

ALTERATIONS IN THE ERYTHROCYTE SEDIMENTATION RATE OF FRESH WATER FISH, *CHANNA PUNCTATUS* ON EXPOSURE TO TEMPERATURE STRESS FROM GODAVARI RIVER, NANDED

Jagtap A. R.* & Mali R. P.

*P G Dept. of Zoology, Yeshwant Mahavidyalaya, Nanded (Maharashtra)

E-mail of Corresponding Author: ashu_anamica@rediffmail.com

Abstract

Out of various environmental factors that influence aquatic organisms, temperature is the most all-pervasive. The environmental temperature also affects blood vascular system of aquatic organisms. The present paper deals with the effect of temperature on the Erythrocyte Sedimentation Rate of freshwater fish, *Channa punctatus*. The freshwater fish, *Channa punctatus*, were collected from Godavari River, Nanded (Maharashtra). They were acclimated to laboratory condition. The fishes were exposed to different temperatures viz. 15°, 20°, 25°, 30°, 35° and 40° C. The sedimentation rate depends on the RBC count variations. The Erythrocyte Sedimentation Rate was observed at different temperature stress. The values were compared with the fish's acclimated to ambient temperature. The Erythrocyte Sedimentation Rate was found to be increased when *Channa punctatus* acclimated to cold temperature stress. The sedimentation of erythrocytes was found to be decreased at warm temperature stress.

Keywords: Temperature Stress, Erythrocyte Sedimentation Rate, *Channa punctatus*

1. Introduction

Temperature is considered to be the most critical factor among most of the ecological factors affects the aquatic environment^{9,10, 21}. Today temperature is being a serious problem throughout the world. Numbers of factors are responsible for the increase in temperature of the environment. The uncontrolled increased pollution and green houses are responsible for emission of enormous amounts of carbon dioxide and nitrous oxides¹². The increase in concentration of gases in atmosphere results in the global warming trend in Earth's Climate^{25, 18}. Hematological study is widely used to adaptations, including the assessment of general health condition. The hematological parameters are used to assess the functional status of the blood stream and have been used as indicator of stress in the aquatic environment^{6, 13}.

The various biochemical indices are used to assess the health of aquatic organisms exposed under various environmental stress conditions. The physical properties of blood are very sensitive to environmental changes¹⁷. Blood parameters are considered as patho-physiological indicator of the whole body and therefore important in diagnosing the structural and functional status of the fish under various stresses². The blood is fluid connective tissue which acts as the main transporting system of the body in all animals. In poikilotherms like fish it plays vital role during every movement for maintaining the physiological nature of the body

with respect to the fluctuating environmental parameters²⁶.

The erythrocytes are uniformly suspended in the plasma in circulation. If an anticoagulant added to a specimen of blood and let stand it in a glass tube, the corpuscles which are heavier than plasma found to settled at the bottom of the tube, while the plasmas remains as a clear supernatant fluid for 1 hour. This process of sedimentation of erythrocyte under the force of gravity alone is known as Erythrocyte Sedimentation Rate (ESR)²². The ESR is applied clinically as an indication of the presence of tissue damage due to stress conditions. Hence Erythrocyte Sedimentation Rate is a common hematology test that is non-specific measure of inflammation¹⁵. The increase or decrease in Erythrocyte Sedimentation Rate shows the physiological dysfunction in the fish.

Hematological parameters give an excellent picture of the processes occurring in the organism under the influence of environmental changes. The study was conducted to assess the changes in the erythrocyte sedimentation rate of freshwater fish, *Channa punctatus* (Bloch), an air breathing Indian Teleost, exposed to different temperature conditions.

2. Materials and Methods

The freshwater fish, *Channa punctatus* was collected from the Godavari River, Nanded (Maharashtra) with the help of local fisherman for the present investigation. They were brought to the laboratory and kept in glass aquarium with continuously aerated tap water. The fishes were

acclimated at room temperature for 8-10 days prior to experimentation. The experimental set was designed to investigate hematological parameters including estimation of hemoglobin in blood of freshwater fish, *Channa punctatus*. The fishes were acclimated to different temperatures for 24 hrs, 48 hrs, 72 hrs and 96 hrs.

Blood sample in fishes were obtained directly by puncturing the caudal vessel¹. The blood collected using 2 ml sterile disposable syringe with No. 21 needle. The use of glass syringes avoided because it may quicken coagulation²². The syringe rinsed with anticoagulant (potassium salt of ethylene diamine tetra acetic acid, EDTA). The needle inserted in the caudal vessel and very slightly aspirated during penetration. Blood was taken under gentle aspiration and then the needle withdrawn. After detaching the needle from the syringe, the blood mixed well in a vial containing anticoagulant (EDTA) at the concentration of 5 mg EDTA per ml of blood⁷. Each analysis repeated six times and results subjected to statistical analysis⁵. The collected blood of fish was used for the hemoglobin content.

2.1 Estimation of Erythrocyte Sedimentation

Rate: Estimation of Erythrocyte Sedimentation Rate was done by using Wintrobe Tube Method²⁴. When an anticoagulated blood allowed standing vertically, sedimentation of erythrocytes occurs. The anticoagulant used in Wintrobe Method was EDTA solution. The anticoagulated blood taken in a tube and kept undisturbed in vertical position in a rack. This will allow the sedimentation of erythrocytes. After one hour the level of fall of red cells noted as mm/hour.

3. Result & Discussion

Fishes are ectotherms, their body temperature changes as per external environmental temperature. The heat capacity of water is higher than air, thermal conductance of water is also higher, and therefore fish are greatly influenced by the effects of increased temperature. The environmental factor-temperature affects all biological organization. The short term exposure of temperature is a serious concern of fish populations²².

The evaluation of blood chemistry parameters provide a baseline and as a tool in fish health management. The blood of fishes is closely related to its response to changes in the environment where it lives, natural or artificial. The fish respond to a particular stressor according to characteristic features of stress reaction common to the majority of most forms of environmental stressors which are responsible for

the alteration in the blood characteristics results the disturbances in the metabolic activities and suppression of immune system^{14,3}.

Effect of temperature on snake headed freshwater fish *Channa punctatus* causes changes in Erythrocyte Sedimentation Rate acclimated to cold and warm temperature stress. The sedimentation rate depends on the RBC count variations. The rate of fall of erythrocytes alters in erythropoiesis rate and in anemic conditions in vertebrates.

The freshwater fish, *Channa punctatus* selected for the present investigation were exposed to different temperatures i.e. 15° C, 20° C, 30° C & 35° C. The temperature of control set was 26° C. The ESR was estimated by Wintrobe Method. The total ESR content estimated for 24, 48, 72 and 96 hrs of continuous exposure. The amount of ESR content found to be increased at cold (15 °C & 20 °C) and decreased at warm (30 °C & 35 °C) temperature stress. As temperature and ESR content in *Channa punctatus* showed inverse relation i.e. as temperature increases the ESR rate decreases up to 96 hr period of exposure. The values for ESR content in *Channa punctatus* at $15 \pm 1^\circ \text{C}$, $20 \pm 1^\circ \text{C}$, $30 \pm 1^\circ \text{C}$ and $35 \pm 1^\circ \text{C}$ for four days are listed on the Table No. 3.4. The values obtained by exposure to cold ($15 \pm 1^\circ \text{C}$ and $20 \pm 1^\circ \text{C}$) and warm ($30 \pm 1^\circ \text{C}$ and $35 \pm 1^\circ \text{C}$) were compared with control values. The data is represented in the table and graph (Table 3 & Graph 3.1).

The present results showed the increase in Erythrocyte Sedimentation Rate (ESR) content when *Channa punctatus* acclimated to cold condition. The fish blood showed decrease in ESR content when acclimated to warm temperature stress relative to that of control set. The increase or decrease in ESR showed the physiological dysfunction in the fish. The ESR depends on the number of RBC's. As RBC count increases it affects on the ESR rate and when RBC count decreases results in the sedimentation of RBC's. An increase in ESR was may be due to increase in the concentration of fibrinogen which develops into fibrinogenemia under stress condition. The increase in haemolysis rate showed the direct relation with ESR content. As rate of hemolysis increases the ESR content found to be increased. The increase in ESR was also may be due to fragility of erythrocytes as a result of stress induced disruptions in the formation and release of erythrocytes from haematopocitic tissue⁴. The overall observation of the result shows that erythrocyte sedimentation rate is negatively correlated with total erythrocyte

count i.e. lower the total erythrocyte count higher will be the erythrocyte sedimentation rate.

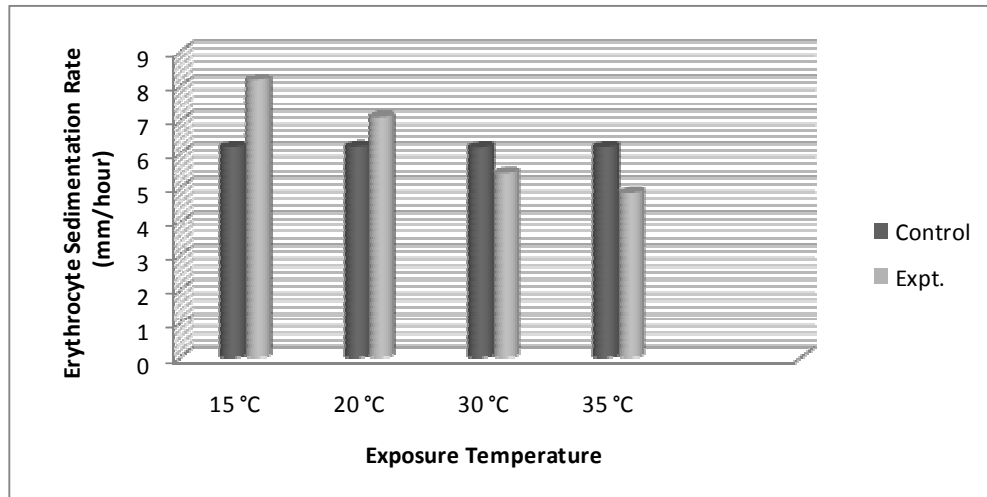
The increase in Erythrocyte Sedimentation Rate may be due to fragility of erythrocytes as a result of stress induced disruptions in the formation and release of erythrocytes from haematopoietic tissue⁵.

Many of the investigators study the changes observed under the influence of stress condition

on the hematological parameters of fishes^{8,11, 13,19, 20}.

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Fig. 1- Graph: Effect of Temperature stress on ESR of Fresh Water Fish, *Channa punctatus*



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