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**RESEARCH ARTICLE**

# BLOOD ELECTROLYTES IN SOME FRESH WATER INDIAN CARPS IN RELATION TO THE AQUATIC BODY

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**ABSTRACT**

Sodium ($Na^+$), potassium ($K^+$) and Chloride ($Cl^-$) play an important role in osmoregulation and homeostasis. In the present study sodium, potassium, chloride and phosphate concentration in the blood of four Indian fresh water carps, *Labeo rohita, Catla catla, Cirrhana mrigala* and *Labeo fimbriatus* has been investigated in relation to a aquatic body. The results indicate that higher concentration of sodium in the blood of all the four types of carps has been noticed in comparison to other electrolytes. The degree of these concentration is as sodium>chloride>phosphate>potassium. The aquatic body in which these fishes are harbored has water with proper electrolyte concentration needed for physiological activities including osmoregulation and homeostatic mechanisms. Hence, the results of blood electrolytes found in these fishes are in normal levels indicating proper environmental conditions for their survival and are in healthy.



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## INTRODUCTION

Electrolyte ($Na^+$, $K^+$, $P^+$, and $Cl^-$ ) levels indicate the operation of a variety of homeostatic mechanisms in the body (Clarke, 1998). Sodium ($Na^+$), potassium ($K^+$) and Chloride ($Cl^-$) play an important role in osmoregulation and homeostasis. In vertebrates, the $Na^+$ concentration in the extracellular fluid surpasses that in the cytosol, whereas $K^+$ is higher in the intracellular fluid compared to the plasma. In fish, $Na^+$ enters the gill cells from the blood; co-transported with $K^+$ and $Cl^-$and driven by an electrochemical gradient favorable to $Na^+$. Cl exits the apical portion of the cell through a channel that is very similar to the defective structure that produces cystic fibrosis in animals. $Na^+$ is transported back across the basolateral membrane into the blood by $Na^+$/ $K^+$ activated ATPase. Furthermore, the $Na^+$/ $K^+$ ratio is vital for the ion permeability barriers in the cell membrane (Evans, 1993). One of the divalent ions, calcium ($Ca^{++}$), serves a number of functions in fish. It combines with phosphorus ($P^+$) for the deposition of bone. It is possible that bone serves as a reservoir of calcium for plasma and tissues. Additionally, $Ca^{++}$appears to be important in the reproduction and mitochondrial functions. It is generally recognized that $Ca^{++}$ has an important role in osmoregulation (Wurst and Stickney, 1989). The physical and chemical changes in aqueous environment often cause some physiological changes in fish, thus, the water quality of an aquatic body is very crucial because it determines the productivity and other parameters necessary for fish survival. Many countries have legislated against the use of chemical poisons in aquatic systems and instead have policies favoring the use of natural bio–degradable alternatives to remove unwanted fish species in aquatic systems. Environmental factors such as pH, turbidity, alkalinity, dissolved oxygen, temperature and conductivity influence the rate of reaction of pollutants entering the water or the lethal effects on the aquatic organisms (Fagbenro, 2002). Water temperature affects all aspects of metabolism and at high temperatures metabolic rate increases alkalinity, acidity and pH determine fish health and the well-being of fish (Ross and Ross, 2002). In the present study blood levels of sodium, chloride, potassium and phosphate, levels have been determined in relation to the electrolytes of the aquatic body in four fresh water Indian carps,

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## MATERIALS AND METHODS

Sodium and Potassium are determine d by colorimetric method (using commercial kit available in the market), Sodium is precipitated as triple salt with magnesium and uranyle acetate.

**Table 1. Blood electrolytes in four Indian carp fishes collected from a aquatic body**

| | Fish Species | Sodium | chloride | Potassium | Phosphate |
|---|---|---|---|---|---|
| *1* | *Labeo rohita* | 138.16 ± 1.16 (SE=0.477) | 100.83 ±0.75 (SE = 0.307 ) | 3.98 ± 0.00 ( SE =0.003 ) | 12.26 ± 0.01 ( SE =0.036 ) |
| **2** | *Catla catla* | 138.00 ± 0.89 (SE=0.365) | 100.83 ± 0.75 (SE = 0.307 ) | 4.16 ± 0.00 ( SE =0.003 ) | 15.01 ± 0.00 ( SE =0.003 ) |
| **3** | *Cirrhana mrigala* | 127.83 ± 0.75 (SE= 0.307 ) | 100.83 ± 0.75 (SE = 0.307 ) | 4.11 ± 0.00 ( SE =0.003 ) | 13.32 ± 0.00 ( SE =0.003 ) |
| **4** | *Labeo fimbriatus* | 132.00± 0.89 (SE =0.365 ) | 97.00 ± 1.41 (SE+ 0.577 ) | 3.98 ± 0.00 ( SE =0.003 ) | 12.96 ± 0.00 ( SE =0.003 ) |

Each value is expressed as mean ± SD, N = 6. All values are significant P = < 0.01

The excess of uranyl ions are reacted with ferrocyanide in an acidic medium to develop a brownish colour. The intensity of the colour produced is inversely proportional to the concentration of sodium in the sample. Potassium reacts with sodium tetra phenyl boron in a specially prepared buffer to form a colloidal suspension. The amount of turbidity produced is directly proportional to concentration of potassium in the sample. Phosphorus is determined by Molybdate UV method. (Using commercial kit available in the market), When inorganic phosphorus reacts with ammonium molybdate in an acidic medium to form a phosphomolybdate complex which is measured in UV range i.e., at 340 nm. The absorbance of the complex is directly proportional to the amount of phosphorus present in the sample. Thermo Scientific ICE 3000 series AA Spectrophotometer was used for determination of blood samples.

**Statistical treatment of the data**

The experimental data was analyzed statistically by adopting varied statistical methods. Standard deviation and the student's- t' test was carried out to know the levels of significance using the standard formula. All the values of P below 5% level are designated as significant, and the values above 5% level are designated as non-significant (Mungikar, 2003).

**Observation**

Electrolytes are most important substances which influence the distribution and retention of body water. Sodium (chief cation of extracellular fluid), chloride and potassium (chief cation of intracellular fluid) are the most important osmotically effective electrolytes. The range of sodium in the fishes is 127.83 - 138.16 mmol/L with an overall mean of 133.99 mmol/L and potassium range is 3.98 -4.16 mmol/L with an overall mean of 4.05 mmol/L the range of chloride is 97.00 -100.83. Phosphorus is combined with calcium in bones. It is found in every cell of the body and some amount is combined with proteins, lipids, carbohydrate and other compounds in blood and muscle in the fishes. Phosphorus content is found moderate in the range of 12.26 -15.01 mg/dl in the blood of *N.notopterus* with an overall mean of 13.38mg/dl. The values presented in the Table – 1

## DISCUSSION

The biochemical Serum electrolyte parameters such as for sodium ($Na^+$) potassium ($K^+$) calcium ($Ca^{++}$ and phosphorus (P+) in the fresh water fish *N.notopterus* reported by Kulkarni (2015) in comparison with other reported fishes such as *Acipenser stellatus* (Shahasvani *et al*., 2010) in which $Na^+$, $K^+$, $Ca^{++}$, $P^+$ are at higher concentration, since this fish is a marine fish and these electrolytes are naturally higher in the environment. In another fish from marine habitat, black scorpion *Scorpiaena porcus* reported by Celik, (2004), the serum consists of electrolytes $Na^+$, $K^+$, $Ca^{++}$, $P^+$ were higher. In large number of different species of fish, the blood electrolyte levels has been determined and reported that the $Na^+$ levels were higher in *Scohthalamus niloticus* (157.00 ± 0.3 – 186.00 ± 0.4 mmol/l) *Oreochromis niloticus* (161.8 ± 4.2 mmol/l), *Piaractus brachypomus* (150.4 mmol/l) *Acipenser naccarii* (140.6 ± 4.8) and *Salmo salar* (137 ± 1.1 – 196 ± 18.6mmol/l). The K levels were lower than the values in *Scophthalmus aquosus* 4.1 ± 0.18 – 5.48 ± 0.15 mmol/l) *Oreochromis niloticus* (4.83 ± 1.15 mmol/l)and Pagas auratus (6.0 mmol/l) but were higher than these of *Salmo salar* (1.3 ± 0.4 – 4.5 ± 0.1 mmol/l. Calcium activities were lower than values reported in *Oreochromis niloticus* (17.43 ± 6.02 mg/dl) but were higher than *Pagas auratus* (3.1 mg/dl) *Piaractus brachypomus* (10.80 mg/dl) and *Acipenser naccarii* (2.3 ± 0.1) and $Ca^{++}$ values were similar to those reports in *Scophthalmus aquosus* 3.49 ± 0.11 – 4.43 ± 0.10 mg/dl and *Salmo salar* (3.3 ± 0.1 – 4.7 ± 1.4 mg/dl) and suggested that the electrolyte ($Na^+$, $K^+$, $Ca^{++}$and $P^+$) levels indicate the operation of a variety of homeostatic mechanisms in the body (Clarke, 1998). Potts and Rudy, (1972) measured some serum parameters in green sturgeon (*A. medirostris*), in which $Na^+$ (114 mmol/l), $K^+$ (1.5 mmol/l) and $Ca^{++}$ (2.6 mmol/l). Sodium levels were found lower and potassium ($K^+$) found higher and higher calcium levels were found in *N. notopterus* (Kulkarni,2015). Holmes and Donaldson, (1969) measured some parameters in *Acipenser oxyrinchus* ($Na^+$: 151 mmol/l, $K^+$: 2.7 mmol/l and $Ca^{++}$: 1.9 mmol/l). In the present study, the $Na^+$ and $K^+$ levels were in a medium and moderate levels in all the four carps compared to other fishes mentioned above. Natochin *et al*., (2000) monitored the biochemical parameters of blood serum in Russian sturgeon, *Acipenser gueldenstaedtii* from 1974 through 1993 and the reported range of values for $Na^+$ is 115.40–165.00 mmol/l and for $K^+$ -2.20–4.60 mmol/l . In the carps the blood electrolyte values observed for Na and K are having similar range of values (sodium -127-138 mmol/l and for Potassium- 3.98 -4.1 mmol/l). The sodium and potassium is involved in the regulation of acid-basic balance maintaining there by an ionic adequacy on the tissue functions (Davis, 2004; Tavares-Dias *et al*., 2008). Phosphorus plays an important role in growth and bone mineralization and also in lipid and carbohydrate metabolism. Thus the levels of serum

electrolytes offer important knowledge concerning the health status of diseases and impact of stress on fish (Wurst and Stickney, 1989; Evans, 1993).

The values obtained for various electrolytes in the present study for the Indian carp fresh water fishes were found to be normal values indicating healthy condition of the fish and the fishes are thriving well in the aquatic body of Gulbarga with favorable environmental conditions.

**Conclusion**

The blood electrolyte level has been studied in four species of Indian carp fishes such as *Labeo rohita, Cutla cutla, Cirrhana mrigala and Labeo fimbriatus* indicates that the values are more or less normal in comparison to other fishes reported. Thus indicating that all the four types of fishes are healthy and probably their osmoregulation and homeostatic mechanisms are functioning normally and probably these four types of fishes are not stressed. However, there is variation of values between the fish species and this could be the method of capture, age of fish, method of drawing blood and diet are all variables that should be considered in accepting study specimens and evaluating results.

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