[20]: eudominant (> 10%), dominant (5.1%-10%), subdominant (2.1%-5%), recedent (1.1%-2%) and subrecedent (< 1.0%) of given species.

Prevalence (%), meaning intensity and abundance, were calculated according to formula given by Upadhyay *et al*. as follows[21]:

$$\text{Prevalence (\%)} = \frac{\text{No. of infected fish}}{\text{Total No. of fish examined}} \times 100$$

$$\text{Mean intensity} = \frac{\text{No. of collected parasites}}{\text{No. of infested fish}}$$

$$\text{Abundance} = \frac{\text{No. of parasites}}{\text{No. of fish examined}}$$

2.5. Physico-chemical parameters

Water quality parameters measured in the two fish farms included pH, dissolved oxygen, temperature and ammonia. Dissolved oxygen was measured in mg/L by using oxygen meter, and pH was measured by using pH meter; water temperature was measured by using thermometer while ammonia was measured colorimetrically by using ammonia test kit[22].

2.6. Data analysis

The differences between dominance, prevalence (%), mean

intensity and abundance of parasitized fish in the two farms in relation to sex were determined by using the Fisher's exact test.

3. Results

3.1. Prevalence, intensity and abundance of parasites recovered from examined fish

A total of 80 adults of *C. gariepinus* were examined from farm 1 and farm 2 (40 in each farm). Out of the 40 specimens examined in farm 1, 12 specimens were infested with 61 monogenean parasites [17 *Dactylogyrus* sp., 30 *Gyrodactylus* sp. and 14 *Macrogyrodactylus clarii* (*M. clarii*)]. Prevalence of monogenean parasites in farm 1 was 30%, intensity was 5.08 and abundance was 1.53. In farm 2, 9 out of the 40 specimens examined were infested with 29 monogenean parasites (6 *Dactylogyrus* sp., 16 *Gyrodactylus* sp. and 7 *M. clarii*). Prevalence of monogenean parasites in farm 2 was 22.5%, intensity was 3.22 and abundance was 0.73. Figures 1-5 show the skin, gills and fin of infected fish.

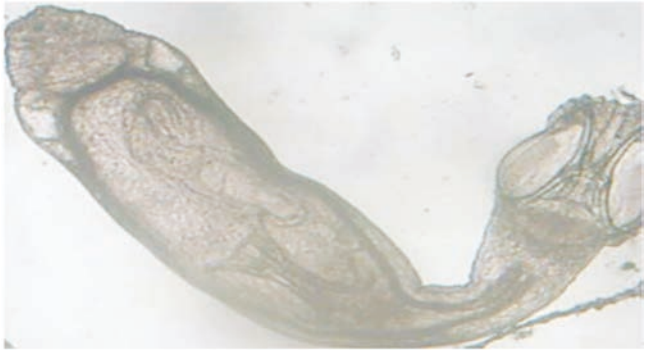

Figure 1. *M. clarii* recovered from an infected fish (Mag × 40).

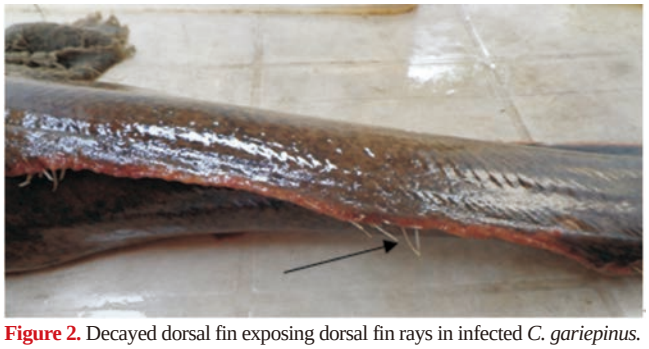

Figure 2. Decayed dorsal fin exposing dorsal fin rays in infected *C. gariepinus.*

Figure 3. Decayed caudal fin in infected *C. gariepinus.*

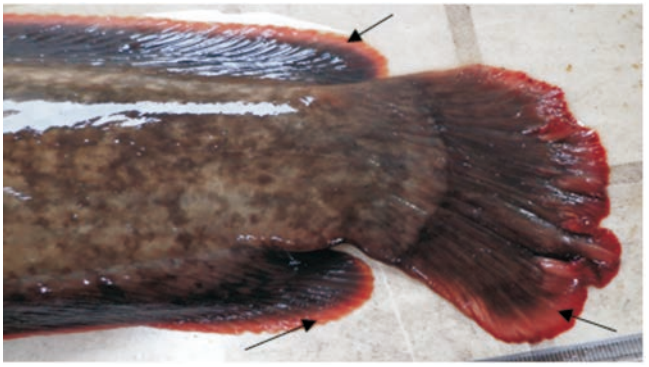

Figure 4. Bloody hemorrage at the tip of the dorsal, anal and caudal fins of infected *C. gariepinus.*

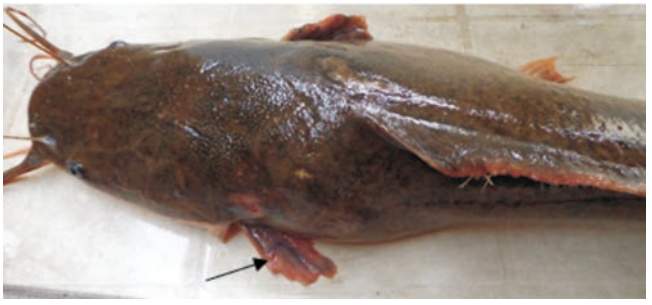

Figure 5. Ulceration of the pelvic fin of infected *C. gariepinus.*

3.2. Prevalence, intensity and abundance of parasites recovered in relation to sex

In farm 1, 16 female (40%) and 24 male (60%) *C. gariepinus* were examined. Out of 16 females examined, 7 samples were infested with 44 monogenean parasites with prevalence (43.75%), intensity (6.29) and abundance (2.75). Out of 24 males examined, 5 samples were infested with 17 monogenean parasites with prevalence (20.83%), intensity (3.40) and abundance (0.71). In farm 2, 18 female (45%) and 22 male *C. gariepinus* (55%) were examined. Out of 18 females examined, 7 samples were infested with 25 monogenean parasites with prevalence (38.89%), intensity (3.57) and abundance (1.39). Out of 22 males examined, 2 samples were infested with 4 monogenean parasites with prevalence (9.09%), intensity (3.22) and abundance (0.18).

3.3. Prevalence, intensity, abundance and dominance of monogenean parasites in relation to organ specificity

The prevalence of ectoparasites in relation to organ specificity showed that in Farm 1, parasites were most prevalent in the gills, followed by the skin and the least in the fins. A total of 17 *Dactylogyrus* sp. and 28 *Gyrodactylus* sp. were recovered from the skin, and 2 *Gyrodactylus* sp. were recovered from the fins and 14 *M. clarii* were recovered from the gills. *Dactylogyrus* sp. recovered from the gills had a dominance value of 27.87 (eudominant parasite), prevalence (10.0%), mean intensity (4.25) and abundance (0.43). *Gyrodactylus* sp. recovered from the skin and fins had a dominance value of 49.18 (eudominant parasite), prevalence (15.0%), mean intensity (5.00) and abundance (0.75).

M. clarii recovered from the gills had a dominance value of 22.95 (eudominant parasite), prevalence (5.0%), mean intensity (7.00) and abundance (0.35).

In Farm 2, parasites were the most prevalent in the skin and fins, followed by the gills. A total of 6 *Dactylogyrus* sp. and 7 *M. clarii* were recovered from the gills and 16 *Gyrodactylus* sp. were recovered from the skin and fins. *Dactylogyrus* sp. recovered from the gills had a dominance value of 20.69 (eudominant parasite), prevalence (5.0%), mean intensity (3.00) and abundance (0.15). *Gyrodactylus* sp. recovered from the skin and fins had a dominance value of 55.17 (eudominant parasite), prevalence (10.0%), mean intensity (4.00) and abundance (0.40). *M. clarii* recovered from the gills had a dominance value of 24.14 (eudominant parasite), prevalence (7.5%), mean intensity (2.53) and abundance (0.18).

3.4. Physicochemical parameters

Results of physicochemical parameters showed that in Farm 1, pH ranged between 6.8 to 7.1, water temperature ranged between 28 ˚C to 29 ˚C, dissolved oxygen ranged between 3.5 mg/L to 3.8 mg/L and ammonia ranged from 0.00 mg/L to 0.004 mg/L. In Farm 2, pH ranged between 6.9 to 7.2, water temperature ranged between 28 ˚C to 29 ˚C, dissolved oxygen ranged between 3.3 mg/L to 3.7 mg/L and ammonia ranged from 0.00 mg/L to 0.005 mg/L.

4. Discussion

Monogenean parasites are reported to cause high mortality of fish in tanks since they have a tremendous reproductive capacity, leading to a rapid buildup of infections to produce a large number of parasites capable of causing mortality in the hosts[4]. The present study showed that *C. gariepinus* examined from the two farms were infested with three species of monogenean parasites including *M. clarii*, *Gyrodactylus* sp. and *Dactylogyrus* sp. Infestation rate of monogenean parasites was higher (30%) in Farm 1 than in Farm 2 (22.5%). Findings of this study revealed that a total of 90 monogenean parasites belonging to 3 species were identified from 14 infected fish samples from the two farms (61 in Farm 1 and 29 in Farm 2). According to Khalil and Mashego[23], the occurrence of monogeneans on the skin and gills of *C. gariepinus* will affect its culture in ponds and tanks. Observations in this study that fishes infested with monogeneans were lethargic, swimming near the surface with clamped fins are in accordance with findings of Reed *et al*[24]. Findings of Harris's study on the population dynamics of monogenean parasites in tanks, showed that infections persisted for at least 9 months, with parasites growing rapidly at the initial stage before being limited by a host response[25]. Furthermore, he explained that at their peak, parasite populations contained several hundred individuals but then dropped to less than 20 following the host. The infected fish which exhibited a reduced appetite was observed to swim to the corners or sides of the concrete tank, rubbing their body against the walls of the tank. Findings of this study agree with reports of Khalil and Mashego[23], and Douellou and Chishwa who recovered, described and illustrated specimens of *Macrogyrodactylus* from the gills of *C. gariepinus* from Middle Letaba Dam and Mokgoma-Matlala Dam in South Africa and Lake Kariba in Zimbabwe[26]. Khan *et al*. and Peerven and Ullah attributed the infestation of bottom dwellers such as *Gyrodactylus* sp. to the fact that water temperature remains constant in the bottom as compared to the surface of water[27,28]. Evaluation of the dominance index based on the classification of Niedbala and Kasprzak showed that the three species of monogenean parasites were eudominant (*D*-value > 10%)[20]. Prevalence of parasites in fish is the proportion of fish hosts infected among all the hosts examined whereas mean intensity is the mean number of parasites found in the infected fish hosts. Among the three monogenean species recovered in the two farms, *Gyrodactylus* sp. was more abundant (46) followed by *Dactylogyrus* sp. (23) while *M. clarii* was the lowest (21). Prevalence (30%), intensity (5.08) and abundance (1.53) of monogenean parasites recorded in Farm 1 were not significantly higher ($P > 0.05$) than prevalence (22.5%), intensity (3.22) and abundance (0.73) recorded in Farm 2. These findings suggest that prevalence, intensity and abundance of monogenean parasites vary from one farm to another and this may be attributed to variations in environmental parameters such as temperature, pH, dissolved oxygen levels, *etc*. In the present study, prevalence, mean intensity and abundance of monogenean parasites in relation to sex showed that in both farms, female *C. gariepinus* were more infected than male. In Farm 1, prevalence of 43.75% and 20.83% (females and males), intensity of 6.29 and 3.40 (females and males) and abundance of 2.75 and 0.71 (females and males) were recorded. In Farm 2, prevalence of 38.89% and 9.09% (females and males), intensity of 3.57 and 3.22 (females and males) and abundance of 1.39 and 0.18 (females and males) were recorded. This observation is similar to findings of Alam *et al*. that female fishes were more infected than the male fishes[29]. However, Alam *et al*. attributed the cause of higher intensity in female fishes to ecological habitat and sex hormones which were responsible for depressing the level of parasite infestation[29]. Similarly, Aloo *et al*. explained that the main reason for the variation in parasitic infestation in relation to sex was physiological[30]. Organ specificity of monogenean parasites showed that *M. clarii* and *Dactylogyrus* sp. were recovered from the gills while *Gyrodactylus* sp. was recovered from the skin and fins. According to Reed *et al*.[24], *Dactylogyrus* usually prefer the gills as a feeding and attachment site as primarily found in freshwater fish while *Gyrodactylus* glue their eggs to the skin of the catfish using an adhesive material.

Monogenean parasites such as *M. clarii*, *Dactylogyrus* sp. and *Gyrodactylus* sp. are common parasites of farmed *C. gariepinus* which is the most cultured fish species in Nigeria. However, the prevalence, mean intensity and abundance showed that females were prone to high rate of infection than male fish. Monogenean parasites were found to exhibit a high degree of organ specificity as *M. clarii* and *Dactylogyrus* sp. colonized the gills while

Gyrodactylus sp. colonized the skin and fins. In conclusion, high abundance of these parasites may cause poor growth performance and high mortality in *C. gariepinus*, leading to huge monetary loss and low profit margin by increasing production cost due to the cost of treatments.

Conflict of interest statement

We declare that we have no conflict of interest.

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