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HAEMATOLOGICAL AND BIOCHEMICAL PROFILE OF *Clarias gariepinus* FROM OPI LAKE IN NSUKKA LOCAL GOVERNMENT AREA, ENUGU STATE

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ABSTRACT

Haematological and biochemical analysis have been recognized as helpful tools for monitoring fish health. The objective of the study was to investigate the reference value for the haematological and the biochemical profile of *Clarias gariepinus* from Opi Lake, Nsukka Local Government Area of Enugu State, Nigeria. A total of thirty samples of *Clarias gariepinus* comprising twelve males and eighteen females were obtained from the Lake. The blood samples were collected and analysed to obtain the haematological and biochemical parameters using standard methods. The results show that the haematological profile of *Clarias gariepinus* from Opi Lake were significantly different ($p<0.05$) between male and female. The result of the biochemical analysis was also influenced by sex, as the serum aspertate aminotranferase (AST) and alanine aminotransferase (ALT) were significantly higher in females than males. The results of this study provide useful information for comparative studies and also for water quality and fish health status monitoring.

Keywords: Haematology, Biochemistry, *Clarias gariepinus*, Opi Lake

INTRODUCTION

Fish farming is regarded globally as an important agricultural industry in the food production process. It is seen as an essential agricultural practice that can significantly lower nutritional inadequacies worldwide and, as a result, successfully eliminate poverty (Kaleem and Sabi, 2021; Ogunji and Wuertz, 2023). Aquaculture has been found to have the fastest growth rate within Nigeria's agricultural industry. Although there has been a noticeable standstill in recent years, it has been rising at a rate of 13.6% year since 2000, greatly contributing to economic development (Ogunji and Wuertz, 2023).

A crucial concern for guaranteeing the growth of fish output is the application and validation of standardised, low-cost, non-lethal techniques for health monitoring of fish (Pollard *et al*., 2022).

Haematological and biochemical parameters are important indicators of fish health status (Fazio *et al.* 2012; Melefa *et al*., 2020).

Even though blood parameters are a useful tool for assessing the health of aquatic life, there are a number of internal and external issues that might make the process challenging (Seibel *et al*.,2021). The haematological characteristics of aquatic organisms are affected by biological and environmental conditions (Adeyemo, 2007).

The blood parameters are affected by various factors such as species, age, sex, health, nutrition and the external environment of the fish (Gabriel *et al.* 2004 and Fazio *et al*. 2012). The biochemical parameters also reflect the physiological condition of the fish (Newman *et al*.,1997). referred to as the catfish, *Clarias gariepinus* are freshwater fish that are found in tropical regions of West Africa. They are found in lakes, ponds, and rivers and among the most cultured economically and ecologically important fish species in Nigeria (Truter *et al*., 2023).

Although a number of studies (Okafor and Chukwu, 2010; Fazio *et al*., 2012; Ebeh *et al*., 2016) have shown the value of haematology and plasma biochemistry as biomarkers for fish health assessment in aquatic environments, to the best of our knowledge, there is no information about these parameters in the African catfish (*Clarias gariepinus*) from Opi Lake, Nsukka, Nigeria. Analysing *Clarias gariepinus*'s haematological and biochemical parameters may yield some insightful data for aquaculture and environmental management.

The proper assessment of fish health condition depends on the availability of baseline reference values for these parameters (Nwani *et al.*, 2016 and Parrino *et al.*, 2018). Therefore, the aim of this study was to provide baseline data for the haematological and biochemical parameters for *Clarias gariepinus* from Opi lake.

Study area

Opi lake is a tropical freshwater located between 6º45 – 45^{0}28N and 7º29 – 7º35 E in the valley of river Uhere, Northeast of Nsukka, Enugu State, Nigeria. The soil is porous and subject to severe erosion. The vegetation and climate of the lake area has been described (Hare and Carter, 1987). The lake has no permanent inlet, but during the flood period the lake over flows through a small channel at the southern end. The lake has a gentle slope shoreline with thick marginal vegetation (Inyang, 1995).

Fish sampling

A total of thirty samples of *Clarias gariepinus* were collected from Opi Lake and transported to the laboratory. The fish samples had an average length and weight of 31.44 ± 2.29cm and 303.34 ± 29.3g respectively. Blood samples were collected immediately by caudal puncture with the aid of a heparinized 2cm^3 disposable plastic syringe and the blood transferred into lithium heparin anticoagulant tube to prevent the blood from clotting. The blood samples were used to determine the blood parameters (Hb, PCV, RBC, and WBC counts).

Estimation of haematological parameters

The red blood cell (RBC) count was estimated using an improved microscope Neubauer counter and blood diluting fluid (Sood, 2006). The white blood cell (WBC) count was determined also with a Neubauer microscopic counter with blood diluting fluid. The packed cell volume (PCV) was determined by centrifugation of the blood for 5 min at 10,000 revolutions per minute (rpm) in heparinised glass capillaries using a microhaematocrit centrifuge. Leukocyte differential

count was determined using the Leishman technique. The haemoglobin (Hb) concentration was determined by the cyanmethaemoglobin method (Blaxhall and Daisley 1973). The PCV, Hb and RBC were used in calculating the erythrocyte indices (MCV, MCH and MCHC) according to Dacie and Lewis 1984

Mean Corpuscular Volume (MCV) (fL) = $\frac{PCV}{RBC} \times 10$

Mean Corpuscular Haemoglobin (MCH) (pg) = $\frac{Hb}{RBC} \times 10$

Mean Corpuscular Haemoglobin Concentration (MCHC) (g dl^{-1}) = $\frac{Hb}{PCV} \times 100$

Biochemical analysis

Blood samples were centrifuged for 5 min to obtain plasma, which was used to estimate alkaline phosphatase (ALP), aspartate aminotransferase (AST) and alanine aminotransferase (ALT). The levels of plasma ALT and AST were determined according to Reitman and Frankel (1957), while ALP was determined using the method of Babson *et al*. (1984).

Statistical analysis

Data obtained were subjected to descriptive statistics (means and standard deviations) and One-Way Analysis of Variance (ANOVA) using SPSS 20.0.

RESULTS AND DISCUSSION

Haematological parameters

The values obtained for the haematological parameters for male and female *C. gariepinus* in this study is shown in Table 1. The mean Packed cell volume (PCV), red blood cell count (RBC), haemoglobin concentration (HB), white blood cell count (WBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were 27.83 ± 0.83%, 9.78 ± 0.21%, 10.07 ± 0.17, 10083.33 ± 114.18 g/dl, 28.37 ± 0.47, 10.36 ± 0.17 and 38.82 ± 0.87 respectively. The PCV observed ranged from 18 – 34 % and WBC ranged from 8900 – 10900 (Table 1). The haematological profile of *Clarias gariepinus* from Opi Lake varied between male and female. The PCV, RBC and HB were significantly different between male and female fish ($p < 0.05$). PCV, HB and RBC in female were higher (Table 2). WBC was not different significantly between male and female.

Table 1: Summary of haematological profile of *Clarias gariepinus* from Opi Lake (n = 30)

Parameters	Mean ± standard error	Minimum	Maximum
PCV (%)	27.83 ± 0.83	18	34
RBC ($\times 10^6$)	9.78 ± 0.21	7.11	11.21
HB (g/dl)	10.07 ± 0.17	8.70	11.80
WBC ($\times 10mm^3$)	10083.33 ± 114.18	8900	10900
MCV(fl)	28.37 ± 0.47	21.71	32.97
MCH(pg)	10.36 ± 0.17	8.47	13.36
MCHC(g/dl)	38.82 ± 0.87	28.79	50.00

n = number examined.

Table 2: Haematological profile of male and female *Clarias gariepinus* from Opi Lake

Parameter	Male (n = 12)	Female (n = 18)	p – value
PCV (%)	23.25 ± 0.92	30.89 ± 0.46	< 0.001
RBC ($\times 10^6$)	8.61 ± 0.24	10.56 ± 0.07	< 0.001
HB (g/dl)	9.24 ± 0.13	10.62 ± 0.17	< 0.001
WBC ($\times 10mm^3$)	10166.67 ± 205.36	10027.78 ± 135.72	0.560
MCV(fl)	27.10 ± 1.0	29.22 ± 0.29	0.063
MCH (pg)	10.82 ± 0.31	10.06 ± 0.17	0.027
MCHC(g/dl)	40.32 ± 1.43	34.48 ± 0.67	0.002

n = number examined.

Biochemical profile of *Clarias gariepinus* from Opi Lake

The mean serum ALT of the fish was 44.87 ± 0.98 µ/L and range from minimum to maximum recorded values of 35 and 54. The mean AST was 56.57 ± 1.03 µ/L and ranged from 42 – 68. The mean ALP was 30.73 ± 0.64 µ/L (Table 3). Serum ALT and AST were significantly higher in female than male (Figure 1). ALP was not significantly different between male and female *Clarias gariepinus* of Opi Lake.

Table 3: Summary of biochemical profile of *Clarias gariepinus* from Opi Lake (n = 30)

Parameters	Mean ± standard error	Minimum	Maximum
ALT (1 µ/L)	44.87 ± 0.98	35	54
AST (1 µ/L)	56.57 ± 1.03	42	68
ALP (1 µ/L)	30.73 ± 0.64	24	38

n = number examined.

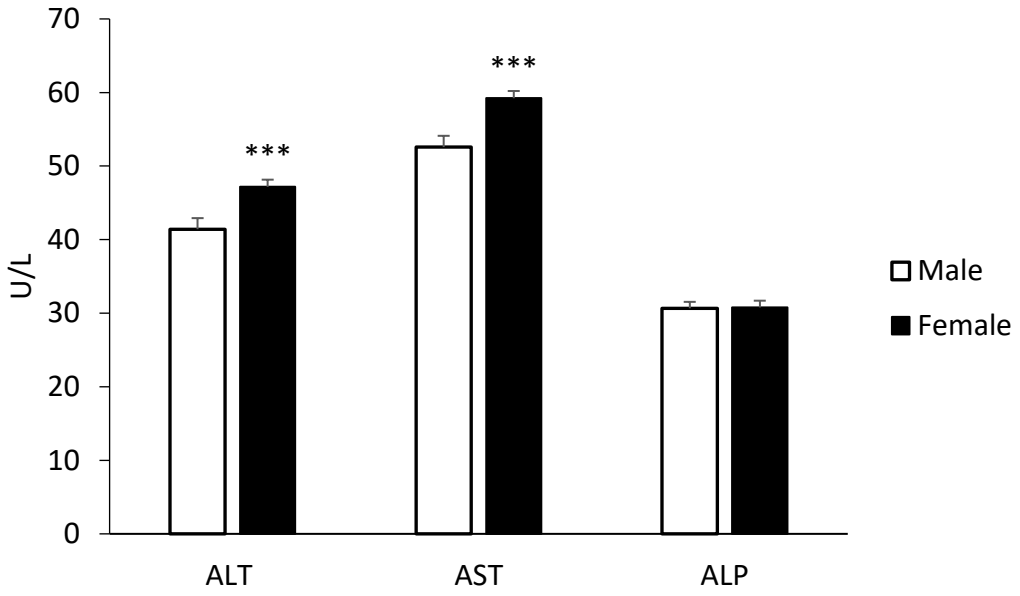

Figure 1: Biochemical profile of male and female *Clarias gariepinus* from Opi Lake

Discussion

Fish haematological and biochemical parameters are very useful in assessing changes in fish health status (Fazio *et al.* 2012; Melefa *et al*., 2020). According to Srivastava and Choudary 2010, these parameters are greatly affected by changes in the fish ambient environment. In the present study, some variations were observed in the haematological parameters of the male and female fish. The PCV, RBC and Hb values were significantly different between male and female fish. The observed higher levels of these blood parameters in the female may be a response to higher metabolic demands in the female fish (Satheeshkumar *et al*., 2011). There was no significant difference in the observed values of WBC between the male and female fish.

The RBC of an organism determines the dissolved oxygen carrying capacity of the blood (Al, 2000). The RBC level in this study was higher than values obtained for *Clarias gariepinus* from Geriyo lake, Nigeria (Onyia *et al.*, 2015) for *Parachanna obscura* (Adebayo *et al*., 2007) from south-western Nigerian freshwaters. The observed differences in the RBC levels may be attributed to the fact that these lakes are located in different ecological zones.

Hb values obtained in this study were higher than 4.46 gdl^{-1}recorded for *Synodontis membranacea* and 4.46 gdl^{-1} for *Heterotis niloticus* by Odo *et al.* (2009). According to Svobodova *et al.* (2008), active species have higher haematological values than non-active ones. Therefore, the high RBC and Hb levels observed in this study is expected for *Clarias gariepinus* which is a very active tropical fish.

The WBC is responsible for immune defence in fish as it helps to fight infection (Magnadoir, 2006). According to Romano *et al*. (2017), WBC counts is dependent on the fish environment and other factors such as infections, age and fish species. The WBC values in this study were within the recommended range for healthy fish (Hrubec *et al*., 2000), even though lower than 4.18 ± 0.28 x109 l^{-1} recorded for *Clarias gariepinus* by Abalaka (2013). The values obtained for PCV in this work were within the recommended range of 23-43% for healthy fish (Wedemeyer and Yasutake,1977). The PCV values here were lower than that of *C. gariepinus* (65.02±18.64%) from Lake Geriyo (Onyia *et al*., 2015). These may also be attributed to differences in the ecological zones.

The values for MCV, MCH and MCHC were calculated based on the values for RBC, PCV and Hb. Therefore, the variations observed in them is dependent on these haematological parameters. The observed low values of MCV and MCH in this work could be related to the size of the fish. The values for MCHC in this work are within the range by Goel et al. (1984) for healthy fish.

Serum ALT and AST were significantly higher in female than male. ALP was not different between male and female fish in this study. Serum biochemistry differs between species and are dependent on ambient temperature, age, and sex of the fish (Jawad *et al.*, 2004).

CONCLUSION

The result of this study provides useful information on the haematology and biochemical parameters in *C.gariepinus* from Opi lake. This will serve as baseline data for fish health assessment and environmental monitoring.

REFERENCES

Abalaka, S.E. (2013). Evaluation of the Haematology and Biochemistry of *Clarias gariepinus* as Biomakers of Environmental Pollution in Tiga dam, Nigeria. *Brazilian Archives of Biology and Technology*, 56(3):371-376.

Adebayo, O.T., Fagbenro, O.A., Ajayi, C.B. and Popoola, O.M. (2007). Normal haematological profile of *Parachanna obscura* as a diagnostic tool in aquaculture. *International Journal of Zoological Research* 3(4): 193–199.

Babson, A. L., S. J. Greeley, S. C. M. Coleman, and G. E. Philips. (1984). "Phenolphtalein Monophosphate as a Substrate for Serum Phosphatase." *Clincal Chemistry* 12 (18): 482–490.

Dacie, J.V. and Lewis, S.M. (2001). *Practical Haematology*. 9th Edition. Churchill Livingstone, London, 633Pp.

Fazio F, Faggio C, Marafioti S, Torre A, Sanfilippo M, Piccione G. (2012). Comparative study of haematological

profile on Gobius niger in two different habitat sites: Faro Lake and Tyrrhenian Sea. Cahiers De Biologie Marine 53:213–219.

Gabriel, U.U., Ezeri, G.N.O. and Opabunmi, O.O. (2004). Influence of sex, source, health status and acclimation on the haematology of Clarias gariepinus (Burch, 1822). African Journal of Biotechnology 3:463–467. DOI:10.5897/AJB.

Goel, K.A., Mishra, B.P., Gupta, K. and Wadhwa, S. (1984). A comparative Haematological study on a few freshwater Teleost. *Indian J. Fisheries.* 31(1):108-112.

Hare, L. and Carter J.C.H. (1987). The benthos of a natural West African lake, with emphasis on the diet migrations and Lumar and seasonal penodicities of the chaoboams (*Diptera, chaoboidae*). *Freshwater Biology*. 16,759–780.

Ebeh, H. N., Ogbonna, S. A. and Nwani, C.D. (2016): Plasma biochemistry, haematological and biometric reference values of Protopterus annectens of Anambra River, Nigeria, Zoology and Ecology.

Hrubec, T.C., Cardinale, J.L. and Smith, S.A. (2000). Haematology and Plasma Chemistry Reference Intervals for Cultured Tilapia (Oreochromis Hybrid). *Veterinary Clinical Pathology* 29(1): 7 –12.

Inyang, N. M. (1995). The fish fauna of Opi lake, South eastern Nigeria, with particular reference to the Biology of *Tilapia zilli.* Journal of Aquacultural Science. 10, 29–36. *Journal for the Tropics*. 12(1):579-582.

Jawad, L.A., Al–Mukhtar, M.A. and Ahmed, H.K. (2004). The relationship between haematocrit and some biological parameters of the Indian shad, *Tenualosa ilisha* (Family Clupeidae). *Animal Biodiversity Conservation* 27: 478–483.

Kaleem, O. and Sabi, A.-F.B.S. (2021) .Overview of aquaculture systems in Egypt and Nigeria, prospects, potentials, and constraints. *Aquac. Fish. 6*, 535–547.

Magnadottir B. (2006). Innate immunity of fish (overview). Fish and Shellfish Immunology 20:137–151. DOI:10.1016/j. fsi.2004.09.006.

Melefa, T.D., Bernard O. Mgbenka, Ifeanyi O. Aguzie, Felix A. Andong, Uju Nwakor, Nwani, C.D., (2020). Morphological, haematological and biochemical changes in African catfish Clarias gariepinus (Burchell 1822) juveniles exposed to clotrimazole Comparative Biochemistry and Physiology, Part C 236, 108815.

Newman, S. H., Piatt, J. F. and White, J. (1997). Haematological and plasma biochemical reference ranges of Alaskan seabirds: their ecological significance and clinical importance. *Waterbirds* 20(3): 492–504.

Nwani, C. D., O. P. Somdare, J. A. Ukonze, V. C. Ejere, A. O. Nwadinigwe, J. C. Nwani, G. E. Odo, and O. N. Ugbor. 2016. "Subchronic Exposure to Fenthion Induce Haematological Changes in African Catfish *Clarias gariepinus* (Burchell 1822)."*Journal of Aquatic Animal Health* 28 (4): 229–234.

Odo, G. E., Nwamba, H. O. and Eyo, J. E. (2009). Aspect of the Biology of *Heterotis niloticus* Cuvier 1829 (Osteoglossiformes: Osteoglossidae) in the Anambra flood River system, Nigeria. *Animal Research International* 6(2): 994 – 1002.

Ogunji, J and Wuertz, S. (2023). Aquaculture Development in Nigeria: The Second Biggest Aquaculture Producer in Africa. *Water*.15(24):4224. https://doi.org/10.3390/w15244224.

Okafor, A. I., and L. O. Chukwu. (2010). Haematological Profile of the African Lungfish, *Protopterus annectens* (Owen) of Anambra River Nigeria. *Journal of American Science* 6 (2): 123–130.

Onyia, L.U., Diyaware, M.Y., Michael, K.G., Musa, M. and Ochokwu, I. J. (2015). Comparison of Haematological Indices, Blood Group and Genotype of *Clarias gariepinus* (Burchell, 1822)and *Clarias anguillaris* (Linneaus, 1758). *Journal of Fisheries and Aquatic Science* 10(5): 392– 399.

Parrino, V., T. Cappello, G. Costa, C. Cannavà, M. Sanfilippo, F. Fazio and S. Fasulo (2018) Comparative study of haematology of two teleost fish (*Mugilcephalus* and *Carassius auratus*) from different environments and feeding habits, The European Zoological Journal, 85:1, 193-199, DOI: 10.1080/24750263.2018.1460694.

Pollard, S., Anderson, J.C., Bah, F., Mateus, M., Sidhu, M. and Simmons, D. (2022). Non-Lethal Blood Sampling of Fish in the lab and Field With Methods for Dried Blood Plasma Spot Omic Analyses. Front Genet. Mar 24;13:795348. doi: 10.3389/fgene.2022.795348. PMID: 35401689; PMCID: PMC8988233.

Reitman, S., and S. Frankel. (1957). Colorimetric Method for the Determination of Serum Oxaloacetic and Glutamine Pyruvic Transaminases. *American Journal of Clinical Pathology* 766:28–56.

Romano, N., Scapigliati, G. and Abelli L. (2017). Water oxygen content affects distribution of T and B lymphocytes in lymphoid tissues of farmed sea bass (Dicentrarchus labrax). Fishes 2:16. DOI:10.3390/fishes2030016.

Satheeshkumar, P., Ananthan, G., Senthil Kumar, D. and Jagadeesan, L. (2011). Haematology and biochemical parameters of different feeding behaviour of teleost fishes from Vellar estuary, India. *Comp Clin Pathol* DOI 10.1007/s00580-011-1259-7.

Seibel, H., Baßmann, B. and Rebl, A. (2021). Blood Will Tell: What Hematological Analyses Can Reveal About Fish Welfare. Front Vet Sci. Mar 30;8:616955. doi: 10.3389/fvets.2021.616955. PMID: 33860003; PMCID: PMC8042153.

Sood, R. (2006). *Textbook of Medical Laboratory Technology*. New Delhi: Jaypee Brothers Medical.

Srivastava S, Choudhary SK. (2010). Effect of artificial photoperiod on the blood cell indices of the catfish, *Clarias batrachus.* Journal of Stress Physiology and Biochemistry 6:22–32.

Svobodova, Z., Pravola, D. and Palackova, J. (1991). Unified methods of haematological examination of fish. *Research*

Inst. of fish culture and Hydrobiology. Vodnany, Czechoslovakia., 31Pp.

Truter, M., Hadfield, K.A. and Smit, N.J. (2023). Review of the metazoan parasites of the economically and ecologically important African sharptooth catfish Clarias gariepinus in Africa: Current status and novel records. Adv Parasitol.;119:65-222. doi: 10.1016/bs.apar.2022.11.001. Epub 2023 Jan 20. PMID: 36707175.

Wedemeyer, G.A. and Yasutake, W.T. (1977). Clinical methods for the assessment of the effect of environmental stress on fish health. *Technical paper at the US fish and wildlife service*. No.89. Washington, DC, US Dept. of interior, Fish and wildlife service, 180Pp.