Comparative Study On The Prevalence Of Trichodiniasis And Monogeniasis In *Clarias gariepinus* (Burchell, 1822) Of Different Age Groups In The University Of Calabar Fish Farm And Its Implication To Fish Farmers

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ABSTRACT
The objective of this study was to comparatively evaluate the prevalence of trichodiniasis and monogeniasis in the African Catfish *Clarias gariepinus* of the different age groups from the University of Calabar fish farm, Cross River State, Nigeria. A total of three hundred (300) *C. gariepinus* samples of different age groups (100 fingerlings, 100 juveniles, and 100 adults) were collected with hand net necropsied for parasitological analysis. Skin, gill, and fin biopsies were prepared from each collected sample following standard methods for microscopic analysis. The results showed that of three hundred (300) *C. gariepinus* examined from different age groups 22 fish (13 fingerlings, 6 juvenile and 3 adults) were infested with 62 ectoparasites (36 in fingerlings, 16 in juveniles and 10 in adults) belonging to *Trichodina heterodentata* and *Gyrodactylus sp.* with an overall prevalence of 7.33 %. The impact assessment of parasites showed that the abundance, intensity, and prevalence were higher in fingerlings (0.36, 2.77 and 13.00%), followed by juveniles (0.16, 2.67 and 6.00%) and lowest in adults (0.10, 3.33 and 3.00%). In the three age groups of fish, *T. heterodentata* and *Gyrodactylus sp.* were most prevalent in the gills and least likely in the skin, suggesting that the gills are their most preferred external organ. The results of this study showed that trichodiniasis and monogeneasis are more common in *C. gariepinus* of a lower age group with implication on the general welfare of the fish. Therefore, to prevent the outbreak of trichodiniasis and monogeneasis, standard quarantine procedure, water quality management, good nutrition, adequate stocking density, and proper hygienic conditions is recommended.

Keywords: Ectoparasitic infestation, *Trichodina heteredontata, Gyrodactylus sp.,*Disease outbreak, Huge monetary loss, Standard quarantine procedure

Introduction

Fish farming is a major contributor to job creation, wealth generation and source of livelihood to millions of people in both developed and developing countries. In Nigeria, fish production through aquaculture is increasing because of the increase in demand for fish protein due to its rich nutritional profile and health benefits (Eyo and Ivon, 2017; Eyo and Akanse, 2018). Fish is also a good source of animal protein for livestock (Abidemi-Iromini and Adelegan, 2019; Bichi and Yelwa, 2010). The African Catfish *Clarias gariepinus* which belongs to the family Clariidae is the most culturable fish species in Nigeria. This is attributed to its ability to tolerate varying environmental conditions, fast growth rate, high stocking densities, disease resistance, high fecundity, acceptability of compounded feed, nice taste, excellent meat quality, high market value and ease of artificial breeding (Eyo *et al.,* 2022). Despite the intensive culture of *C. gariepinus* in Nigeria, many farmers are still facing challenges in their farms such as poor growth rate, low survival, and consequently significant production and economic losses due to the outbreak of diseases. Parasitic diseases such as trichodiniasis and monogeneasis can cause significant damages to cultured *C. gariepinus* resulting in poor growth, impaired welfare, high mortality and huge monetary loss (Eyo *et al.,* 2015). Trichodina and monogenia species which are the causative agents of trichodiniasis and monogeneasis are very common external parasites found in farmed fish. In tropical aquaculture, Trichodinia species, monogenian species and other ectoparasites pose hazardous threats to fish welfare and health. This is a critical problem especially where organic content and increasing temperature accelerates the parasites life cycles (Ghoneim *et al.,* 2015). Some of these ectoparasites are capable of developing in humans if infected fish is eaten raw or inadequately cooked but if the fish is thoroughly cooked, no public health threat is envisaged (Ekanem *et al.,* 2011, Ekanem *et al.,* 2014; Udechukwu *et al.,* 2018).Several research findings have been documented on ectoparasites of farmed fishes in Nigeria (Udechukwu *et al.,* 2018; Eyo *et al.,* 2015; Bichi and Yelwa, 2010; Bichi and Dawaki, 2010; Adeyemo and Falaye, 2007; Awa *et al.,* 1988; Inyang-Etoh and George, 2018). The University of Calabar fish farm is one of the reliable suppliers of *C. gariepinus* of different age groups such as fingerlings, juveniles, table-size fish and broodfish to farmers and fish consumers in Cross River State and other neighbouring states like Akwa Ibom State, Rivers State and Ebonyi State in Nigeria. This indicates the need to determine the disease status of fish farms supplying fish farmers with farm inputs such as fingerlings, juveniles, and broodstock. Therefore, the objective of this study was to comparatively evaluate the prevalence, mean intensity, and abundance of trichodiniasis and monogeneasis in *C. gariepinus* of the different age groups in the University of Calabar fish farm and its implication to fish farmers.

MATERIALS AND METHODS Study Area

The study area for this study is the University of Calabar fish farm, Cross River State, Nigeria. It is geographically located at Latitude 4˚55'N and Longitude 8˚26'E along the coastal plain of Nigeria bordering the Gulf of Guinea.

Collection of experimental fish

A total of three hundred (300) *C. gariepinus* samples of different age groups were collected with handnet from the University of Calabar fish farm (100 fingerlings, 100 sub-adults, and 100 adults) between February 2015 to October 2015 and used for this study. Samples collected were transported alive to the Fisheries and Aquaculture Laboratory, Institute of Oceanography, University of Calabar for identification and examination. Samples were collected based on visible signs of parasite infection such as lesions, wounds, patches, fin rot and behavioural signs such as erratic swimming, loss of appetite and rubbing the skin against the walls of the pond.

Age grouping of the experimental fish

Before the examination, the experimental fishes were grouped according to age including fingerlings, juveniles and adults. Length data was used in categorizing the fishes into the three age groups (3 – 5 cm for fingerlings, 6 – 10 cm for juveniles and > 25 cm for adults).

Clinical examination and parasitological analysis

After grouping, the fish specimens were necropsied for parasitological analysis. For each sample, the fins, gills, and skin were examined. Fin biopsy was prepared from the caudal and dorsal fin, skin biopsy was prepared from the entire length of the lateral body wall while gill biopsy was prepared from the second arch (Roohi *et al.,* 2014). Wet mounts of all biopsied tissues were examined with OLYMPUS CX22 binocular microscope for trichodina and monogenea. For ectoparasite identification, sketches were made as observed on the binocular microscope and compared with fish parasites pictorial guide given by Parpena (1996).

Parasite Impact Assessment (PIA)

The parasite impact assessment was evaluated using indices including abundance, intensity, and prevalence (%) and was calculated using the formula given by Upadhyay *et al.,* (2012) as follows:
Abundance = Number of parasites/Number of fish examined
Intensity = Number of collected parasites/ Number of infested fish
Prevalence (%) = (Number of infected fish/Total Number of fish examined)*100

Measurement of morphometric parameters of *T. heterodentata*

Measurement of the span of the denticle of trichodina was from the tip of the blade to the tip of the ray as following the protocol of Arthur and Lom (1984). Morphometric parameters of *T. heterodentata* measured were body diameter, adhesive disc diameter, denticle number, denticle length, blade length, ray length and central path width. All measurements were in micrometer as recommended by Van As and Basson (1989) with the aid of photomicrograph taken with OLYMPUS CX22 binocular microscope, equipped with Moticam 2300ï›š image capture system.

Measurement of water quality parameters

Water quality parameters were measured in the ponds where fingerlings, juveniles, and adults *C. gariepinus* were collected. The water quality parameters measured were pH, temperature, dissolved oxygen, and ammonia. pH was measured with pH Model SAEG pHS-25C), the water temperature was measured with a mercury in glass thermometer, dissolved oxygen was measured with MW600 Dissolved oxygen Milwaukee Smart DO meter in mg/L and ammonia level was measured colorimetrically with NUTRIFAN ammonia test kit.

Statistical analysis

Results obtained for prevalence (%), intensity and abundance of ectoparasites in *C. gariepinus* of different age groups from the University of Calabar fish farm were subjected to One Way Analysis of Variance to test for significance at P = 0.05 level using Predictive Analytical Software (PASW) version 18.

RESULTS

Number of fish examined, infested and parasites recovered from *C. gariepinus* of different age groups from the University of Calabar fish farm

Out of three hundred (300) examined *C. gariepinus* of different age groups from the University of Calabar fish farm, 22 specimens were infested with 62 ectoparasites with an overall prevalence of 7.33 %. In fingerlings, 13 (13.00 %) out of 100 examined samples were infested with 36 ectoparasites. In juveniles, 6 (6.00 %) out of 100 examined samples were infested with 16 ectoparasites. In adults, 3 (3.00 %) out of 100 examined samples were infested with 10 ectoparasites. Table 1 shows the number of fish examined, number of fish infested and number of ectoparasites recovered.

Table 1: Number of fish examined, infested and parasites recovered from *C. gariepinus* of different age groups from the University of Calabar fish farm

Size Class (cm)	No. of fish examined	No. of fish infested	No. of parasites collected	% of fish infected
Fingerlings (3 – 5 cm)	100	13	36	13.00
Juveniles (6 – 10 cm)	100	6	16	6.00
Adults (> 25 cm)	100	3	10	3.00
Total	300	22	62	7.33

Abundance, intensity, and prevalence of parasites recovered from *C. gariepinus* of different age groups from the University of Calabar fish farm

Result obtained for abundance, intensity, and prevalence of *T. heterodentata* and *Gyrodactylus sp.* recovered from *C. gariepinus* of different age groups from the University of Calabar fish farm is shown in Table 2. Abundance was highest (0.36) in fingerlings, followed by juveniles (0.16) and least in adults (0.10). The intensity was highest (3.33) in adults, followed by fingerlings (2.77) and least in juveniles (2.67). Prevalence was highest (13.00 %) in fingerlings, followed by juveniles (6.00 %) and least in adults (3.00 %).

Table 2: Abundance, intensity, and prevalence of parasites recovered from *C. gariepinus* of different age groups from the University of Calabar fish farm

Size Class (cm)	Abundance	Intensity	Prevalence
Fingerlings (3 – 5 cm)	0.36	2.77	13.00
Juveniles (6 – 10 cm)	0.16	2.67	6.00
Adults (> 25 cm)	0.10	3.33	3.00
Total	**0.21**	**2.82**	**7.33**

Abundance, intensity, and prevalence of parasites in *C. gariepinus* of different age groups from the University of Calabar fish farm in relation to organ specificity

The prevalence of ectoparasites recovered from *C. gariepinus* of different age groups in relation to organ specificity (Table 3.) showed that in fingerlings, parasites were most prevalent in the gills and least in the skin. Twenty (20) *T. heterodentata* was recovered from the gills whereas 16 *Gyrodactylus sp* was recovered from the skin. *T. heterodentata.* recovered from the gills of fingerlings had an abundance of 0.20, intensity (4.00) and prevalence of (5.00 %). *Gyrodactylus sp* recovered from the skin of fingerlings had an abundance of 0.16, intensity (2.00) and prevalence of (8.00 %). In juveniles, ectoparasites were also most prevalent in the gills and least in the skin. Ten (10) *T. heterodentata* was recovered from the gills and 6 *Gyrodactylussp* was recovered from the skin. *T. heterodentata* recovered from the gills of juveniles had an abundance of 0.10, intensity (5.00) and prevalence of (2.00 %). *Gyrodactylus sp* recovered from the skin of juveniles had an abundance of 0.06, intensity (1.50) and prevalence of (4.00 %). In adults, ectoparasites were only recovered from the skin. Six (6) *T. heterodentata* recovered from the skin of adult *C. gariepinus* had an abundance of 0.06, intensity (6.00) and prevalence of (1.00 %). *Gyrodactylus sp* recovered from the skin of adults had an abundance of 0.04, intensity (2.00) and prevalence of (2.00 %).

Table 3: Abundance, intensity, and prevalence of ectoparasites in *C. gariepinus* of different age groups from the University of Calabar fish farm in relation to organ specificity

Age Group	No. of fish Examined	No. of fish infested	Parasite species	No. of parasites Collected	Organs	Abun	Int	Pre (%)
Fingerlings (3 – 5 cm)	100	5	*T. heterodentata*	20	Gills	0.20	4.00	5.00
		8	*Grrodactylus sp*	16	Skin	0.16	2.00	8.00
Total	**100**	**13**		**36**		**0.36**	**2.77**	**13.00**
Juveniles (6 – 10 cm)	100	2	*T. heterodentata*	10	Gills	0.10	5.00	2.00
		4	*Grrodactylus sp*	6	Skin	0.06	1.50	4.00
Total	**100**	**6**		**16**		**0.16**	**2.67**	**6.00**
Adults (> 25 cm)	100	1	*T. heterodentata*	6	Skin	0.06	6.00	1.00
		2	*Grrodactylus sp*	4	Skin	0.04	2.00	2.00
Total	**100**	**3**		**10**		**0.10**	**3.33**	**1.00**

* Abn = Abundance, Int = Mean Intensity and Pre = Prevalence

Morphometric measurement of *T. heterodentata*

Morphometric parameters (Table 4) measured were body diameter, adhesive disc diameter, denticle number, denticle length, blade length, ray length and central path width. Body diameter ranged between 51.0 – 60.0 µm with a mean of 55.4 ± 1.40 µm. Adhesive disc diameter ranged between 41.0 – 59.0 µm with a mean of 51.2 ± 2.50 µm. The number of denticles ranged between 20.0 – 25.0 µm with a mean of 23.5 ± 1.40 µm. Denticle length ranged between 8.0 – 12.0 µm with a mean of 10.0 ± 1.5 µm. Blade length ranged between 4.0 – 7.0 µm with a mean of 6.5 ± 2.1 µm. Ray length ranged between 4.0 – 9.0 µm with a mean of 6.5 ± 2.1 µm. Central path width ranged between 2.0 – 4.0 µm with a mean of 3.2 ± 0.6 µm.

Table 4: Morphometric measurement of *T. heterodentata*

Indices	Range (µm)	Mean (µm)	No. of Structures measured
Body^{D}	51.0 – 60.0	55.4 ± 1.40	32
Adhesive disc^{D}	41.0 – 59.0	51.2 ± 2.50	32
Denticle number	20.0 – 25.0	23.5 ± 1.40	32
Denticle^{L}	8.0 – 12.0	10.0 ± 1.5	106
Blade^{L}	4.0 – 7.0	5.5 ± 1.2	106
Ray^{L}	4.0 – 9.0	6.5 ± 2.1	106
Central part^{W}	2.0 – 4.0	3.2 ± 0.6	106

D = Diameter, L = Length, W= Width

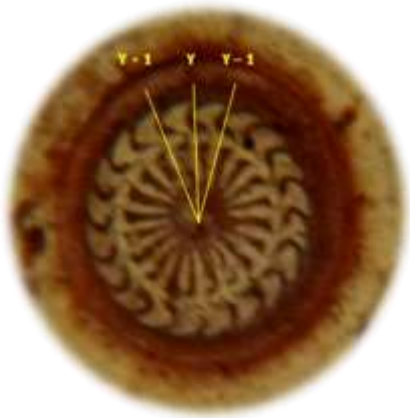

Fig.1: Photomicrograph showing *Trichodina heterodentata* as an adhesive disc recovered from *C. gariepinus*

Mean Water Quality Parameters

Results of water quality parameters (Table 5) showed that in fingerlings pond, mean pH was 6.96 ± 0.03, mean water temperature 29.5 ± 0.01 °C, mean dissolved oxygen (4.62 ± 0.05 mg/l) and mean ammonia (0.003 ± 0.01 mg/L). In juveniles pond, mean pH was 6.92 ± 0.05, mean water temperature 29.8 ± 0.02 °C, mean dissolved oxygen (4.13 ± 0.02 mg/l) and mean ammonia (0.005 ± 0.03 mg/L). In adult pond, mean pH was 6.94 ± 0.02, mean water temperature 29.7 ± 0.03 °C, mean dissolved oxygen (4.20 ± 0.04 mg/l) and mean ammonia (0.009 ± 0.02 mg/L).

Table 5: Mean water quality parameters of ponds where different age groups of *C. gariepinus were* collected

Ponds	Fingerlings Pond	Juveniles Pond	Adults Pond
pH	6.96 ± 0.03	6.92 ± 0.05	6.94 ± 0.02
Water temperature (°C)	29.5 ± 0.01	29..8 ± 0.02	29.7 ± 0.03
Dissolved Oxygen (mg/l)	4.62 ± 0.05	4.13 ± 0.02	4.20 ± 0.04
Ammonia (mg/l)	0.003 ± 0.01	0.005 ± 0.03	0.009 ± 0.02

Discussion

Trichodiniasis and monogeneasis are diseases capable of causing high mortality of fish in aquaculture within a short period of time resulting in huge monetary loss and time wastage. Findings of the present study showed that 22 specimens were infested out of three hundred (300) examined *C. gariepinus* of different age groups from the University of Calabar fish farm with a total of 62 ectoparasites. Parasite impact assessment (PIA) showed that the overall prevalence of ectoparasites (7.33 %) obtained in this study was quite low. This finding is very low compared to 70% reported by Ghoneim *et al.,* (2015) for cultured African catfish (*Clarias gariepinus*) in ElBehera Province, Egypt and 44 % reported by Diab *et al.,* (2006) for cultured *C. gariepinus* in Abassa. The parasites recovered belonged to two parasitic species including

Trichodina sp and *Gyrodactylus sp*. and their morphological characters were similar to the description of Paperna (1996). In this study, the morphometric parameters measured including body diameter, adhesive disc diameter, denticle number, denticle length, blade length, ray length and central path width agreed with findings of Van As and Basson (1989), Van As and Basson (1992), Basson and Van As (1994), Al-Rasheid *et al.,* (2000), Dove and O ´Donoghue (2005) and Martins *et al.,* (2006) for *T. heterodentata* in different fish species. Abundance, intensity, and prevalence of parasites were highest in fingerlings, followed by juveniles and least prevalent in adults. This indicates that *C. gariepinus* fingerlings were more susceptible to *Trichodina sp*. and *Gyrodactylus sp*. which is attributed to a weaker immune system (Ekanem *et al.,* 2011). These findings agree with findings of Eyo and Effanga (2018) that susceptibility to ectoparasites is higher in fish of a lower class size which could subsequently lead to breathing problems. Findings obtained in this study disagrees with that of Poulin (2000) who reported that older fishes have a longer time span to accumulate parasites compared to younger fishes and may provide more external and internal space for parasite development with a larger surface area for skin and gill parasites. Fish infected with Trichodina and monogenean parasites displayed some behavioral characters such as rubbing, loss of appetite, flashing, excessive mucus secretion in gills and rapid breathing. This agrees with finding of Eyo *et al.,* (2015) who reported the same observation for *C. gariepinus* infected with Monogenean trematodes including *Gyrodactylus sp.* and *Dactylogyrus sp.* in two fish farms in Calabar, Nigeria. Prevalence of ectoparasites in *C. gariepinus* from Unical farm in relation to organ specificity showed that *T. heterodentata* and *Gyrodactylus sp* were recovered from the skin and gills. Specifically, *Gyrodactylus sp*. was recovered from the skin whereas *Trichodina sp* was recovered from both the skin and gills. According to Eyo *et al.,* (2013), trichodonids infection in the skin and gills of fish hosts with mucus secretion in their gills could result in irritation and breathing problems. In the present study, a thickened gill filaments, coupled with fusion and congestion of the secondary gill lamellae is similar to previous findings that ectoparasites such as Trichodina spp and monogenia spp infection caused oedema, haemorrhage, leucocytic infiltration, congestion, and gills fusion in fishes (Yemmen *et al.,* 2011; Noor El- Deen, 2015; Khallaf *et al.,* 2020). Also, Klinger and Floyd (2002) reported that these ectoparasites cause serious gill and skin irritation with excessive mucus secretion. In cultured or farmed fish, parasitic infections may be impactful than in wild fishes due to stressful conditions attributed to frequent deterioration of water quality and crowding (Bondad-Reantaso *et al.,* 2005). The inhibitive quality of both chemical (dissolved oxygen, salinities) and physical (current, temperature, depth) factors of the environment and fish species may lead to reduced parasite infections in wild fishes (Ghoneim *et al.,* 2015). Also, Inyang-Etoh and George (2018) submitted that farmed fishes are more exposed to parasitic infections which may be attributed to poor management practices leading to the predisposition of the fish to infection. In this study, the water quality of ponds where the different size of fishes was collected was within the recommended level for optimal growth and survival of freshwater fishes.

Conclusion

In conclusion, trichodiniasis and monogeneasis were more prevalent in *C. gariepinus* fingerlings which is a lower age group. The implication is that farmers may record significant losses arising from impaired welfare, poor consumption and conversion of feed to body weight, poor growth performance, low fecundity, poor sperm quality and high mortality. Also, farmers may record low or no profitability with huge monetary loss. Therefore, to prevent the outbreak of trichodiniasis and monogeneasis, fish should be farmed following standard recommendations for optimal growth and good health such as standard quarantine procedure, water quality management, good nutrition, adequate stocking density, and proper hygienic conditions. However, in case of clinical symptoms of parasites infestation, accurate and early diagnosis, efficient preventive and palliative measures should be adopted to reduce the impacts of these parasites in fish farms.

References

1. Abidemi-Iromini, A. O. and Adelegan, R. A. 2019. Growth Status and Parasitic Fauna of *Clarias gariepinus* collected from Ogbese River and Owena River, South-West Nigeria. Journal of Agriculture and Ecology Research International, 19(2): 1-12.
2. Adeyemo, A. O. and Falaye, A. E. 2007. Parasitic incidence in cultured *Clarias gariepinus*. Animal Research International, 4(2):702– 704.
3. Arthur, J. R. and Lom, J. 1984. Trichodinid protozoa (Ciliophora: Peritrichida) from freshwater fishes of Rybinsk Reservoir, USSR. *Journal of Protozoology*, 31(1): 82-91.
4. Awa, J. N., Anyanwu, P. and Ezenwa, B. 1988. Incidence of parasites infection of pond raisedTilapia sp and some cultivable fish species from three ecological areas of Lagos State. Pages 20 –21. In: Nigerian Institute for Oceanography and Marine Research (NIOMR) 1988 Annual Report.
5. Bichi, A. H. and Dawaki, S. S. 2010. A survey of the ectoparasites on the gills, skin and fins of *Oreochromis niloticus* at Bagauda Fish Farm, Kano, Nigeria. Bayero Journal of Pure and Applied Sciences, 3(1):83–86.
6. Bichi, A. H. and Yelwa, S. I. 2010. Incidence of piscine parasites on the gills and gastrointestinal tract of *Clarias gariepinus* (Teugels) at Bagauda Fish Farm, Kano. Bajopas Bayero Journal of Pure and Applied Sciences, 3(1):104–107.
7. Bondad-Reantaso, M.G., Subasinghe, R. P., Arthur, J. R., Ogawa, K., Chinabut, S. and Adlard, R. 2005. Disease and health management in Asian aquaculture. Vet. Parasitol.,132:249272.
8. Diab, A.S., El-Bouhy, Z. M., Sakr, S. F. and Abdel-Hadi, Y. M. 2006. Prevalence of some parasitic agents affecting the gills of some cultured fishes in Sharkia, Damietta and Fayium governorates, ISTA7, Arrizona, Mexico.

9. Ekanem A.P., Eyo V.O., Udoh P.J. and Okon J. A. 2014. Endo parasites of landed fish from Nsidung beach, Calabar, Cross River State, Nigeria. Journal of Scientific Research and Reports, 3(6): 810-817.
10. Ekanem, A. P., Eyo, V. O. and Sampson, A. F. 2011. Parasites of landed fish from Great Kwa River, Calabar, Cross River State, Nigeria. International Journal of Fisheries and Aquaculture, Vol. 3 (12), pp. 225-230.
11. Eyo, J. E., Iyaji, F. O. and Obiekezie, A. I. 2013. Parasitic infestation of Synodontis batensoda (Rüppell, 1832, Siluriformes, Mockokidae) at Rivers Niger-Benue Confluence, Nigeria. African Journal of Biotechnology, 12(20): 3029-3039.
12. Eyo V.O., Edet T.A. and Ekanem A.P. 2015. Monogenean parasites of the African catfish Clarias gariepinus cultured in Calabar, Cross River State Nigeria. Journal of Coastal Life Medicine, 3(6): 930-934.
13. Eyo, V. O. and Effanga, E. O. 2018. Ectoparasitic infestation of the Nile Squeaker, *Synodontis schall* (Bloch and Schneider, 1801) from the Cross River Estuary, Nigeria. International Journal of Aquatic Biology, (2018) 6(1): 37-43.
14. Eyo, V. O. and Ivon, E. A. 2017. Growth performance, survival and feed utilization of the African Catfish *Heterobranchus longifilis* (Valenciennes, 1840) fed diets with varying inclusion levels of *Moringa oleifera* leaf meal (MLM). Asian Journal of Biology, 4(1): 1 – 10.
15. Eyo, V. O. and Akanse, N. N. 2018. Comparative Study on the Condition Factor, Hematological and Serum Biochemical Parameters of Wild and Hatchery Collected Broodfish of the African Catfish *Heterobranchus longifilis* (Valenciennes 1840). Asian Journal of Advances in Agricultural Research, 5(4):1-8.
16. Eyo, V. O., Arong, G. A. and Opeh, P. A. 2022. Effects of weevil infested feed on the fecundity and gonad development of the African Catfish *Clarias gariepinus* (Burchell, 1822). J Agri Sci Agrotech., , 1(1): 1 – 13.
17. Ghoneim, W. M., Khalil, R. H., Saad, T. T., Tanekhy, M. and Abdel-Latif, H. M. R. 2015.
18. Ectoparasite fauna of cultured African catfish, *Clarias gariepinus* (Burchell, 1822), ElBehera Province, Egypt. International Journal of Fisheries and Aquatic Studies 2015; 3(1): 19-22
19. Inyang-Etoh, A. and George, U. 2018. Parasitic Incidence in Cultured *Clarias gariepinus* (Burchell, 1822) Collected from Homestead Concrete Pond in Akwa Ibom State, Nigeria. Nature and Science, 16(5): 7 – 11.
20. Khallaf, M., El-Bahrawy, A. and Ahmed Elkhatam, A. 2020. Prevalence and Histopathological Studies of *Trichodina spp.* Infecting *Oreochromis niloticus* in Behera Governorate, Egypt. Journal of Current Veterinary Research, 2(1): 1 – 7.
21. Klinger R.E. and Floyd F. 2002. Introduction to Freshwater Fish Parasites. Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.
22. Noor El-Deen, A. I., Abd El-Hady, O. K., Kenawy, A. M. and Mona, S. Z. 2015. Study of the Prevailing External parasitic diseases in cultured freshwater tilapia (*Oreochromis niloticus*) Egypt. Life Science Journal. 12(8):30-37.
23. Paperna I. 1996. Parasites infections and disease of fishes in Africa. CIFA Technical paper no. 31 food and agriculture organization, Rome.
24. Poulin R. 2000. Variation in the intraspecific relationship between fish length and intensity of the parasitic infection. Biological and statistical causes. Journal of Fish Biology, 56: 123137.
25. Udechukwu, C. U., Panda, S. M., Sunday, I. D. and Bello, F. A. 2018. Parasites associated with *Clarias gariepinus* (African catfish) from dam, plastic and concrete ponds in Bauchi metropolis, Bauchi State, Nigeria. GSC Biological and Pharmaceutical Sciences, 2(2), 0105.
26. Upadhyay, J., Jauhari, R. K. and Devi, N. P. 2012. Parasitic incidence in a cyprinid fish Labeo rohita (Ham.) at river Song in Doon valley (Uttarakhand). Journal of Parasitic Diseases, 36(1): 56-60.
27. Van AS, J. G. and Basson, L. 1989. A further contribution to the taxonomy of the Trichodinidae (Ciliophora: Peritrichia) and a review of the taxonomic status of some fish ectoparasitic trichodinids. *Systematic Parasitology*, 14(3): 157-179.
28. Van AS, J. G. and Basson, L. 1992. Trichodinid ectoparasites (Ciliophora: Peritrichida) of freshwater fishes of the Zambesi River System, with a reappraisal of host specificity. *Systematic Parasitology*, 22(2): 81-109.
29. Yemmen, C., Quilichini, Y., Ktari, M.H., Marchand, B. and Bahri, S. 2011. Morphological, ecological and histopathological studies of TrichodinagobiiRaabe, 1959 (Ciliophora: Peritrichida) infecting the gills of Soleaaegyptiaca. Protistology 6(4), 258–263