# Haematological Parameters of Heteroclarias Fingerlings Exposed to Different Temperature Levels Under Laboratory Conditions in Minna, Nigeria

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**Abstract:** The study was conducted to investigate the effects of different water temperatures on the haematological parameters of Heteroclarias fingerlings under laboratory conditions. A total of one thousand eight hundred fingerlings, four weeks' old were randomly distributed to four water temperature levels: 26.91 (control), 28.0, 30.0 & 32.0°C) respectively in a complete randomized design. Blood was collected from pooled samples in triplicate from an average of three fingerlings from each experimental treatment. The haematological and the physicochemical parameters were determined at the end of the study based on standard experimental procedures. Results showed that water temperature did not significantly ($P > 0.05$) affect the haematological parameters except the MPCV (26.50±2.10%) that was significantly ($P < 0.05$) lowest in the fingerlings maintained at 30.00°C. The findings revealed that the dissolved oxygen concentration ranged from 6.16 ± 0.91 mg/L at control temperature to 4.58 ± 0.97 mg/L at 320°C and decreased significantly ($p<0.05$) with increase in water temperature, while other physicochemical parameters of the water were not significantly ($P > 0.05$) affected. Water pH, Ammonia concentration and Dissolved oxygen concentration were within the optimum range for fish culture in the tropics. The conclusion of this study showed that water temperature had effect only on MPCV and dissolved oxygen concentration at higher temperature levels.

**Keywords:** Water temperature, Heteroclarias, Haematological parameters and physicochemical parameters.

## INTRODUCTION

Water temperature is known to affect the functional immunology response in ectothermic animals like fishes (1). Acclimation is the sum total of the adjustment which in all organisms such as fish adapt to long term changes in environment. The changes are most frequently thought in terms of seasonal or other temperature changes but can also occur in response to changes in oxygen level, salinity or other environmental factors. The changes are complex mixture of adjustment of hormones, metabolic pathways, enzymes and behaviour which occur at functional levels from the molecular and cellular to the whole organism and population (2). In ectothermic organisms, physiological rate can be adjusted to compensate for some changes in temperature. In fish, thermal acclimation is generally determined by blood parameter changes, during which an initial period of thermal stress is followed by gradual compensation. When a stable blood parameter level that is consistent between the old and new thermal state is reached the animal is considered to be fully acclimated (3). Adeyemo *et al.* (2) documented in his works on haematological response of *Clarias. gariepinus* to changes in acclimation temperature and revealed a decrease in Haematocrit (Ht), Haemoglobin (Hb) and Total Plasma Protein (TPP) at 23±1°C and 41±1$^0$C relative to control (29±1$^0$C).

It is well known that a reduced quantity and quality of erythrocytes and a decreased haemoglobin level lead to a deteriorated oxygen supply. In addition to the transport of oxygen, erythrocytes have other functional tasks in the body, an insufficient quantity and quality of red blood cells would therefore consequently have several additional effects on metabolism beyond the simple oxygen supply for tissue metabolism, decreased TPP has also been reported to be suggestive of malabsorption of nutrients (4). Fish differ in their tolerance to extremes of temperature depending on the species involved, stage of development, environmental temperature, Dissolved Oxygen (D.O), pollution, season and extent to which the environment is heated and that temperature fluctuations affect feeding rate, spawning, dissolved oxygen uptake, pH level and other water quality parameters, which would affect the well-being of the fish. Studies have shown that when the water quality is affected by toxicants, any physiological changes will be reflected in the values of one or more of the haematological parameters (5).

Therefore, the present study was carried out to investigate the influence of different levels of water temperature on the haematological and physicochemical parameters of Heteroclarias fingerlings under laboratory conditions.

## MATERIALS AND METHODS

**Experimental Site:** The study was conducted at the Biology laboratory of the School of Life Sciences, Bosso Campus, Federal University of Technology, Minna. Niger State.

**Source of the Experimental Fish:** A population of one thousand eight hundred old Heteroclarias fingerlings with average weight of 1.01 g were purchased from a private fish farm in Lagos, Lagos state, Nigeria.

**Acclimatization of the Fingerlings:** The fingerlings were acclimatized in rearing tanks for a period of seven days to allow them to recover from transportation stress, fed on a commercial diet (the feed size ranged from 0.3 – 0.5mm (Coppens) to satiation, morning and evening. Water exchange was done twice in a week (6).

**Experimental Set-Up:** The experiment consisted of four treatments with three replicates per treatment, each with stocking density of four hundred and fifty fingerlings. Treatment 1 was the control (26.91°C), while treatments 2, 3 and 4 had water temperature maintained at 28°C, 30°C and 32°C respectively using thermo-regulator. Constant power supply was achieved with the aid of inventer (3.0KV). Twelve plastic indoor aquaria tanks, 25 litres capacity ($55\times35\times35cm^3$) filled with borehole water up to 20 cm level were stocked with 150 fingerlings each. The fingerlings were fed on a commercial diet (Coppens) to satiation, morning and evening following the method of Ayanwale *et al.* (6).

**Determination of Physicochemical Parameters:** Water temperature of the control treatment was determined weekly with mercury in bulb thermometer (10-110$^0$C range), while other treatments were fixed with thermoregulators. Dissolved Oxygen, Hydrogen Ion Concentration (pH) and Ammonia ($NH_3$) were determined weekly based on standard methods (7).

**Haematological Analysis:** The haematological analysis was done at Pathology Department General Hospital, Minna, Niger state. Blood samples were taken from three fingerlings per replicate. The fingerlings were bled from the ventral region near the heart by using a sterilized razor blade according to the method of Adeyemo *et al.* (2). The blood was allowed to flow freely into sample bottles containing 6 % EDTA (Ethylene Diamine Tetra Acetic Acid) solution, an anticoagulant and to the other plain sample bottles (without EDTA) according to the method of Haruna and Adikwu (8). Owing to insufficient amount of blood, from each experimental treatment, blood was collected from pooled samples in triplicate (from an average of three fish each; (9). The blood sample collected in the EDTA bottles were used for the determination of Mean Packed Cell Volume (MPCV), Mean Total Erythrocyte Count (MTEC) and Mean Total Leucocyte Count (MTLC). Serum was obtained from samples without EDTA by centrifugation and then transferred into non-heparinised bottle and stored in a refrigerator and later used for the determination of Mean Blood Protein Level (MBPL) and Mean Blood Glucose Level (MBGL) (8).

**Data Analysis of the Experiment:** The data collected were analysed for significant differences ($P < 0.05$) by the analysis of variance (ANOVA) using a Computer Statistical Package for Social Sciences (SPSS). Duncan Multiple Range Test (Post Hoc), (10) method was used to separate the means where there were statistically significant differences ($P < 0.05$).

## RESULTS AND DISCUSSION

The results of haematological parameters of Heteroclarias fingerlings exposed to different water temperature levels for a period of 12 weeks are shown in Table 1. Generally, there were no significant differences ($p>0.05$)

in the MTEC (3.00± 0.75 x $10^{12}$/L at 26.91 °C to 3.25 ± 0.35 x $10^{12}$/L at 32.00°C , MTLC (4.35 ± 0.25 x $10^{9}$/L between 30.00 & 32.00°C to 5.30 ± 1.40 X $10^{9}$/L at 28.00°C, MBGL (81.08 ± 0.30 mMol/L at control temperature to 81.98 ± 0.55mMol/L at temperatures of 28.00 & 30.00°C) and MBPL (6.65 ± 0.65/dL at 28.00°C to 7.70 ± 0.10g/dL at 32.00 °C) respectively at the end of the study period. However, the MPCV (26.50± 2.10 %) was significantly lowest ($p < 0.05$) among fishes maintained at 30.0 °C. The results of physicochemical parameters of the water medium in which the Heteroclarias fingerlings were exposed to different temperature levels are presented in Table 2. The oxygen consumed (6.16 ± 0.91 mg/L) by the fingerlings under control treatment was significantly higher ($P < 0.05$) than those of higher temperature levels.

**Table 1: Mean (±SD) of Haematological Parameters of Heteroclarias Fingerlings Exposed to Different Water Temperature Levels for a Period of 12 Weeks**

| Haematological Parameters | Temperature Levels (°C) | | | |
|---|---|---|---|---|
| | 26.91 (control) | 28.00 | 30.00 | 32.00 |
| Mean Packed Cell Volume (%) | 31.30±7.67[b] | 29.50±1.30[ab] | 26.50±2.10[a] | 28.80±2.10[ab] |
| Mean Total Erythrocyte Count (x$10^{12}$/L) | 3.00±0.75[a] | 3.10±0.20[a] | 3.05±0.15[a] | 3.25±0.35[a] |
| Mean Total Leucocyte Count (x$10^{9}$/L) | 4..60±0.20[a] | 5.30±1.40[a] | 4.35±0.25[a] | 4.35±0.85[a] |
| Mean Blood Glucose Level (mMol/L) | 81.08±0.30[a] | 81.98±0.55[a] | 81.98±0.15[a] | 88.29 ± 0.00[a] |
| Mean Blood Protein Level (g/dL) | 6.85±0.25[a] | 6.65±0.65[a] | 7.05±0.25[a] | 7.70.±0.10[a] |

Values followed by the same superscript(s) in the same row, are not significantly different at ($p>0.05$) tested by DM

**Table 2: Mean (±SD) Of Physicochemical Parameters of Heteroclarias Fingerlings Exposed to Different Water Temperature Levels for a Period of 12 Weeks**

| Temperature levels ($^0$C) | Dissolved oxygen concentration (mg/L) | Ammonia concentration (mg/L) | pH |
|---|---|---|---|
| 26.91 (control) | 6.6 1 ± 0.91[b] | 0.17 ± 0.09[a] | 6.78 ± 0.89[a] |
| 28.00 | 5.57 ± 0.73[ab] | 0.15 ± 0.09[a] | 6.95 ± 0.37[a] |
| 30.00 | 4.85 ± 1.01[a] | 0.16 ± 0.08[a] | 6.88 ± 0.27[a] |
| 32.00 | 4.58 ± 0.97[a] | 0.15 ± 0.09[a] | 6.82 ± 0.27[a] |

Values followed by the same superscript(s), in the same column, are not significantly different at ($P > 0.05$) tested by DMR

Table 1 also revealed that there were no significant differences ($P > 0.05$) in the ammonia concentration and water pH of the fingerlings in all the treatments. The low MPCV value in the controlled fishes may be attributed to feed or water temperature (11). Water temperature indicated no significant effect on other haematological parameters because the fingerlings had a high adaptive ability and were not under thermal stress (3, 2). This finding was contrary to the works of (12) who reported that red blood cell level increased at 32°C and decreased at 15°C when compared to control (22°C) and had significant ($P<0.05$) difference; while haemoglobin (HB), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) and Red Blood Cell (RBC) were changed but haematocrit was unchanged at 12 hours. The higher value of concentration of dissolved oxygen recorded at control temperature (26.91$^0$C) suggested that the fingerlings were not under any physiological stress. This is because the concentration of dissolved oxygen (6.16 ± 0.91mg/L) was above 5.00mg/L recommended as minimum dissolved oxygen required for fish growth (6). The authors also noted that temperature accelerated metabolic activities of the fingerlings thereby, resulting into decrease in the concentration of oxygen available at high temperature levels. The ammonia concentration was not influenced by temperature because of daily removal of left over feed, and faecal samples and thus, preventing or reducing the risk of build-up of ammonia in the treatments (6). The pH values of water from all the treatments were within the tolerance range of 6.0 to 8.0 documented for juveniles of *Heterobranchus bidorsalis* and *C. gariepinus* (13).

## CONCLUSION

Water temperature had effect only on MPCV and dissolved oxygen concentration at higher temperature levels. Water pH, ammonia concentration and dissolved oxygen concentration were within the optimum range for fish culture in the tropics.

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