Distribution and Associated Factors of *Gyrodactylus Malalai* Infestation in North African Catfish, *Clarias Gariepinus* in Ilorin, Nigeria

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Research Article

Keywords: North African catfish, *Gyrodactylus malalai*, Infestation, Monogenean, Disease

Posted Date: November 30th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-1074271/v1>

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Abstract

This study examined the occurrence and associated factors of *Gyrodactylus malalai* infestation in 30 cultured North African catfish in Ilorin, Nigeria. Four organs (gills, eyes, fin and skin) were collected from each fish (resulted into 180 organs) and observed for the existence of *G. malalai*. Fifty percent (50%) of the fish examined were infested with *G. malalai*. Males (30%) fish were more affected than the females (20%). Density, intensity and index of infestation were significantly different between males and females ($p < 0.05$). Fish with total length of 40.0 to 49.9 cm were significantly infested than fish with total length of 20.0 to 29.9 cm ($p < 0.05$) but body weight did not significantly affect the occurrence of *G. malalai* infestation ($p > 0.05$). Gills is most targeted organ of *G. malalai* infestation with higher percentage of infestation (8.33%), density of infestation (0.22), intensity of infestation (2.60), and index of infestation (3.25) than the eye with 2.22, 0.06, 1.57, and 0.43, respectively ($p < 0.05$). In conclusion, *Gyrodactylus malalai* infestations are high in North African catfish and could multiply rapidly and could lead to mortality if not properly managed. Furthermore, total length is identified as the predisposing factor for *G. malalai* infestation in fish

Introduction

Fish farming has become a robust industry in Nigeria in the last one decade, having production increased from 35,000 metric tons to 800,000 metric tons (FAO 2018). Individuals and the private sector had invested in aquaculture production involving mainly the semi-intensive and intensive systems. Also, Nigeria has a large market size for fish consumption because of her huge population (estimated at 200 million) and an inadequate fish supply had also contributed to the expansion. African catfish, *Clarias gariepinus* is the most cultured fish species in Nigeria due to its growth performance and market value (Adeshina et al. 2019; Adeniyi 2020) but parasitic infections are greatly affecting its activities (Adeshina et al. 2021). Universally, parasites are enormous concern to freshwater fishes in the tropical regions (Ekanem et al. 2011) and a major limiting factor to the growth of cultured fish in Nigeria (Bichi and Yelwa 2010).

Freshwater fish species are affected by many monogenetic trematodes, including *Dactylogyrus* species, *Gyrodactylus* species especially *Gyrodactylus malalai*. The *G. malalai* is a viviparous organism which releases its larvae freely into the environment and/or host, hence dominate within 24 hours. The *G. malalai* infection targets fish skin and gills resulting into skin de-coloration, peeling, de-scaling, dermatitis, sloughing, and high mortalities (Garcia-Vavijo et al. 2007; Shinn et al. 2010; Prikrolova et al. 2012; Abdel-Latif and Khafaga 2020). Infections with *G. malalai* are capable of causing up to 63% mortality in fish (Adeshina et al. 2021). Between the month of June and December 2020, fish farmers in Ilorin reported high mortality catfish showing *G. malalai* infections symptoms. It is therefore important to investigate the distribution and factors associated *Gyrodactylus malalai* infection in African catfish, *Clarias gariepinus* for proper management and prevent bankruptcy in fish farming business, hence the need for this study. In view of this, the main objective for this study was to determine the occurrence, abundance and distribution of *Gactylogyrus malalai*, and evaluate its associated factors that enhance its infections.

Materials And Methods

Description of the study area

The experiment was done at the Department of Aquaculture and Fisheries, University of Ilorin, Nigeria. Ilorin, the Kwara State capital is in North Central Zone of Nigeria and situated on latitude 8°30'N and longitude 4°32'E.

Collection and transportation of fish specimens

A multisampling technique was adopted for this research study. The fish farms selected in Ilorin metropolis were stratified into large, medium and small scales using stratified methods as described by Fagbenro and Adebayo (2007). Thirty (30) African catfish were randomly selected comprises of ten (10) fish from each stratified group. The fish specimen collected was transported alive after purchase in their original water in a plastic container properly covered and well aerated to the laboratory at the Department of Aquaculture and Fisheries, University of Ilorin. The sex differential of African catfish was performed using genital papillae commonly used in *C. gariepinus* as described by Omitoyin (2006). The fish were weighed using sensitive scale and the lengths were measured using meter board calibrated in centimeter.

Collection of fish organs

Four (4) organs (muscle, fin, gill and eyes) of the fish specimen were collected for examination of *G. malalai* from each of the fish specimen which led to one hundred and twenty (120) samples. The fins, gills and eyes were aseptically collected while the fish muscles were trimmed carefully to expose any embedded parasite cysts. The organs were collected in triplicates. The whole gills were rinsed and examined under a compound microscope with magnification of 10 xs, 40 xs and 100 xs. Tissue specimen from fins, eyes and gills pieces were cut, rinsed with normal saline solution and placed in 4% formalin buffer 10% for 24hrs in vials, shaken and the sediment examined under the microscope (Model: XSZ-170BN).

Parasites identification

All the parasites recovered from the organs of the fish specimen were manually counted and recorded. Morphological features were used to identify the parasites as described by Ravichandran et al. (2009).

Calculation of parasitological indices

The analysis for *G. malalai* infestation to find percentage, density, intensity and index of infestation were calculated by following the formula given by Adeshina et al. (2016).

$$\text{Percentage of infestation} = \frac{\text{Infested samples}}{\text{Total samples examined}} \times 100$$

$$\text{Density of infestation} = \frac{\text{Number of parasites recovered}}{\text{Total samples examined}}$$

$$\text{Intensity of infestation} = \frac{\text{Number of parasites recovered}}{\text{Number of infested samples}}$$

Index of infestation

$$= \frac{\text{Number of samples infested} \times \text{Number of parasites recovered}}{\text{Total samples examined}}$$

Statistical analysis

Descriptive statistics were used to analyze the data, while the significance of parasite occurrence between males and females was analyzed using Chi-square test. Also, Mann–Whitney U test was performed for the significance of difference in the intensity of the infection between males and females ($p > 0.05$) while infestation among the organs were analyzed using one-way analysis of variance with the aid IBM SPSS, version 20.

Results

Table 1 and Figure 1 showed that 50% of the fish examined were infested with *G. malalai*. A total number of 82 parasites were recorded. Percentage of infestation was higher in male fish (30.0%) than the female fish (20.0%). Furthermore, density, intensity, and index of infestations were significantly higher in male fish when compared to the female with p -values of 0.010, 0.020, and 0.013 respectively.

Table 2 revealed *G. malalai* infestation in African catfish in relation to total length. The result showed that there were statistically significant differences in the percentage, density, intensity and index of infestation at $p=0.001$, $p=0.133$, $p=0.001$ and $p=0.002$ respectively. Fish with total length of 40.0 – 49.9 cm had highest percentage of infestation (20.0%), density of infestation (1.30) and index of infestation (7.80). however, fish with total length of 30.0 – 39.9% cm had highest intensity of infestation (6.75). Occurrence of *G. malalai* in farmed African catfish in relation to body weight is presented in Table 3. There were no significant differences in the percentage ($p=0.579$), density ($p=0.693$), intensity ($p=0.440$), and index ($p=0.362$) of infestation between the fish groups of various body weights.

Table 4 depicts the distribution of *G. malalai* in the organs of African catfish. There were significant different in the percentage, density, intensity and index of infestation ($p < 0.05$) of *G. malalai* among the

organs of African catfish. Gill is the most infested organ where percentage of infestation, density, intensity of infestation, and index of infestation were 8.33%, 0.22, 2.60 and 3.25, respectively. On the other hand, the least values, 2.22%, 0.04, 1.75, and 0.16, for percentage, density, intensity and index of infestation, respectively were obtained from the eye of the fish examined.

Discussion

Huge fish mortality was reported in fish farms in Ilorin in the year 2020. The mortality was associated with monogenean parasites infection such as *Gyrodactylus* species. In this study, thirty (30) samples of *Clarias gariepinus* from different farms in Ilorin metropolis were observed for *G. malalai* infection from which 50% were infected. These parasites have been observed in Kenya from both farmed and capture fish (Otachi 2009). In the present study, male fish are more susceptible to *G. malalai* infection than the female; this observation is similar to the work of Goselle et al. (2008) who reported higher intensity of helminthes parasites in male fish than female fish. This may be because male fish are more active than females during the breeding period, and so are more prone to infestation by higher number of parasites infection. Physiology is the core reason for the dissimilarities in the parasitic load in fish (Aloo et al. 2004). Also, significantly higher intensity, density and index of parasitic infection in the male than female in this study are highly related to physiology and physiology functions of sex of the fish.

The findings from this study indicated that the percentage, density, and index of infection were significantly related to the total length of fish. The percentage, density, and index of infection were observed in fish with total length ranged from 40.0 to 49.9 cm while the no infection was noticed in fish with 20.0 – 29.9 cm total length. The percentage of infection in relation to length of host agrees to Chandra (1985) who reported higher abundance of *Pallisentis* sp in the intermediate length fish. Goselle et al. (2008) also observed higher infestation of helminthes in *C. gariepinus* with higher total length than shorter-sized fish, which were associated to the fact that as the fish increases in length, there is possibility of re-infestation by parasites. Similarly, Madanire-Moyo and Avenant-Oldewage (2012) reported higher parasites infestation in longer *C. gariepinus*. This observation may not be unconnected to the fact that fish with high total length occupies and covers wider areas of water and thus exposed it to parasites in the water column. However, fish body weight did not affect *G. malalai* infestation significantly in *C. gariepinus* in the present study. The finding on the insignificant effect of body weight in this study is in contrast to the observation of Allumma and Idowu (2011) who reported higher parasites infestation in fish of higher body weight. This difference might be due to different ages of fish used in work of Allumma and Idowu (2011). The older the fish, the higher it exposed to parasites infestation due to longer period of time spent in the water column and agents in the environment; but in the case of the present study, the fish were of same age.

In addition, the distribution of *G. malalai* in the organs was found to be significantly different. Gills are most targeted organ of *G. malalai* infestation in the African catfish, followed by the skin, while eye had the least occurrence. Significantly higher percentage, density, intensity and index of infestation observed in gills and skin in could be attributed to their exposure to the water and environment. Gill is the

respiratory organs of fish, and thus its contact with water is constant, hence becomes easier to attack by parasites. The observation on higher parasite infestation in the gills and skin in the present study is in agreement with the works of Garcia-Vavijo et al. (2007), Shinn et al. (2010), and Prikrolova et al. (2012).

Conclusion

This study concluded that *Gyrodactylus malalai* infestations are high in African catfish, *Clarias gariepinus*. Furthermore, total length was identified as the predisposing factor for *G. malalai* infestation in the *C. gariepinus*. Due to its viviparous nature and proliferation of *G. malalai*, it could multiply rapidly and could lead to huge biological and economical losses if not properly managed.

Declarations

Funding: The research leading to these results received funding from Alhaji Abdulwaheed.

Conflict of interest/competing interests: The authors declare that they have no conflict of interest.

Availability of data and material: The data sets generated during and or analysed during the current study are available from the corresponding author on reasonable request.

Code availability: Not applicable

Authors' contribution: Ibrahim Adeshina: designed the study and drafted the paper; Seyramsarah Blossom Setufe: statistical analysis; Kaosarat Omolara Abdulwaheed: experimental test; Olarinke Victoria Adeniyi: manuscript revision.

All authors read and approved the final manuscript.

Ethical approval: The studies have been approved by the appropriate institutional ethics committee and have been performed in line with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later comparable ethical standards.

Consent to participate: Not applicable

Consent for publication: Not applicable

Acknowledgement: This work was supported by University of Ilorin, Kwara State and the Department of Aquaculture and Fisheries, Faculty of Agriculture. We likewise appreciate the efforts of Eric Adu Acheampong for taking his time in rearranging this manuscript before submission.

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Tables

Table 1 Occurrence of *Gyrodactylus malalai* in African catfish in relation to sex

Parameters	Female	Male	Total	<i>p</i> -value
Number of fish examined	13.00	17.00	30.00	
Number of infested fish	6.00	9.00	15.00	
Number of parasites	23.00	59.00	82.00	
Percentage of infestation (%)	20.0	30.0	50.0	0.001
Density of infestation	0.73	1.97	2.70	0.010
Intensity of infestation	3.83	6.56	10.39	0.020
Index of infestation	4.60	17.70	22.30	0.013

Table 2 Occurrence of *Gyrodactylus malalai* in African catfish in relation to Total length (cm)

Parameters	Total length (cm)					<i>p</i> -values
	20.0-29.9	30.0-39.9	40.0-49.9	50.0-59.9	Total	
Number of fish examined	1	10	13	6	30	
Number of fish infested	0	4	6	5	15	
Number of parasites	0	27	39	16	82	
Percentage of infestation (%)	0.0	13.3	20.0	16.7	50.0	0.002
Density of infestation	0.0	0.90	1.30	0.53	2.73	0.031
Intensity of infestation	0.0	6.75	6.50	3.20	16.37	0.0021
Index of infestation	0.0	3.60	7.80	2.67	14.07	0.001

Table 3 Occurrence of *Gyrodactylus malalai* in farm raised African catfish in relation to weight (g) $p>0.05$

Parameters	Body weight (g)		Total	<i>p</i> -values
	400.0-499.9	500.0-599.9		
Number of fish examined	17	13	30	
Number of fish infested	8	7	15	
Number of parasites	44	38	82	
Percentage of infestation (%)	26.7	23.3	50.0	0.579
Density of infestation	1.47	1.27	2.74	0.693
Intensity of infestation	5.50	5.43	10.93	0.440
Index of infestation	11.73	8.87	20.60	0.362

Table 4 Occurrence of *Gyrodactylus malalai* in farm raised African catfish in relation to its organs

Parameters	Body weight (g)				Total	<i>p</i> -values
	Skin	Gills	Fins	Eye		
Number of organs examined	30	30	30	30	180	
Number of organs infested	13	15	7	4	39	
Number of parasites	25	39	11	7	82	
Percentage of infestation (%)	7.22	8.33	3.89	2.22	21.66	0.005
Density of infestation	0.14	0.22	0.06	0.04	0.46	0.021
Intensity of infestation	1.92	2.60	1.57	1.75	7.84	0.001
Index of infestation	1.81	3.25	0.43	0.16	5.65	0.035

Figures

Figure 1

Gyrodactylus malalai recovered from the gill of an infected fish (Mag. 40x)