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Abstract
The present study was designed to evaluate the haematological parameters of pond and river catfish (Clarias gariepinus) in Maiduguri, Borno state, Nigeria. Forty adult of C. gariepinus, twenty from pond and twenty from river were used for the present study. The haematological features have been used widely in vertebrate animals including man. The application of haematological procedures is very important for aquaculturist in assessing fish health as it monitors stress. The mean weight and length of fish from pond were 750 g and 46 cm, while that of river fish were 620 g and 43 cm respectively. There was no significant differences of the haematological parameters between the two groups. However there was significant difference in the erythrocyte sedimentation rate between the two groups with higher value in the pond fish than the river fish. This could be attributed to stocking density, humidity, water temperature and oxygen content of the water. There was also significant difference in the leucocyte count between the two groups with the pond fish having higher sizes of heterophils, monocytes, eosinophils and basophil while higher size of lymphocyte in river fish.

Keywords: Haematolgy, pond and river catfish, Maiduguri, Nigeria

1. Introduction
Substantial knowledge of the haematological parameters of fish, is an important tool that can be used as an effective and sensitive index to monitor physiological and pathological changes in fishes. Normal ranges for various blood parameters in fish have been established by different investigators in fish physiology and pathology [1, 2]. Studies on blood indices has proven to be a valuable criteria for assessing the health status of both cultured and wild fish, as these indices provide reliable information on metabolic disorders, deficiencies and chronic stress status before they manifest clinically [3]. Exogenous factors, such as management, diseases and stress, always induce marked significant changes in haematological parameters [4-6].

Studies of the haematological parameters have been carried out to determine the systematic relationships among certain species [7-11]. It is well known that blood comprises 1.3–7% of the total body weight of fish and it represents one of the most active components which, accompanied by haemopoietic organs, contributes to metabolic processes by ensuring gas exchange between the organism and the environment [12, 13]. For this reason, blood parameters are increasingly used as indicators of the physiological condition or sub-lethal stress response in fish to endogenous or exogenous changes [12, 13].

Red blood cell indices provide information about the haemoglobin content and size of red blood cells, abnormal values indicates presence of anaemia and type of anaemia [14]. These indices include the Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC). Fish Blood is one of the most readily accessible body fluid used for diagnostic purposes [15]. Haemogram is particularly recommended as a routine tests in fish hatcheries as a marker for health status in fish [16].

Fish erythrocytes is generally ellipsoidal with concentric, round or oval nucleus, with densely clumped nuclear chromatin with anucleated cells are sometimes observed, the basophilic cytoplasm is clear and about (7 X 12μm) in size [17]. Three forms of thrombocytes are normally found; rod, tear drop and spindle shape which are about (4 X 7.5 μm), (3.5 X 10 μm) and (3.5 X15 μm) in size respectively, although round cells could also be observed [17]. Monocytes are the largest among the leucocytes of catfish and ranges from 9 to 13 μm in diameter with pale
blue cytoplasm commonly filled various number of vacuoles, and nucleus that is round, although bean-shape could be observed. The neutrophils are spherical, 9-10 μm in diameter, characterized by numerous fine dark purple granules scattered in the cytoplasm. Degranulated neutrophils are commonly seen in the adults with nucleus that is normally eccentric and round. Basophils are characterized by coarsened and dark stained granules, depending on the activities of the cells, and ranges between 9-10 μm in diameter. Eosinophils are characterized by coarse acidophilic and uniform oval shaped granule, about 7-8 μm in diameter.

The purpose of this present study was to obtain a baseline knowledge on the haematological variations of the pond and wild African catfish (C. gariepinus). Assesment on these haematological parameters will provide useful informations for further research, that can be used as a biomarker in association with stress conditions and as an available tool to diagnose and monitor disease conditions in fishes.

2. Methodology

2.1 Study area

The study was conducted in the Physiology Laboratory of the Department of Veterinary Physiology, Pharmacology and Biochemistry, University of Maiduguri, Nigeria. Maiduguri is located between latitude 11° and 50° north and longitude 13° and 36° east. The annual rainfall average 320mm, rainy season begins in June and last till October and dry season begins in November and last till May. The rainfall is monsoonal, generally been heaviest in August. The annual temperature average 35.4 °C, the climate of Maiduguri can be divided into six zones: Guinea zone, sunado-Guinea zone, sunado-sahelian zone, sahelo-sudanian, sudanosaharan zone and Saharan zone [18].

2.2 Sources of fish

The total of forty adult catfish of both sexes were randomly used for this study. Twenty each of wild and farmed (pond) African catfish (Clarias gariepinus) were used. The mean weight of pond fish was found to be 750 g and mean length 46 cm, while that of wild fish was 620 g and mean length was 43 cm. The pond fish were bought from fish farmers in Maiduguri, while the wild ones were bought from fish retailers in Gamboru market in Maiduguri, Nigeria whose fish were from Lake Alau. The Lake is located 20 km south east of Maiduguri, Borno State and is situated at the semi-Arid north Eastern Zone of Nigeria (11°40N to11°45N and 13°10 E to 13°20 E). It is believed to be a remnant of former Mega Chad. It receives an annual delivery of water from Ngada and Yedzeram rivers system, but whiles these two rivers and their other tributaries dries up completely, Lake Alau retains water throughout the year [19].

2.3 Haematological procedures

The fish were transported alive in plastic trough containing chlorine free water to the Laboratory. The fish were allowed to acclimatize at water temperature range of 21 to 24 °C for two weeks prior to the commencement of the study. The fish were fed twice on daily basis throughout acclimatization period, but was withheld 24hours prior to the commencement of the procedure. Blood was collected through caudal vein using a 2ml sterile plastic syringe. Plastic instead of glass syringe was used in order to prevent quick coagulation [20]. Determination of haemoglobin (Hb), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and leucocytes differential counts were all carried out according to this method [21]. The blood sample for haematocrit were collected in heparinized capillary tubes, the end of the tubes were sealed with plasticine and the tubes spun for 7 minutes in a micro hematocrit centrifuge at a speed of 12,900 pm. The haematocrits were measured with a micro capillary reader.

2.4 Leucocyte differential count

Leucocyte count were read on the slide with the aid of a microscope and a counter. Blood chart for blood components were prepared and used for identification of the different cell types. For the chart, aid was obtained from work done [22-24].

2.5 Statistical analysis

The results were expressed as mean± standard error of mean. Difference between the two groups was analyzed using student T-test and differences were considered significant at P<0.05 and not significant at P>0.05.

3. Results

Table 1: Full blood count of Pound and River Catfish

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pond catfish</th>
<th>River catfish</th>
</tr>
</thead>
<tbody>
<tr>
<td>X ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hb (g/dl)</td>
<td>12.94 ± 0.87</td>
<td>12.12 ± 0.05</td>
</tr>
<tr>
<td>PCV (%)</td>
<td>33.70 ± 2.00</td>
<td>32.80 ± 1.93</td>
</tr>
<tr>
<td>RBC (x 10^6/mm³)</td>
<td>3.20 ± 0.13</td>
<td>3.21 ± 0.17</td>
</tr>
<tr>
<td>WBC (x 10^3/mm³)</td>
<td>4135 ± 260.39</td>
<td>4130 ± 78.88</td>
</tr>
<tr>
<td>ESR (mm)</td>
<td>&lt;2.05 ± 0.49</td>
<td>&lt;2.15 ± 0.47</td>
</tr>
</tbody>
</table>

Where Hb= Haemoglobin, PCV= Packed cell volume, RBC= Red blood cells, WBC= White blood cells & ESR= Erythrocyte sedimentation rate

Table 2: Hematological indices of Pound and River Catfish.

<table>
<thead>
<tr>
<th>Parameter</th>
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<th>River catfish</th>
</tr>
</thead>
<tbody>
<tr>
<td>X ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCV (fl)</td>
<td>10.53 ± 0.61</td>
<td>10.24 ± 0.75</td>
</tr>
<tr>
<td>MCH (pg)</td>
<td>40.56 ± 5.13</td>
<td>39.28 ± 2.68</td>
</tr>
<tr>
<td>MCHC (%)</td>
<td>38.48 ± 2.85</td>
<td>37.57 ± 3.01</td>
</tr>
</tbody>
</table>

Where MCV= Mean corpuscular volume, MCH= Mean corpuscular haemoglobin & MCHC= Mean corpuscular haemoglobin concentration

Table 3: Differential Leukocytes counts of Pound and River Catfish.

<table>
<thead>
<tr>
<th>Parameter</th>
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<th>River catfish</th>
</tr>
</thead>
<tbody>
<tr>
<td>X ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HET (%)</td>
<td>32.40 ± 1.70</td>
<td>33.20 ± 2.35</td>
</tr>
<tr>
<td>MON (%)</td>
<td>10.30 ± 1.77</td>
<td>9.30 ± 1.57</td>
</tr>
<tr>
<td>EOS (%)</td>
<td>11.00 ± 1.49</td>
<td>10.60 ± 1.71</td>
</tr>
<tr>
<td>BAS (%)</td>
<td>2.70 ± 1.25</td>
<td>1.50 ± 0.85</td>
</tr>
<tr>
<td>LYM (%)</td>
<td>43.60 ± 3.20</td>
<td>45.90 ± 2.08</td>
</tr>
</tbody>
</table>

Where HET= Heterophil, MON= Monocyte, EOS= Eosinophil, BAS= Basophil, & LYM= Lymphocyte

Table 4: Comparative Cells Sizes of pond and river catfish

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pond catfish</th>
<th>River catfish</th>
</tr>
</thead>
<tbody>
<tr>
<td>X ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HET (μm)</td>
<td>10.82 ± 0.39</td>
<td>9.08 ± 0.24</td>
</tr>
<tr>
<td>MON (μm)</td>
<td>6.65 ± 0.19</td>
<td>5.14 ± 0.35</td>
</tr>
<tr>
<td>EOS (μm)</td>
<td>12.64 ± 0.32</td>
<td>10.22 ± 0.18</td>
</tr>
<tr>
<td>BAS (μm)</td>
<td>57.49 ± 3.90</td>
<td>58.83 ± 0.18</td>
</tr>
<tr>
<td>LYM (μm)</td>
<td>8.26 ± 0.13</td>
<td>8.38 ± 0.34</td>
</tr>
<tr>
<td>RBC (μm)</td>
<td>8.91 ± 0.76</td>
<td>8.91 ± 0.97</td>
</tr>
</tbody>
</table>

Where HET= Heterophil, MON= Monocyte, EOS= Eosinophil, BAS= Basophil, LYM= Lymphocyte & RBC= Red blood cell

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4. Discussion
The result of the haematological parameters of pond and river fish in the present study shows no significant difference between the Hb, PCV, RBC and WBC values this agrees with the report of Romeo et al. who reported a similar values in *Hoplias malabaricus* and *Geophagus brasiliensis* [15]. There was a significant difference between the erythrocyte sedimentation rate (ESR) of the two groups with the pond catfish having lower value as compared to the river catfish, this result is similar to that of Adakole [16] and lower to the work reported by Davis A K et al. [23] which shows variation in ESR of *Clarias gariepinus* at difference stackings densities, which suggest that stacking densities could affect the values of erythrocyte sedimentation rate in this specie. There was no significant difference in the values of MCV, MCH and MCHC between the pond and river catfish which also agrees to the work reported by Davis A K [24].

Differential leukocyte count, Heterophil, Eosinophil and lymphocyte were compared between the groups which agrees to the report of Romeo et al. [29] on catfish exposed to disodium Ethylene Bisdithio Carbamates. J Pharmocol Thera. 1993; 33:319-330.


5. References
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