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HAEMATOLOGY, SERUM BIOCHEMISTRY AND CONDITION FACTOR OF THE AFRICAN SNAKEHEAD FISH, *Parachanna obscura* FROM NIGERIA'S HYDROLOGIC AREAS

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ABSTRACT

Rapid change in the conservation status of *Parachanna obscura* from least concerned to endangered species raises concerns over the health of the natural populations of this stock in Nigeria. This study therefore investigated the haematology, serum biochemistry and condition factor of *P. obscura* from Nigeria's freshwater environment to assess their wellbeing. All eight hydologic areas in Nigeria were purposively selected while one river in each of the basins was randomly chosen for sampling of *P. obscura*. These randomly selected rivers were from Anambra (Niger South), Imo (Eastern south) , Ibbi (Upper Benue), Kaduna (Niger Central), Katsina Ala (Lower Benue), Hadejia (Lake Chad), Ogun (Western Littoral) , and Sokoto (Niger North) rivers. Fish samples were collected quaterly for a year from fishermen's catch. One-way ANOVA and Duncan's Multiple Range Test were employed for data analysis. Percentage parked cell volume, lymphocytes, neutrophil and monocytes as well as haemoglobin and red blood cells were not significantly different ($p>0.05$) across populations. However, other haematologic parameters differed significantly among the populations. Samples from river Ibbi had significantly higher levels of glucose (47.75±3.22 mg/dL), aspartate aminotransferase (42.25±2.72 U/L), alanine aminotransferase (33.25±2.14 U/L) and blood urea nitrogen (1.91±0.31 mg/dL). Condition factors averaged 0.81±0.01. The present study showed that measured haematologic and serum biochemistry parameters as well as the condition factor were within normal reference values for *P. obscura* or similar tropical fish species reference values. Therefore, other causes of the decline in population of this species in Nigeria should be investigated.

Keywords: *Parachanna obscura*, Nigeria's freshwater environment, Population decline, Endangered tropical fish species.

INTRODUCTION

Parachanna obscura is the most widespread African Channidae and endemic to the inland waters of the Republic of Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Democratic Republic of Congo, Cote d'Ivoire, Ethiopia, Gambia, Ghana, Guinea, Guinea Bissau, Mali, Niger, Nigeria, Senegal, Sierra Leone, Sudan and Togo (Teugels, 2003). It is hardy and can withstand environmental extremes and has rapid growth rate (Osho and Usman, 2019). This fish is recommended for growing children and post-operation patients due to its balanced nutrient profile that aids recuperation (Ama-Abasi and Ogar, 2013). The high gastronomic attributes and possession of few bones does not only make this fish an important part of the staple diets for many people in Africa but also a species of commercial importance. Therefore, the demand for this fish that can no longer be met by its hitherto seemingly abundant natural populations, has generated increasing concern over the rapid change of the conservation status of this fish from least concerned to endangered species (Kpogue *et al.,* 2013). This raises questions over the health of the natural populations of this stock in Nigerian waters **(**AU-IBAR, 2012). It has been suggested that successful farming of this species in semi-intensive and intensive systems could help not only to preserve and enhance natural stocks but also to guarantee continuous production for direct human consumption. A number of researches have been conducted on *P. obscura*, including: parasitic helminth infection of *P. obscura* (Osho, 2017), the proximate composition (Ama-Abasi and Ogar, 2013) and feeding habit (Bolaji *et al.,* 2011).

However, there is dearth of comprehensive knowledge on the haematology**,** serum biochemistry and condition factor of the natural populations of *P. obscura* in Nigeria. These wild populations are very important for the conservation of the species as they serve as the

gene bank for its domestication. A documentation of the hematologic and blood chemistry parameters of the natural populations is one of the processes used in determination of stock membership and provides baseline information for early detection of infectious disease and identification of sublethal conditions affecting production performance. This, in turn will contribute to more specific, timely and effective disease treatment in the future (Hrubec *et al.,* 2000). Hence, the objective of this study was to investigate the haematological and serum biochemical parameters, as well as, condition factor of natural populations of *P. obscura* from Nigeria's freshwater environment.

MATERIALS AND METHODS

Study Site

Nigeria is located between Longitudes 2° 49'E and 14° 37'E and Latitudes 4° 16'N and 13° 52' North of the Equator. The country is tropically placed, experiencing high temperatures and humidity, distinct wet and dry seasons with some variations between South and North. Nigeria has eight natural hydrological areas: Niger North, Niger Central, Upper Benue, Lower Benue, Niger South, Western Littoral, Eastern Littoral, Lake Chad (Ita, 1993). All the eight natural hydrological areas were sampled for *P. obscura* in the present work as shown in figure 1.

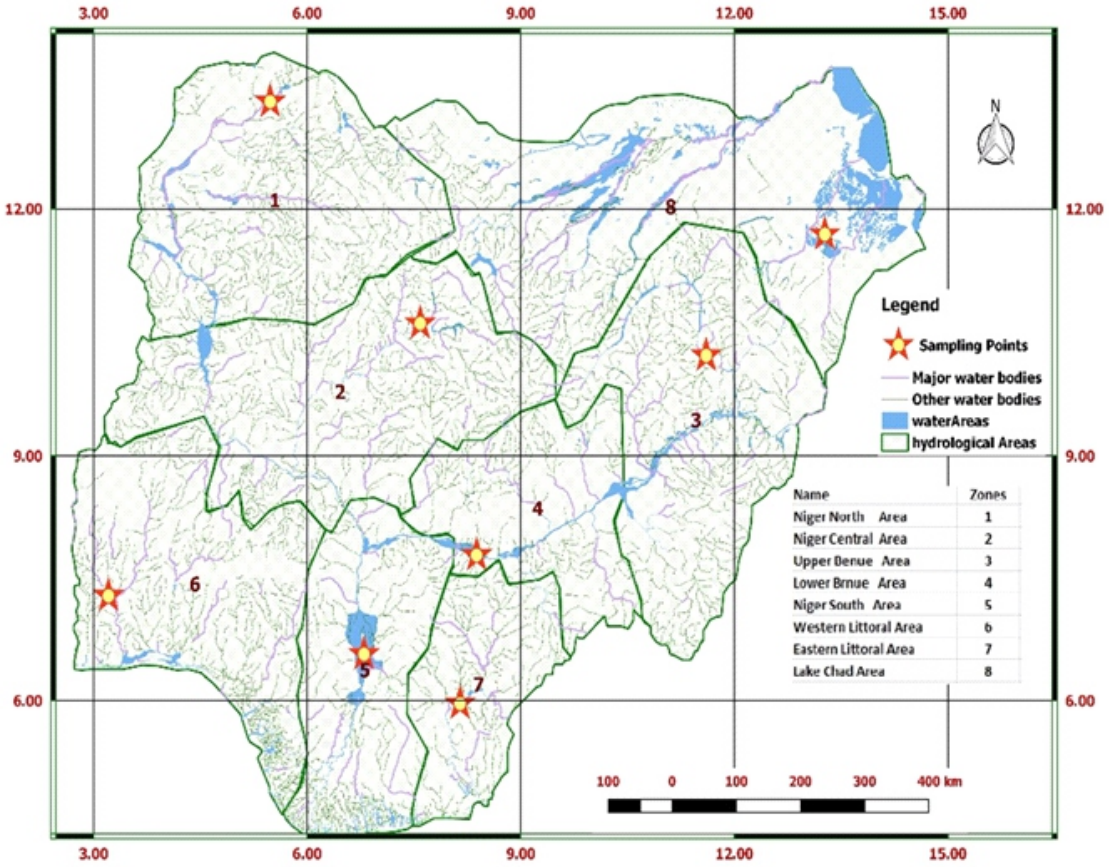

Figure 1: Map of Nigeria Showing Hydrologic Areas and Sampling Sites Adapted from Ita, (1993)

Experimental Design

Two stage sampling techniques (EPA, 2002) was adopted for the collection of *P. obscura* samples from the eight hydrological areas of Nigeria's freshwater. All the hydologic areas were purposively selected while one major river in each of the basins was randomly chosen for sampling of *P. obscura*. These randomly selected rivers were: Anambra (Niger South), Imo (Eastern south) , Ibbi (Upper Benue), Kaduna (Niger Central), Katsina-Ala (Lower Benue), Hadejia (Lake Chad), Ogun (Western Littoral) , and Sokoto (Niger North) as shown in figure 1.

Collection of the fish samples was done quaterly

for a year from fishermen's catch.

Fish Availability

Parachanna obscura was obtained in required quantities in five of the rivers sampled (Anambra, Imo, Katsina Ala, Ogun and Ibbi). The fish was not encountered in Rivers Kaduna and Hadejia while it was incidental catch in River Sokoto.

Haematology and Serum Biochemical Analysis

Five fish were used per quarter from each of the five rivers where the fish was obtained for the haematoloy and serum biochemistry analysis. A total of 100 live *P. obscura* comprising 20 fish per population were therefore used for the haemotology and serum biochemistry experiement. Blood samples were collected through the caudal peduncle and processed for either haematological parameters or serum biochemistry as described by Osho *et al.* (2016). Red blood cell (RBC), total white blood cell count (WBC), packed cell volume (PCV), haemoglobin concentration (Hb), platelet, lymphocytes, monocytes, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), **mean corpuscular hemoglobin concentration** (MCHC) were analyzed (Dacie and Lewis, 2001). The serum biochemical parameters (total protein, albumin, globulin, cholesterol, glucose, aspartate aminotransferase, creatinine, alanine aminotransferase, blood urea nitrogen, **a**lkaline phosphatase were measured using Hitachi 902 automatic analyser (Dauda *et al.*, 2018**).**

Condition Factor (K)

A total of 400 *P. obscura*, comprising 80 fish from each of the five rivers where the fish was obtained, were used to assess the condition factor. The condition factor was calculated for each of the populations using

K = 100W/L3 (Tesch, 1978)

Where K = Condition factor;

W = Weight of fish in (g); L = Total Length of fish in cm.

Data Analysis

Data generated were subjected to descriptive (means and standard deviation) and inferential statistics (one way analyses of variance) while Duncan Multiple Range Test (DMRT) was used to separate means that are significant. Using SPSS 22.0 Statistical Package (SPSS 22.0 for Windows, SPSS Inc., Chicago, IL, USA) at a $á_{0.05}$. Condition factor was computed with Microsoft excel, differences in means were calculated on SPSS 22.0 using one way ANOVA and follow up test was done using DMRT.

RESULTS

Haematology and Serum Chemistry

The results of packed cell volume (PCV) showed no significant difference ($P>0.05$) among the populations. The values ranged between 23.00±1.08% and 29.75±1.9% with the Katsina-Ala (23.00±1.08%) and Ibbi (29.75±1.9%) populations having the least and highest values respectively. The haemoglobin values were between 7.53±0.37g/dL and 9.78±0.64 g/dL in all populations, also showing no statistically significant differences ($p>0.05$) among the populations. The mean white blood cell values varied significantly ($P<0.05$) among the populations. Fish populations from Anambra and Katsina-Ala rivers with mean white blood cell values of 7.20±1.63 $\times10^9$/L and 8.2. ±1.51 $\times10^9$/L respectively, were not significantly different but showed variations with population from other zones. However, fish populations from Imo, Ogun and Ibbi rivers with respective mean white blood cell values of 5.70±1.03($\times10^9$/L), 11.40±0.77($\times10^9$/L) and 11.40±0.77($\times10^9$/L) were significantly different ($P<0.05$) from one another and the other populations. As shown in table 1, mean values of the platelets were between 5.50±0.29$\times10^9$/L and 9.00±0.58$\times10^9$/L for all the samples and this parameter showed no significant difference ($P<0.05$) among the various populations. Mean corpuscular hemoglobin concentration values was the same for all the populations. Lymphocytes, neutrophil and monocytes ranged from 31.25±2.59% to 36.25±3.38%, 62.75±3.38% to 67.75±5.19% and 0.75±25to 1.00±00% respectively in all the populations. These values were however not significantly different among the various populations.

Table 1: Haematological Parameters of *Parachanna Obscura* from Nigeria Freshwater Environment

Parameter	Anambra	Katsina-Ala	Imo	Ogun	Ibbi
PCV (%)	25.25±1.80[a]	23.00±1.08[a]	23.75±4.73[a]	27.00±3.02[a]	29.75±1.9 [a]
Hgb (gm/dL)	8.40±0.544[a]	7.53±0.37[a]	7.80±1.58[a]	8.88±1.02[a]	9.78±0.64[a]
RBC ($\times10^{12}$/L)	7.33±1.87[a]	3.63±0.38[a]	7.14±2.13[a]	5.73±4.46[a]	4.50±0.29[a]
WBC ($\times10^{9}$/L)	7.20±1.63[bc]	8.2. ±1.51[bc]	5.70±1.03[c]	11.40±0.77[b]	24.80±2.37[a]
Platelet ($\times10^{9}$/L)	7.50±0.96[a]	5.50±0.29 [a]	7.00±1.91 [a]	7.50±0.96 [a]	9.00±0.58 [a]
MCV(fl)	41.25±9.65[b]	64.75±5.15[a]	38.00±5.79[b]	58.50±10.60[ab]	65.75±1.65[a]
MCH(Pg)	13.25±3.20 [b]	30.25±4.59[a]	12.25±1.89[b]	18.75±3.42 [b]	7.45±2.25 [b]
MCHC (%)	33.00±00[a]	33.00±.00 [a]	33.00±00[a]	33.00±00[a]	33.00±00[a]
Lymphocyte (%)	35.50±2.63 [a]	34.75±1.88[a]	31.25±2.59[a]	36.25±3.38 [a]	34.50±1.32[a]
Neutrophil (%)	63.75±2.500[a]	64.00±2.12[a]	67.75±5.19[a]	62.75±3.38 [a]	64.50±1.32[a]
Monocytes (%)	0.75±25 [a]	1.00±00 [a]	1.00±00 [a]	1.00±00 [a]	1.00±00 [a]

PCV: packed cell volume, Hgb: haemoglobin, RBC: red blood cell. WBC: white blood cell, MCV: mean corpuscular volume, MCH: mean corpuscular haemoglobin, MCHC: Mean corpuscular hemoglobin concentration

Values with the same superscript are significantly different at $P<0.05$

Table 2 shows that the total protein mean values were not significantly different ($P<0.05$) among the populations and were within the ranges of 3.11 ±0.57 g/100 ml and 4.31±0.19 g/100 ml. The albumin and globulin values were also not significantly different among the populations and had mean values ranging from 0.94±0.14 g/L to 1.19±0.07 g/L and 1.98±0.24 g/L to 3.12±0.15 g/L respectively among the populations. The cholesterol value of the fish population from Ibbi (41.50±2.22 mg/dL) was significantly higher than those of the others which showed no significant difference ($P>0.05$). Glucose results followed similar pattern with the Ibbi (47.75±3.22 mg/dL) population having the highest value among the populations. The least value of 22.75±1.11 mg/dL was recorded for the Katsina-Ala population while that of Ibbi population had glucose value of 47.75±3.22 mg/dL. The mean creatinine values were significantly different ($P<0.05$) among the populations and had values that ranged between 1.20±0.03 mg/dL and 1.69±0.31 mg/dL, with the population from Ogun river having the highest value. Aspartate aminotransferase values also varied significantly between populations from the zones; however, the highest value was recorded for the population from Ibbi with mean value of 42.25±2.72 U/L. The alanine aminotransferase and blood urea **n**itrogen in similitude had mean values that were not significantly different ($p<0.05$) among the populations. The mean values of the alkaline phosphatase were significantly different among the various populations, with the Katsina-Ala and Imo populations having some level of similarity and the Ogun and Ibbi populations also being similarly grouped while the Anambra population stood out as the least in value.

Condition Factor

The result of the condition factor of each of the studied population of *P. obscura* and the average are shown in table 3. The condition factors varied significantly among the populations. The values ranged from 0.66±0.10 to 0.89±0.02 with Katsina-Ala river populations and Anambra river having the least and highest values respectively.

Table 2: Blood Chemistry Values of *Parachanna Obscura* from Nigeria Freshwater Environment

Parameter	Anambra	Katsina-Ala	Imo	Ogun	Ibbi
Tp (g/L)	3.11 ±0.57[a]	3.70±0.31[a]	3.24±0.55[a]	3.30±0.67[a]	4.31±0.19[a]
Alb (g/L)	1.36±0.25[a]	1.17±0.23[a]	0.94±0.14[a]	1.06±0.26[a]	1.19±0.07[a]
Glo (g/L)	2.03±1.05[a]	1.98±0.24[a]	2.31±0.44[a]	2.240.65[a]	3.12±0.15[a]
Cho (mg/dL)	26.25±3.42[b]	22.75±1.11[b]	27.75±5.36[b]	29.50±5.56[b]	41.50±2.22[a]
Glu (mg/dL)	28.00±4.24[b]	26.75±2.7[b]	26.50±4.50[b]	36.00±5.85[ab]	47.75±3.22[a]
Crea (mg/dL)	1.44±0.24[ab]	1.20±0.03[b]	1.67±0.27[ab]	1.69±0.31[ab]	1.44±0.24[a]
AST (U/L)	29.50±5.57[ab]	24.50±1.71[b]	30.25±7.98[ab]	38.00±5.48[ab]	42.25±2.72[a]
ALT (U/L)	23.50±4.50[a]	20.50±1.71[a]	23.50±6.02[a]	31.00±4.84[a]	33.25±2.14[a]
BUN mg/dL	1.29±0.13[a]	1.17±0.45[a]	1.46±0.27[a]	1.58±0.31[a]	1.91±0.31[a]
ALP (U/L)	24.75±4.46[b]	28.00±4.32[ab]	27.75±5.54[ab]	42.25±6.06[a]	41.00±3.11[a]

Tp: total protein, Alb: albumin, Glo: globulin, Chol: cholesterol, Trig: Gluc: glucose, Crea: creatinine, AST: aspartate aminotransferase, ALT: alanine aminotransferase, BUN: Blood Urea Nitrogen, ALP: **a**lkaline phosphatase

Values with the same superscript are significantly different at P<0.05

Table 3: Condition factors of *Parachanna Obscura* Populations from Different Freshwater Bodies in Nigeria

Population source	Mean condition factor	P-value
Anambra	0.84±0.03[ab]	0.00
Katsina-Ala	0.66±0.10[d]	
Imo	0.75±0.02[c]	
Ogun	0.89±0.02[a]	
Ibbi	0.79±0.01[bc]	
Total Average	0.81±0.01	

Values with the same superscript are significantly different at P<0.05

DISCUSSION

The PCV of *P. obscura* populations from different water bodies were within the limits documented by Adebayo *et al.* (2007) who gave reference value of apparently healthy *P. obscura* to be 26.40±3.89%. Argungu *et al.* (2015) also reported that PCV of *Channa striatus* range from 28.67±1.76% to 33.63±2.74%. Haemoglobin values were higher than what was obtained by Kori-Siakpere *et al.* **(2005), who documented the haemoglobin of apparently healthy** *P. obscura* **under laboratory conditions to be 5.70**±1.24 g/dL. It is however, less than 11.48±1.55 g/dL reported by Adebayo *et al.* (2007). The difference in values may be accounted for by age and sex of the tested fish (Hrubec, *et al.,* 2001). Ejraei *et al.* (2015) reported that haemoglobin values of *Ctenopharyngodon idella*, a tropical scaly fish, ranged between 5.97 ± 0.35 g/dL and 9.9 ± 1.6 g/dL depending on age and sex of the fish. The values obtained for all the *P. obscura* in the current experiment are within this limit. Red blood cells (RBC) perform basic roles in the maintenance of haemoglobin functionality (Radu *et al.*, 2009). The RBC from the present study did not differ significantly (p>0.05) among the populations. White blood cell values differed widely among the populations, with the Ibbi population being the most auspicious outlier. In the current study, white blood cells (WBC) ranged from 5.70±1.03×10^9/L to 24.80±2.37×10^9/L. Kori-Siakpere *et al.* (2005) established the WBC normal range for *P. obscura* to be 4.70×10^9/L to 33.30×10^9/L.

White blood cells have the responsibility of body

defence against infectious organisms, and within certain limit, the higher the value, the better is the organism's preparedness for pathogenic and opportunistic infections. From the present studies, the population from the Ibbi have the potential to best fight against such infectious invasion (Douglas and Jane, 2010). However, abnormally high levels could also indicate that the organism's health is already challenged. The mean value of platelets for all the fish from different populations did not show any significant difference ($p>0.05$). Platelets circulate within the blood and bind together when there is recognition of damaged blood vessels. The presence of too high a number is indicative of thrombosis, which is a sign of unpleasant condition such as anaemia, cancer, inflammation, or infection. Too few platelets, on the other hand, is thrombocytopenia with symptoms such easy bruising and frequent bleeding.

The mean corpuscular volume (MCV) values differed significantly between the various population groups. Omitoyin (2006) documented MCV reference value of 72.72 ± 0.01fl for *Clarias gariepinus*. The mean corpuscular hemoglobin concentration (MCHC) value of 33±00% obtained in the current study is within the reference range (33 – 58%) established for *P. obscura* by Adebayo *et al.* (2007). Shahi *et al.* (2012) gave a baseline of 34.9% for *Channa punctatus* while Onyia *et al.* (2014) reported 33±00% for *Clarias angullaries* and 33.15±0.10% for *Clarias gariepinus*. This result is also in tandem with the findings of Omitoyin (2006) who documented the MCHC value of *Clarias gariepinus* to be 33±00%. The percentages of the neutrophils, lymphocytes, monocytes contents of the white blood cells were not significantly different among the populations with respect to each component. This means that none of the population was abnormally challenged in terms of health.

Total protein (TP) was within the baseline values documented for *P. obscura* by Kori-Siakpere (2005) who recorded 2.80 – 6.42 g/L as reference value for *P. obscura*. Increased TP concentration can be due to structural liver alterations that reduce aminotransferase activity consequently leading to reduction in deamination capacity. Hrubec *et al.*, (2000) documented albumin values of apparently healthy tilapia to be between 1.3 g/L and 2.6 g/L with an average of value of 1.8 g/L. The same authors also reported the globulin values to be 1.6 g/L - 4.2 g/L with mean value of 2.1 g/L. Values obtained for both parameters in the present studies are well within the ranges obtained from the tilapia studies. Cholesterol average of 41.50±2.22 mg/dL recorded for the Ibbi population was significantly higher than that of the others and this was followed by the Ogun river population. These two populations had cholesterol values within the obtained range (30.80 – 103.00 mg/dL) recorded for healthy *P. obscura* by Kori-Sapere *et al.* (2005), while the other population had less. The mean values of glucose obtained in the present studies were within the ranges obtained for *Clarias gariepinus* and *Oreochromis niloticus* by Osho *et al.* (2016).

Ajeniyi and Solomon (2010) documented the minimum and maximum creatinine levels for *C. gariepinus* to be 0.8 mg/dL and 1.5 mg/dL respectively. Levels of creatinine in the blood depends mainly on renal function, size as well as environmental factors (British Liver Trust, 2017). The values obtained for all the populations in this study can therefore be considered normal because unlike *C. gariepinus* that are omnivorous, *P. obscura* are carnivorous fish. Vegetarians and omnivores have less nitrogenous waste (Delanghe *et al.*, 1989). The ALT, AST and ALP are parameters used to test liver function. They are normal enzymes present in the hepatocytes which leak into the blood stream when the liver cells are damaged. Phosphatase is found mainly in the bile ducts of the liver and an increased level of ALP can indicate obstructive or cholestatic liver disease, where bile is not properly transported from the liver because of obstruction of the bile duct (British Liver Trust, 2017). Abnormally high value of this parameter can directly indicate damage or malfunctioning of any of these organs also. Nicula *et al.* (2010) recorded values of 38.80±1.88 U/L, 15.40±1.04 U/L and 70±2.59 U/L for AST, ALT and ALP respectively, for some fishes belonging to the family Cyprinidae. For *Clarias gariepinus* reared in earthen ponds, Dorcas and Solomon (2014) reported reference values to be 54-298 U/L, 35-80 U/L and 16-50 U/L for AST, ALT and ALP respectively. The current study has results that are within this range of values.

Condition factor is an index used for monitoring feeding intensity, age and growth rate in fish. It is strongly influenced by both abiotic and biotic environment conditions and can be used to assess the status of the aquatic ecosystem in which fish live (Anene, 2005). Kareem *et al.* (2016) reported that a fish living in favourable environment in terms of food availability and good environmental conditions grow faster with $K \geqslant 1$. However, most of the documented condition factors for *P. obscura* from Nigeria's freshwater environment have reported values less than 1. Bassey and Ajah (2010) also documented condition factors ranging between 0.63 and 0.79 for pond cultured *P. obscura* given different feed types in Calabar, Nigeria while Oyelese (2006) recorded a value of 0.80 for *P. obscura* from Ibadan, southwest Nigeria. Results from the present study are therefore within the ranges that have been documented for captured and cultured *P. obscura* in Nigeria. These results may be due to the fact that the fish species is streamline and not robust fish or round (Osho and Usman, 2019). From the present study, the wellbeing of *P. obscura* from Ogun river was the best.

CONCLUSION AND RECOMMENDATION

The present study showed that the haematological and blood chemistry parameters of *P. obscura* from Nigeria freshwater environment were within normal reference values for the species and/or similar tropical freshwater species. Results from the present study will serve as baseline data for many blood parameters that had not yet been documented for *P. obscura*. This study has shown that decline of the natural population of *Parachanna obscura* in Nigeria is not due to some intrinsic pathological situation of the species, therefore, other causes should be investigated

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