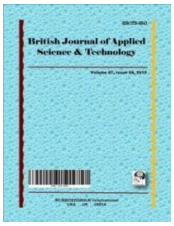

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The Pathology of Nematode Infection in *Parachanna obscura* (Pisces: Channidae Gunther, 1886) of the Cross River System, Nigeria

D. Ama-Abasi[1] and E. M. Oden[2*]

[1]Department of Marine Biology, Institute of Oceanography, University of Calabar, Calabar, Nigeria.
[2]Department of Zoology and Environmental Biology, University of Calabar, Calabar, Nigeria.

Authors' contributions

The work was carried out in collaboration between both authors. Author DAA initiated the work, wrote the protocol, supervised the work, engaged in literature search and wrote much of the manuscript in its revised state, while the author EMO carried out the experiment in the field and laboratory and engaged in literature search. Both authors read and approved the final manuscript.

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ABSTRACT

Study was conducted on the pathology of nematode infection in *Parachanna obscura* of the lower Cross River system, Nigeria. The objective was to find out specific pathological damages in *Parachanna obscura* caused by nematode infection. A total of five hundred and seventeen specimens of *Parachanna obscura* were sampled from artisanal fishers from January 2007 to August 2008. The infected fish were processed through the standard parasitological and histopathological procedures. Damages caused by nematode included black spots on the muscle fillet, muscle disintegration, gastrointestinal occlusion, exfoliation of intestinal mucosa, haemorrhage and distortion of the blood tissue. Infected fish had slightly lower health performance as revealed by the low condition factor compared to the non-infected. A one-way ANOVA however showed that there was no significant difference in the health index ($P > .05$) between the infected and the non-infected. There are potentials that the culture of nematode infected *Parachanna*

**Corresponding author: E-mail:estheroasis40@yahoo.com;*

obscura will lead to economic loss to aqua culturists, in terms of poor fillet quality and reduction in growth due to blood loss and poor nutritional activities. If *P. obscura* is to be used in aquaculture, anti-helminthes treatment must be applied before stocking. Further research would be needed in insitu detection of nematodes. This will boost food security and a turnaround in the economic fortune of the people of the lower Cross River basin.

Keywords: Fish disease; African snakehead; aquaculture; Cross River System.

1. INTRODUCTION

African snakehead, *Parachanna obscura* is an emerging aquaculture candidate in Nigeria and the sub-Saharan region as a whole. The species is preferred for its palatable fillet and strong flesh integrity. [1] reported that the species is high in protein and fat contents thereby making it a good healing agent for post operation patients. In the Cross River basin and the adjoining communities, the species is one of the most important fresh water species of commercial importance alongside, *Chrysichthys nigrodigitatus Heterotis niloticus, Orechromis niloticus* and *Clarias* species. Snakeheads are also sold as live, fried or smoked fish foods in ethnic markets, beaches and restaurants in India, South Eastern Asia, Japan, and in Cross River and Akwa Ibom States of Nigeria. Snakeheads have medicinal uses which have been reported in Malaysia and Indonesia; extracted oils from the species *Channa striata* is used to reduce scarring following surgery [2]. Considering these huge benefits offered by *Parachanna obscura,* it is necessary to exploit the fish for commercial purpose in order to derive its enormous economic gains.

Parachanna obscura is currently being screened for aquaculture in Institute of Oceanography Fish Farm of the University of Calabar, Nigeria. Work done so far on the species include the proximate composition [1], food and feeding habit [3]. Being a predatory species, the efficiency of the *Parachanna obscura* in polyculture system as biological agent for the control of overpopulation of *Tilapia* was mentioned by [4,5]. [6] worked on the relationship between the protein and fat contents of *Parachanna* obscura and its size and concluded that there was a positive linear relationship between the protein and fat contents and the size of the species with the bigger sizes having higher protein and fat contents.

Adebayo et al. [7] reported on the haematology of the species while [8] reported on the parasites of *Parachanna obscura* from Lekki lagoon, Lagos, Nigeria. [9] worked on the incidence of nematode infection on the African snakehead of the lower Cross River system, Nigeria and concluded that the level of infection was low. There is no reported case of the pathology of the nematode infection in *Parachanna obscura.*

Helminthes generally are known to cause varying degree of damages in fish, ranging from lamellar destruction by monogenetic trematode [10] to reproductive impairment by *Eustrongylides* [11]. [12] mentioned some pathogenic effects of nematode on fish to include haemorrhaging, external lumps or nodules and reduced growth and mortality.

There is no report on the pathology of nematode infections in *Parachanna obscura* of the Cross River system. It was the objective of this work therefore to investigate the pathogenicity of nematode infections in African snakehead of the lower Cross River from where experimental specimens are being harvested for culture in Institute of Oceanography Fish Farm. The result of the work is our own contribution to the current screening of the species for aquaculture.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

Cross River takes its source from the western slopes of Cameroon Mountains which has two spurs into Nigeria as Oban Hills in the South and the Obudu hills in the north [13]. The River flows first westward direction and then turns southward before it meanders into the Atlantic Ocean. Its main tributaries include the Great Kwa River from Oban Hill and the Akpa Yafe River from the Cameroon. The River system is found between latitude 4° 00 N and 8° 00 N and longitudes 7° 30' E and 10° 00 E. The riparian vegetation is predominantly mangrove which covers about 15% of the coastline. The mangrove system serves as important nursery and breeding ground for various finned fishes and shellfishes including *Macrobrachium* sp*, Ethmalosa fimbriata,*

Chrysichthys nigrodigitatus at the estuary side of the river system [14]. The freshwater is habitat to various fishes including *Heterotis niloticus, Heterobranchus longifilis, Clarias* sp *and Parachanna obscura*.

2.2 Research Design

A total of 517 specimens of snakehead were obtained from the artisanal fishers in the lower Cross River comprising the main Cross River and its tributary the Great Kwa River. The sampling spanned from January 2007 to August 2008. Live fishes bought were transported to the Parasitological laboratory of the Department of Zoology and Environmental Biology, University of Calabar, Calabar, Nigeria for parasitological studies. The method of [3] was used for gut analysis. Fish specimens were necropsied in accordance with ethical procedures and dissected organs were kept in petri dishes with 0.85% NaCl or physiological saline, for recovery of worms under stereozoom microscope. Muscle filleting was done according to the method of [15]. Fish gills were examined using the method of [16].

2.3 Histopathological Studies

The histopathological studies were carried out in the fish pathology laboratory of Institute of Oceanography, University of Calabar, Calabar according to the method of [17] and [18]. Organs subjected to histopathological studies included the intestine, muscle, blood because initial infection reported by [9] was established appreciably in these organs and tissues. Thins sections of 10µm in size were cut with rotary microtome and processed under standard histological procedures of fixations and stainings. Identification of the nematodes was based on the taxonomic features and methods provided by [19] and [20]. The reference materials of Commonwealth Institute of Helminthology were used also in the identification [21].

2.4 Statistical Analysis

One Way analysis of variance using SPSS was used to find out any significant difference between the health index (condition factor) of the infected and non-infected specimens.

3. RESULTS AND DISCUSSION

Two species of nematodes were identified from *Parachanna obscura* of the lower Cross River system. They were *Neocamallanus sp* and *Paracamallanus cyathopharynx*. Nematodes appeared as ellipsoidal streaks of various sizes scattered in the entire muscle fillets. The cysts formed yellow or brown spots, especially in heavily infected specimens. Cysts appeared as circular or oval shaped in the lining of the fillets. Encysted larvae in the fillets assumed the shape of figure '8' with transparent hyaline yellow coloured sheath (Plate 1).

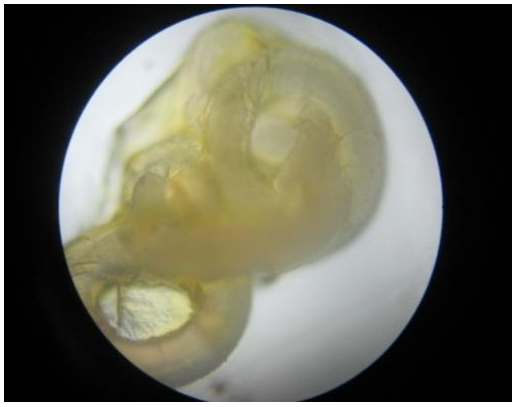

Plate 1. Encysted larva of *Paracamallanus cyathopharynx* in the muscle fillet of *P. obscura*

The pathology due to nematode infection in *P. obscura* was manifested in the following conditions: Tissue damage, necrosis, dissolution of muscle cells, loss of visible striations and degeneration of connective tissues surrounding infected muscle fillets (Plates 2 & 3). There were dead and non-functional cells and a total collapse of the muscle fibres and disintegration of muscle sheet arrangement. Muscle fillets of *Parachanna obscura* infected with nematodes lost their integrity. They were no longer firm. The muscle was soft to the touch and even pulled apart easily.

Encapsulated larvae were extracted from the intestinal lumen. There were obvious cases of gastro-intestinal occlusion. Nematode blocked the entire lumen due to overcrowding. Patches of blood spot were also observed on the lining of the gastro-intestinal tracts. We also observed exfoliation of the intestinal mucosa due to mechanical abrasion. Fish infected with nematodes had a mean lower condition factor (0.74) than those not infected (0.82). However analysis of variance did not reveal any significant difference between the infected and non-infected fish ($p > .05$).

Plate. 2a. Non-infected muscle fillet of *P. obscura*

Plate 2b. Heavily infected muscle fillets of *P. obscura* with nematode cysts

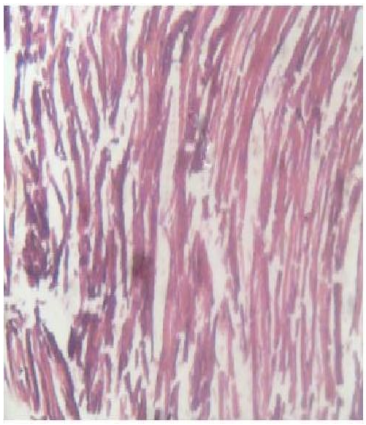

Plate 3a. Muscle fillet of non-infected *P. obscura* with normal distribution of cells

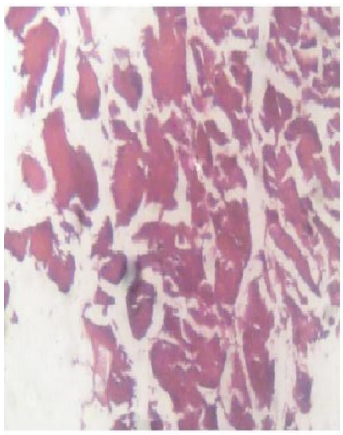

Plate 3b. Dissolution of muscle cells in nematode infected *P. obscura*

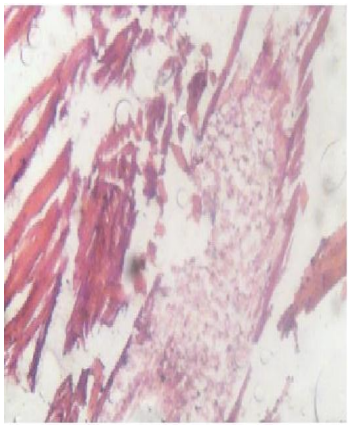

Plate 3c. Disintegrated muscle sheet in nematode infected *P. obscura*

The patches and spots that dotted the muscle fillets of the infected fish distorted the aesthetic impression of the fillets. This may result in the rejection of the fillets by consumers and hence will lead to a reduction in its commercial value. [11] had also reported degeneration of follicular wall tissues in *Clarias gariepinus* infected with *Eustrongylides*. The haemorrahges observed were also mentioned by [12]. Blood loss can lead to several complications with respect to the fish health. This includes predisposition to further infection as the loss will lead to reduction of the white blood corpuscles that fight diseases and infection. Losses of other blood components like the red blood cells will reduce the oxygen carrying capacity of the blood and further results in a decline in metabolic activities. Loss of ions and minerals will lead to osmotic imbalance, all to the detriment of the fish health. [17] stated that intestinal parasites inhibit the digestive activity of the host and indirectly inhibit vitamin and blood sugar metabolism and growth. Parasites in the liver also affect glycogen metabolism and growth. These larvae burrow into, feed on and degenerate the liver cells and blood vessels. This may reduce the size of liver and convert it into a soft and dark coloured mass.

The apparent higher condition factor of non-infected specimens compared to the infected means loss of weight. This is probably due to poor absorption of digested food due to the exfoliation of the intestinal mucosa. This will also affect digestion. Intestinal occlusion due to heavy infection is dangerous as this will block the flow of chyme through the digestive tract. Such physiological perturbation means poor absorption and indirect malnutrition. This explains further why the infected fish were poorer in health compared to the non-infected.

This work has established pathological effects of nematodes infection on the fillets, intestines and blood of *Parachanna obscura*. While there was no significant difference between the health index of the infected and non-infected specimens, which possibly was due to low number of the infected in the samples [9], there are potentials that the culture of nematode infected *Parachanna obscura* will lead to economic loss to aquaculturists, in terms of poor fillets quality and reduction in growth due to blood loss and poor nutritional activities.

We propose that aqua culturists should screen *Parachanna* with anti-helminths drugs bath before stocking. Secondly, regular deworming exercise could be carried out with ant-helminths mixed in compounded feeds in order to ensure that the cultured species are free of nematode infection and other helminths.

4. CONCLUSION

This work has identified haemorrhages, fillet disintegration, intestinal lumen occlusion, reduction in health index as the major pathological effects from nematode infection in *Parachanna obscura*. The index factors are clear; for *P. obscura* to be introduced as aquaculture species, thorough examination of gut and flesh must be conducted. Further research would be needed in the aspect of in situ detection of nematodes. The technique of scanning electron microscope (SEM) and deoxyribonucleic acid (DNA) imagery [22] would be necessary in effective aquaculture of the species. For now, anti-helminthic administration in compounded feeds and regular deworming are recommended.

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COMPETING INTERESTS

The authors have declared that no competing interest exists. Both authors hereby declare that "Principles of laboratory animal care" (NIH publication No. 85-23, revised 1985) were followed, as well as specific national laws where applicable. All experiments have been examined and approved by the appropriate ethics committee

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