HAEMATOLOGICAL PROFILE OF *Parachanna* (*Channa*) *obscura* GUNTHER 1861, *Malapterurus electricus* GMELIN 1789 AND *Malapterurus minjiriya* SAGUA 1987

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ABSTRACT

Reference values for some haematological indices of Parachanna obscura, Malapterurus electricus and Malapterurus minjiriya were determined. The mean ± SD values for erythrocyte count (Ec), leucocyte count (Lc), haematocrit (Hct), haemoglobin concentration (Hbc), erythrocyte sedimentation rate (ESR), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), and plasma protein content (g/dl) determined for P. obscura were 2.00 ± 0.71 x 10^{12} /litre, 40.10 ± 1.32 x 10^{9} /litre, 26.40 ± 3.89 %, 11.48 ± 1.55 g/dl, 13.12 ± 1.26 mm/h, 131.70 ± 108.20 fl, 57.28 ± 43.25 pg, 43.48 ± 6.97 g/dl, 62.90 ± 9.70 g/dl respectively. Ec, Lc, Hct, Hbc, ESR, MCV, MCH, MCHC and plasma protein content determined for M. electricus were 1.96 ± 0.17 x 10^{12} /litre, 31.87 ± 2.30 x 10^{9} /litre, 32.03 ± 1.94 %, 7.08 ± 0.22 g/dl, 2.56 ± 0.53 mm/h, 158.59 ± 5.16 fl, 35.24 ± 1.79 pg, 0.225 ± 0.018 g/dl and 52.89 ± 7.23 g/dl, respectively. Ec, Lc, Hct, Hbc, ESR, MCV, MCH, MCHC and plasma protein content determined for M. minjiriya were 2.09 ± 0.21 x 10^{12} /litre, 38.48 ± 3.10 x 10^{9} /litre, 34.04 ± 2.15 %, 8.28 ± 0.25 g/dl, 2.71 ± 0.58 mm/h, 168.15 ± 8.01 fl, 36.43 ± 2.17 pg, 0.255 ± 0.027 g/dl and 50.85 ± 9.86 g/dl, respectively.

Keywords: Haematological profile, *Parachanna obscura, Malapterurus electricus*, *Malapterurus minjiriya*

INTRODUCTION

The African snakehead fish, *Parachanna* (*Channa*) *obscura* (Gunther 1861) (Family: Channidae) is distributed from the Zaire basin through West Africa as far as the Senegal River in the West and the Nile in the east (Leveque *et al*.,1991). It is of economic importance as food fish in freshwater capture fisheries and has great potential for aquaculture in Africa. Three species of the endemic African electric catfish genus, *Malapterurus* (Lacepede 1803) (Family Malapteruridae), are recognized from tropical Africa (Leveque *et al*. 1991), namely *M. electricus* (Gmelin 1789), *M. minjiriya* (Sagua 1987) and *M. microstoma* (Lacepede 1803). Both *M. electricus* and *M. minjiriya* occur in commercial catches in West Africa (Reed *et al*., 1967; Sagua, 1987; Raji and Olaosebikan, 1998).

The use of haematological characteristics in evaluating the health status of fish as a tool for its management under captive rearing is well established and the knowledge of the haematological profile of a fish also indicates its dietary sufficiency and physiological response to environmental stress. The haematological profile of few tropical African catfish species are well documented in literature (Kori-Siakpere, 1985; Fagbenro *et al*.,1993; Erondu *et al*.,1993; Etim *et al*.,1999) but those of electric catfishes have not been reported. This study reports for the first time, the 'normal' haematological profile of *P. obscura, M. electricus* and *M. minjiriya* specimens, and compares it with that of other freshwater fish species.

MATERIALS AND METHODS

Twenty-five adult live *P. obscura* (standard length, 13.8-24.2 cm; somatic weight, 56.7-194.3 g) were obtained from a Government fish farm and kept in glass tanks (120 litre capacity) supplied with filtered and aerated tap water. Twenty-five adult *M. electricus* and 25 adult *M. minjiriya* specimens (18.5 - 27.4 cm standard length, 88.7 - 209.1 g weight) were obtained live from catches of artisanal fishermen in Lokoja, the confluence of River Niger and Benue Rivers in Nigeria. All fishes were considered healthy on the basis of their appearance and the absence of obvious signs of disease. No sexual selection was made. Blood was collected from the caudal vein of each fish using separate heparinized disposable syringes and hypodermic needles. The determination of blood parameters followed the methods of Daramandy and Davenport (1985) and Svobodova *et al*. (1991) as follows:

Haematrocit (Hct): was measured after centrifugation at 15000 rpm using an MSE micro centrifuge.

Haemoglobin Concentration (Hbc): The indirect acid haematin (Sahli) method was used. This involves the use of a special haemoglobinometer and pipette. Haemoglobin concentration was converted to acid haematin by the action of 0.1N HCl using 0.02 ml pipette. The graduated tube was filled with 20 ml 0.1N HCl and 0.02 ml of blood sample added. The mixture was allowed to stand for 5 minutes and then few drops of distilled water were added until the colour matched the standard. Haemoglobin concentration was later estimated as: Hbc = Value obtained x 17.2gm / 100ml ÷100

Leucocyte Count (Lc): The haemocytometer was also used for Lc determination with 0.8 cm objective of the microscope and large squares (area = 1 mm^2, depth = 0.1mm) having volume of 0.1mm^3 and dilution factor of 20. With four squares used the total count per mm^3 was obtain as: 20 x 1 x L cells ÷ 0.4 = 50 x L cells, where L= number of leucocytes counted.

Erythrocyte Count (Ec): was determined in heparinized blood diluted by the Haymen solution at a ratio of 1:200. Neubauer improved haemocytometer placed on a compound microscope stage was used to count/estimate the erythrocyte population. The number of cells counted, R, (average of two fields) was multiplied by the dilution factor and the volume factor. Each smallest square has a volume of 1/4000 mm^3 (area = 1/4000 mm^3, depth = 1/10 mm) and counting done in 80 squares with the sum total volume if 1/50 mm^3 the dilution factor was 200. The Ec was obtained as: 200 x 50 x R cells = 10. 000 x R

Total Plasma Protein: This was determined by the photometric method based on mauve-coloured complex formed by protein and peptides with a burette agent inside, and was estimated as:
Absolute test x concentration of standard. ÷ Absolute standard, where concentration of standard = 50 g and Absolute standard = 5 g

Total Plasma Lipid: The Bio-Lab-Test Celkove Lipid (TL) was used which is based on the reaction of unsaturated lipids and fatty acids, phospholipids and cholesterol with phosphovanillin agent a fear preceding hydrolysis by sulphuric acid.

Erythrocyte Sedimentation Rate (ESR): Wintrobe haematocrit tube was filled with the fish blood samples and then placed in perfectly vertical position using a wooden sedimentation rack for one hour at ambient temperature (25^oC). The erythrocyte sedimentation rate was determined using haematocrit reader. The erythrocyte column was estimated as % of the total column of the blood and the erythrocyte sedimentation rate within an interval of one hour.

Mean Corpuscular Volume (MCV): The mean corpuscular volume is expressed in fentolitres (fl) as: MCV = Hct X 1000 ÷ Ec

Mean Corpuscular Haemoglobin (MCH): The mean corpuscular hemoglobin is expressed in Picogrammes (Pg) as: MCH = Hbc÷ Ec

Mean Corpuscular Haemoglobin Concentration (MCHC): This was calculated from the haemoglobin concentration value in g l^{-1} and from the haematocrit value using the equation: MCHC = Hbc ÷ Hct X 1000.

Three determinations for each of the haematological indices were made for 25 specimens of each fish species (N = 25). The means and standard deviation (SD) were calculated for all the values obtained.

RESULTS AND DISCUSSION

Erythrocyte Count: Generally, erythrocyte counts (Ec) are used as indicators for anaemia. Mean erythrocyte counts and standard deviation (±SD) obtained for *P. obscura, M. electricus* and *M. minjiriya* were 2.00 ± 0.71, 1.96 ± 0.17 and 2.09 ± 0.21 x 10^{12}/l, respectively (Table 1), and were comparable to those reported for *H. bidorsalis* (Fagbenro *et al*., 1993) and *C. furcatus* (Etim *et al*., 1999), but were higher than values of 1.33 – 1.77 x 10^{12}/l reported for other African freshwater fishes (Table 2). Blaxhall and Daisely (1973) noted that fish biologists rely more on haematocrit and haemoglobin concentration estimates as indicators of anaemia.

Leucocyte Count: Leucocyte counts (Lc) are useful as indicators of disease condition or response to infection, and significantly elevated or depressed values are obtained in abnormal conditions. Mean Lc and standard deviation (±SD) obtained for *P. obscura, M. electricus* and *M. minjiriya* were 40.10 ± 1.32, 31.87 ± 2.30 and 38.48 ± 3.10 x 10^9/l, respectively (Table 1). These values were much lower than values reported for *H. bidorsalis* (Fagbenro *et al*., 1993), *C. nigrodigitatus*[2] (Etim *et al*., 1999) and *H. niloticus* (Fagbenro *et al*., 2000); and may be attributed/related to the conditions in the habitat or the general well-being of the fishes. There are wide variations in the leucocyte counts reported for various African freshwater fish species (Table 2).

Haematocrit: Mean haematocrit values and standard deviation obtained for *P. obscura*, *M. electricus* and *M. minjiriya* were 26.40 ± 3.89, 32.03 ± 2.30 and 34.04 ± 2.15 %, respectively. Values reported for haematocrit of other fishes are usually between 20% and 35% (Table 2), and scarcely attain values greater than 50 % (Clarks *et al*., 1979). The mean haematocrit values in this study were within this range. Haematocrit is important as an indicator of the percentage of packed red blood cells, and the colour of the plasma layer above the packed cells, and could be used to detect haemolysis (Archer and Jeffcott, 1977). There is hence the possibility of using haematocrit as a tool in aquaculture and fisheries

Table 1: Haematological (mean ± SD) profile of *P. obscura*, *M. electricus* and *M. minjiriya*

Haematological parameters	*P. obscura* (n = 25)	*M. electricus* (n = 25)	*M. minjiriya* (n = 25)
Ec (10^{12}/l)	2.00 ± 0.71	1.96 ± 0.17	2.09 ± 0.21
Lc (10^{9}/l)	40.10 ± 1.32	31.87 ± 2.30	38.48 ± 3.10
Hct (%)	26.40 ± 3.89	32.03 ± 1.94	34.04 ± 2.15
Hbc (g/dl)	11.48 ± 1.55	7.08 ± 0.22	8.28 ± 0.25
ESR (mm/h)	1.32 ± 0.26	2.56 ± 0.53	2.71 ± 0.58
MCV (fl)	131.70 ± 10.82	158.59 ± 5.16	168.15 ± 8.01
MCH (pg)	57.28 ± 43.25	35.24 ± 1.79	36.43 ± 2.17
MCHC (g/dl)	43.48 ± 6.97	0.225 ± 0.018	0.255 ± 0.027
Total Plasma protein (g/dl)	62.90 ± 9.70	52.89 ± 7.23	50.85 ± 9.86
Total Plasma lipid (g/dl)	8.21 ± 1.10	6.78 ± 0.89	7.40 ± 0.91

Ec = Erythrocyte count, Lc = Leucocyte count, Hct = Haematocrit, Hbc = Haemoglobin concentration, ESR = Erythrocyte Sedimentation rate, MCV = Mean cell volume, MCH = Mean corpuscular haemoglobin, MCHC = Mean corpuscular haemoglobin concentration

Table 2: Comparison of the normal haematologic indices (mean ± SD) of some tropical African freshwater fishes

Fish Species	Ec (10^{12}/1)	Lc (10^{9}/1)	Hct (%)	Hbc (g/dl)	Reference
Clarias isheriensis	1.55 ± 0.27	ND	31.62 ± 5.17	14.56 ± 2.27	Kori-Siakpere (1985)
Clarias gariepinus	1.39 ± 0.45	30.4 ± 9.6	26.07 ± 6.34	11.64 ± 2.93	Erondu *et al.*(1993)
Heterobranchus longifilis	1.65 ± 0.67	28.3 ± 7.9	34.67 ± 2.52	11.27 ± 2.55	Erondu *et al.*(1993)
Heterobranchus bidorsalis	1.99 ± 0.52	72.5 ± 6.0	24.75 ± 1.23	5.43 ± 0.25	Fagbenro *et al.*(1993)
Chrisichthys furcatus	1.98 ± 0.15	31.0 ± 3.9	34.50 ± 5.89	8.18 ± 1.70	Etim *et al.*(1999)
***Chrisichthys nigrodigitatus*[1]**	1.33 ± 0.25	32.8 ± 3.5	22.00 ± 2.12	8.66 ± 1.91	Erondu *et al.*(1993)[1]
***Chrisichthys nigrodigitatus*[2]**	1.77 ± 0.34	58.2 ± 8.7	31.52 ± 5.27	7.44 ± 1.10	Etim *et al.*(1999)[2]
Heterotis niloticus	1.50 ± 0.20	57.2 ± 4.9	28.12 ± 2.98	4.46 ± 0.43	Fagbenro *et al.*(2000)
Parachanna obscura	2.00 ± 0.71	40.1 ± 1.3	26.40 ± 3.89	11.48 ± 1.55	This study
Malapterurus electricus	1.96 ± 0.17	31.9 ± 2.3	32.03 ± 1.94	7.08 ± 2.20	This study
Malapterurus minjiriya	2.09 ± 0.21	38.5 ± 3.1	34.04 ± 2.15	8.28 ± 2.48	This study

Ec = Erythrocyte count, Lc = Leucocyte count, Hct = Haematocrit, Hbc = haemoglobin concentration, ND = not determined

management for checking anaemic condition in fishes.

Haemoglobin Concentration: In fish blood, oxygen is carried in physical solution and also in combination with haemoglobin. Haemoglobin is crucial for the survival of the fish as its role is directly related to the oxygen-binding capacity of blood. Mean haemoglobin concentration values and standard deviation obtained for *P. obscura*, *M. electricus* and *M. minjiriya* were 11.48 ± 1.55, 7.08 ± 2.20 and 8.28 ± 2.48 g/dl, respectively. The high values of haemoglobin concentration of *P. obscura* is comparable to those of *C. isheriensis* (Kori-Siapkere, 1985), *C. gariepinus* and *H. longifilis* (Erondu *et al.*,1993) (Table 2); and reflects high oxygen carrying capacity of the blood, which is consistent with the correlation of haemoglobin concentration with fish activity as suggested by Lenfant and Johansen (1972). Mean haemoglobin concentration values of both *M. electricus* and *M. minjiriya* were <10 g/dl (Table 1), close to values of 7.44 – 8.66 g/dl reported for estuarine catfishes, *C. nigrodigitatus* and *C. furcatus* (Erondu *et al.* 1993; Etim *et al.* 1999), but were much lower than the corresponding values of 11.64 – 15.43 g/dl reported for air-breathing clariid catfishes, *C. isheriensis*, *C. gariepinus*, *H. longifilis* and *H. bidorsalis* (Kori-Siakpere,1985; Fagbenro *et al.*,1993; Erondu *et al.*,1993).

Erythrocyte Sedimentation Rate (ESR): Erythrocyte sedimentation rate has been used to ascertain the response of fish blood to stress, starvation, pollution, parasitism and nutritional deficiencies (Blaxhall, 1972; Soave and Oikari, 1976; Wedemeyer and Yasutake, 1977). Erythrocyte sedimentation rate for *P. obscura, M. electricus* and *M. minjiriya* were 1.32 ± 0.26, 2.56 ± 0.53, and 2.71 ± 0.58 mm/h, respectively (Table 1). Erythrocyte sedimentation rates for *M. electricus* and *M. minjiriya* were comparable to those reported for *C. nigrodigitatus* and *C. furcatus* (2.32 ± 0.49 and 2.41 ± 0.50 mm/h, respectively) (Etim *et al.*, 1999), but higher than 2.08 mm/h reported for *C. isheriensis* (Kori-Siakpere, 1985).

Total Plasma Protein: The mean total plasma protein in the blood of *P. obscura, M. electricus* and *M. minjiriya* were 62.90, 52.89 and 50.85 g/dl, respectively (Table 1). The total plasma protein value for *P. obscura* was comparable to those reported for *C. nigrodigitatus*[2] (61.1 g/dl) and *C. furcatus* (66.8 g/dl) (Etim *et al.*, 1999), while total plasma protein values for *M. electricus* and *M. minjiriya* comparable to 54.2 g/dl reported for *C. isheriensis* (Kori-Siakpere, 1985).

Mean Corpuscular Haemoglobin Concentration (MCHC): Mean corpuscular haemoglobin concentration values for *P. obscura, M. electricus* and *M. minjiriya* were 0.435 ± 0.070, 0.225 ± 0.018,

0.255 ± 0.027 g/dl. The MCHC values reported for *M. electricus* and *M. minjiriya* were similar to those reported for some other African freshwater catfishes, such as *C. isheriensis* (Kori-Siakpere, 1985), *C. gariepinus, H. longifilis* and *C. nigrodigitatus* (Erondu *et al.*, 1993).

Mean Corpuscular Volume (MCV) and Mean Corpuscular Haemoglobin MCH: There are wide variations in both the mean corpuscular volume and mean corpuscular haemoglobin values reported in literature for various African freshwater fish species.

REFERENCES

ARCHER, R. K. and JEFFCOTT, L. B. (1977). *Comparative clinical haematology*. Blackwell Scientific Publishers, London.

BLAXHALL, P. C. (1972). The heamatological assessment of the health of freshwater fish. A review of selected literature. *Journal of Fish Biology, 4:* 593 – 604.

BLAXHALL, P. C. and DAISELY, K. W. (1973). Routine haematology methods for use with fish blood. *Journal of Fish Biology, 5*: 771 – 781.

CLARKS, S., WHITMORE, D. H. and McMAHON, R. F. (1979). Consideration of blood parameters of largemouth bass, *Micropterus salmoides*. *Journal of Fish Biology, 14:* 147 – 154.

DARAMANDY, E. M. and DAVENPORT, S. G. J. (1985). *Hematological techniques.* 2nd Edition. Janda Churchill, London.

ERONDU, E. S., NUBIAN, C. and NWADUKWE, O. (1993). Hematological studies on four catfish species raised in freshwater ponds in Nigeria. *Journal of Applied Ichthyology, 9:* 250 – 256.

ETIM, L., EKANEM, S. B. and UTIN, A. (1999) Haematological profile of two species of catfish, *Chrisichthys nigrodigitatus* (Lacepede) and *Chrisichthys furcatus* (Gunther) from the Great Kwa river, Nigeria. *Global Journal of Pure and Applied Sciences, 5:* 1 – 4.

FAGBENRO, O. A., ADEDIIRE, C. O., OWESEENI, E. A. and AYOTUNDE, E. O. (1993). Studies on the biology and aquacultural potential of feral catfish, *Heterobranchus bidorsalis* (Geoffrey St. Hilaire 1809). *Tropical Zoology, 6:* 67 – 79.

FAGBENRO, A. O., ADEDIRE, C. O., AYOTUNDE, E. O. and FAMINU, E. O. (2000). Haematological profile, food composition and digestive enzyme assay in the gut of African bony tongue fish, *Heterotis niloticus* (Cuvier 1829) (Osteoglossidae). *Tropical Zoology, 13:* 1 – 9.

KORI-SIAKPERE, O. (1985). Hematological characteristics of *Clarias isheriensis* Sydenham. *Journal of Fish Biology, 27:* 259 – 263.

LENFANT, C. and JOHANSEN, K. (1972). Gas exchange in gill, skin and lung breathing. *Respiration Physiology, 14:* 211 – 218.

LEVEQUE, C., PAUGY, D. and TEUGELS, G. G. (1991). Annotated checklist of the freshwater fishes of the Nile Sudan river basins in Africa. *Revue d Hydrobiolodie Tropicale, 24:* 131 – 154.

RAJI, A. and OLAOSEBIKAN, B. D. (1998). *Field Guide to Nigerian Fresh water fishes*. Federal College of Freshwater Fisheries Technology, New Bussa, Nigeria. 106 pp.

REED, W. W., BURCHARD J., HOPSON, A. J., JENNES, J. and YARO, I. (1967). *Fish and Fisheries of Northern Nigeria.* Ministry of Agriculture, Northern Nigeria, Gaskiya, Zaria. 226 pp

SAGUA, V. O. (1987). On a new species of electric catfish from Kainji, Nigeria, with some observations on its biology. *Journal of Fish Biology, 30:* 75 – 89.

SOAVE, A. and OIKARI, A. (1976). Hematological effects of stress on a teleost, *Esox luscious* L. *Journal of Fish Biology, 8:* 397 – 411.

SVOBODOVA, Z., PRAVDA, D. and PALACKOVA, J. (1991). *Unified methods of hematological examination of fish.* Research Unit of Fish Culture and Hydrobiology, Vodany, Czechoslovakia. 31 pp.

WEDEMEYER, G. T. and YASUTAKE, Y. (1977). Clinical methods for the assessment of the effects of environmental stress on fish health. *Technical Report, Wildlife and US Fish Service*, *No. 89*, 17 pp.