The respiratory mechanisms among fishes are adapted to a variety of environments which regulate their metabolic activities. In response to the varying metabolic requirements under the influence of environmental factors, the oxygen carrying capacity of the blood has been found to change in teleosts. The blood in fishes as in other vertebrates, function as carrier of respiratory gases (Fry, 1957). Several investigators have studied the fish blood in relation to the levels of dissolved oxygen content (Hall, 1928, Prosser et al., 1957; Hughes, 1964) and oxygen carrying capacity (Root, 1931, Black, 1940, Fish, 1940, Fish, 1956 and Singh, 1974). *Channa gachua* (Ham.) is an air breathing fish having (bimodal) gas exchange mechanism i.e. extracting oxygen for its requirements both from the air and water simultaneously under normal condition (Hughes and Singh, 1970; Munshi and Dube, 1973) but it can survive for a considerably longer period under submerged water condition (Hora 1935) i.e. when not allowed to breath air or out of water i.e. exclusively on aerial respiration. Both these conditions (First submerged water condition and second exclusive air breathing) are not the normal feature of respiration in this fish. Therefore, the fish should either die of asphyxiation or develop an adaptive mechanism for survival under such environmental extremes. Since the blood is the carrier of respiratory gases, it is logical to think that any change in the normal respiratory feature of the animal may be reflected in its blood composition. In the present work an attempt has been made to study the changes in the blood parameters in an air breathing fish, *Channa gachua* (Ham.) under different respiratory conditions.

**MATERIALS AND METHODS**

Live specimens of *Channa gachua* were procured from local fish dealers at Siwan, kept in laboratory in glass aquarium (301) for a week for proper acclimatization. The fishes were fed daily on the pieces of goat liver. Fishes of medium size (20-30g) were used in the present study. After seven days the fishes were divided into three groups (A, B and C) each containing ten fishes. Group A was treated as control (respiring both from air and water i.e. normal condition). Group B and C were subjected continuously for 6h to aquatic (submerged water condition with continuous water flow-3 litre/h i.e. aerial respiration prevented) and aerial (i.e. out of water) respiration respectively. Immediately after the experimentation the fishes were sacrificed for haematological studies. The details of the methods employed in the study of different haematological parameters were those of Pandey et al. (1976), Pandey (1977) and Kumari and Pandey (2010) and Ahmad and Razauddin (2018). The significance of difference, if any, was calculated by Student’s t-test at the level of 5%.

**RESULTS AND DISCUSSION**

The result of different haematological parameters during different respiratory conditions (i.e. normal respiratory condition, submerged water condition and exclusive air breathing condition) have been summarised in Table 1. It has been
observed that RBC counts, Hb content and PCV were significantly higher (P<0.05) both in submerged water and air breathing condition. The absolute values (MCV, MCH and MCHC) were higher in control than in experimental groups. The RBC size was also bigger in control as compared to experimental group.

The studies on the different blood parameters in \textit{Channa gachua} (Ham.) were made in the month of February. The values (males+females) obtained for RBC counts and Hb content (Table 1) were slightly lower than the values reported by Dube and Munshi (1973) in \textit{Anabas testudineus} (BL.). Such differences might possibly be due to its different ecological nitch and seasonal effects. RBC counts and Hb content of \textit{C. gachua} seems to be very closer to the values reported by Pandey \textit{et al.} (1976) in \textit{H. fosilis} and Pandey \textit{et al.} (1976) in \textit{C. punctatus} both air breathing fishes, Singh \textit{et al.} (1976) have also reported similar values for RBC counts in \textit{A. cuchia} though its Hb content was higher than in the \textit{Channa}. Joshi and Tandon (1977) have reported the similar values for RBC counts and Hb contents in \textit{Mystus vittatus}. The PCV in \textit{C. gachua} seems to be lower (Table 1) as compared to other air breathing fishes (Singh \textit{et al.} 1976) but it is much nearer to the values reported by Pandey \textit{et al.} (1976) in \textit{C. punctatus}, MCV and MCH of \textit{C. gachua} were similar to that of \textit{C. punctatus} (Pandey \textit{et al.} 1976). Pandey (1977) has also reported the similar values of MCHC in \textit{H. fossilis} as obtained in the present study in \textit{Channa gachua} (Ham.)

The circulatory systems performs gaseous exchange continuously. In the \textit{C. gachua}, it has been found that the RBC number, Hb content and PVC increased significantly (Table 1) under both the experimental conditions (viz. submerged water condition and air breathing condition) as compared to control, having normal respiratory condition. The difference was more pronounced in exclusively air breathing condition. However, on the other hand, a trend of decrease in MCV, MCH, MCHC and RBC size was observed in submerged and air breathing and condition (Table 1). The increase in RBC counts, Hb content and PCV in \textit{Channa gachua} under both the experimental condition may be because of the fact that the animals remained in stressed conditions. Similar findings have been reported by a number of investigators in different animals. Hall \textit{et al.} (1926) have reported an increase in the RBC counts in fishes during asphyxiation. Prosser \textit{et al.} (1957) have shown that the RBC counts and Hb content of the gold fish increased when acclimated to low concentration of oxygen. Hughes (1964) showed that in response to hypoxia, the oxygen carrying capacity of the blood has been increased in fishes by increasing the number of RBC and Hb content in the blood. Singh \textit{et al.} (1976) have also reported an increase in different blood parameters in \textit{A. cuchia} under submerged and air breathing conditions. Thus the present finding in \textit{C. gachua} corroborates the findings of above mentioned workers. The exact mechanism of increase in different blood parameters could not be understood but possibly it may be either due to decrease in total blood volume or the release of RBC stored in the spleen. The later seems to be more logical. The ability of increasing rapidly the number of erythrocytes in the blood by releasing those stored in the spleen. (Toft, 1955) seems to be an important factor in the adaptability of the organism to frequent changes in environment conditions.

\begin{table}[h]
\centering
\begin{tabular}{|l|l|l|l|}
\hline
\textbf{Blood parameters} & \textbf{Normal respiration with} & \textbf{Submerged Water} & \textbf{Exclusive aerial} \\
 & \textbf{access to air (Males +} & \textbf{conditions} & \textbf{respiration} \\
 & \textbf{Females) N=10} & \textbf{(Males+Females) N=10} & \textbf{(Males+Females) N=10} \\
\hline
\text{RBC in million/mm$^3$} & 3.53±0.04 & 3.98±0.06 & 4.45±0.23 \\
\text{Hb g\%} & 12.4±0.12 & 13.8±0.10 & 14.0±0.16 \\
\text{Ht (PCV) \%} & 33.1±0.34 & 37.0±0.41 & 37.6±0.39 \\
\text{MCV \#m$^3$} & 93.76 & 92.96 & 84.89 \\
\text{MCH mg} & 35.12 & 35.17 & 33.93 \\
\text{MCHC \%} & 37.46 & 37.29 & 37.26 \\
\text{Av. RBC surface (\text{\_m$^2$})} & 33.3 & 33.1 & 32.4 \\
\hline
\end{tabular}
\caption{Blood values of \textit{Channa gachua} under normal and different respiratory conditions at 25.5±1.0°C; ±= SEM}
\end{table}
REFERENCES


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