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STUDIES ON TOTAL PLASMA VOLUME, CORPUSCULAR VOLUME AND BLOOD WEIGHT IN RELATION TO BODY WEIGHT IN A FRESH WATER TELEOSTEAN FISH MYSTUS CAVASIUS (HAM.)

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ABSTRACT

In the present work an attempt has been made to study the total plasma volume (TPV), corpuscular volume (TCV) and total blood weight (TBV) in relation to body weight in a fresh water teleostean fish Mystus cavasius (Ham.). Dye dilution technique using Evans Blue (T-1124) and haematocrit method were employed to determine the relative volume of plasma and red blood cells in the blood. TPV, TCV and TBW per gram body weight decreases from lower to higher weight groups but becomes almost constant at 45.1g animals. The details have been discussed in this paper.

Key Word : Total plasma and corpuscular volume, Blood weight, Fish

INTRODUCTION

The blood volume estimations are of much importance in ascertaining the physiological conditions associated with loss or gain of fluid by the body. Several environmental, physiological and pathological conditions such as acute exposure to cold, high temperature, age, muscular and emotional excitement, pregnancy, burns, dehydration and congestive heart failure etc. are responsible for changes in blood of human beings (Conte,et al. 1963). Data on blood volume in foreign species are available but such data are scanty in Indian species of fishes and warrants immediate attention on its study.

Since the observations of Hyde (1908), the blood volume of fishes has attracted a number of workers such as Martin (1950), Conte et al. (1963), Smith (1966), Munshi et al., (1975), Pandey et al. (1975), Pandey (1977), Prabhakar et al. (2014) and Kumari (2018). Thorson (1958, 1961) while

working on various freshwater and marine fishes realised the importance of plasma volume and evaluated this parameters besides total and percentage blood volumes In the present work, determinations of plasma volume, corpuscular volume and blood weight of a teleostean fish, *Mystus cavasius* (Ham.) have been made in different weight groups, and the relationship of these variables with body weight have been computed.

MATERIAL AND METHODS

The live specimens of different sizes (8.2-56.0g) of *Mystus cavasius* (Ham.) were procured from local fish dealers and were kept under laboratory conditions for a few days for proper acclimatization prior to any experiments. They were fed daily with pieces of goat liver. The blood volume and plasma volume were measured by dye dilution technique method using Evans blue (T-1824) and corpuscular volume by haematocrit method using Van Allen (U.S.A.) haematocrit pipette. They used known amount of Evans blue (dye) which was insected into bulbous aorta. After 30 minutes, the concentration of dye in plasma was measured by photoelectric colorimeter.Extrapolation of the excretion stope to zero time was also calculated. During this period the fishes were anaesthetized by MS222 (Sandoz). The details of the methods employed in the determination of blood volume were those given by Pandey et al., (1975), Pandey (1977) and Kumari (2018). The blood weight was determined by weighing the known volume of blood and calculating this with the total known blood volume. The relationship of the plasma volume, corpuscular volume and blood weight with the body weight has been established by least square regression method through logarithmic transformation of the data.

The relationship between body weight and different variables such as total plasma volume (TPV), total corpuscular volume (TCV) and total blood weight (TBW) has been established using the general growth equation $Y=aw^b$. Here w and y are independent and dependent variables while 'a' (intercept) and 'b' (regression coefficient) are two constants.

RESULTS AND DISCUSSION

A straight line relationship (Fig. 1) has been established between the body weight and different blood parameters (TPV, TCV, and TBW) studied in the present study. TPV, TCV and TBW increase from lower to higher body weight showing the following relationships :-

TBW Vs TPV; $Y = 0.0122\ W^{0.8648}$ ($r=0.9724$) ($p<0.05$)
TBW Vs. TCV; $Y = 0.0154\ W^{0.8387}$ ($r=0.9972$) ($p<0.05$)
TBW Vs. TBW; $Y = 0.0517\ W^{0.9273}$ ($r=0.9998$) ($p<0.05$)
TPV Vs. TBW; $Y = 0.2658\ W^{0.9903}$ ($r=9828$) ($p<0.05$)

Studies on blood volumes of Indian fishes have been made variously in relation to body size (Munshi et al., 1975; Pandey et al., 1976; Prabhakar et al., 2014 and Kumari, 2018), sex (Munshi et al., 1975), environmental temperature and different periods of breeding cycle (Pandey, 1977) but information regarding the plasma and corpuscular volume on Indian fishes are very limited. Thorson (1958) using T-1824 has measured the plasma volume in a number of species namely, *Raja ribna* (5.9%), *R. binoculata* (6.5%), *Squalus acnthias* (5.5%) and *Hydrolagus collie* (4.2%). The plasma of *Epiatretus stoulii* (Mc Carthy, 1967) seem to be higher than those reported by Thorson (1958) in a number of fishes. In the present work in *Mystus cavasius* (Ham.), it has been found that the plasma volume varies from 4.02% in smaller fishes (8.2g) to a value of 3.10% in larger specimens (56.0g). Such values are lower than those reported by Thorson (1958) but higher than those reported by Pandey et al. (1975) in *H. fossilis*, Thorson (1961) in his study has indicated that the evolutionary trend in fish appreared to be towards lower blood volume. The explanation for such an evolutionary trend may be associated with the development of a more rapid and efficient circulation of the blood and is accompanied by a more efficient mechanism for the return of venous blood by the tissues (Pandey et al., 1976). A smaller blood volume and shorter circulation time would also speed up all functions of the blood including its oxygen carrying capacity. The value of exponent (b) for blood weight in relation to body weight in *M. cavasius* has been calculated to be 0.9273 which is slightly higher than those reported by Martin (1958) in heavier skate

(b=0.75). Further, in the present work per cent blood weight is found to vary from 4.5% in lower weight group to a value of 3.7% in higher weight group. Such values are very close to that reported by Korzhuyev & Nikolskaya (1951) in *Solea vugaris* (4.0-5.9%), Conte et al. (1963) in fresh water rainbow trout (3.5%) and by Smth (1966) in *Oncorhynchus nerka* (4.0%) and *O. kisutch* (4.5%). TPV, TCV and TBW were higher (per gram body weight) in smaller animals because of the fact that the metabolic rate of younger animals remain higher than in adults. These values (TPV, TCV and TBW) become almost constant at 45.1g fish indicating that the physiology of this fish stabilises at thigh weight. Finally, it can be said that such studies are of great importance in ascertaining the physiological status of the fish.

Table-1 : Showing total plasma volume (TPV), total corpuscular volume (TCV) and total blood weight (TBV) in relation to body weight in *Mystus cavasius* (Ham.) at 25.5±1.0^{0}C. N=8

Body wt (g)	TPV (ml)	TPV/g Body wt.	TCV (ml)	TCV/g . Body wt	TBW (g)	Blood weight (g)		Blood volume	
						Total (g)	%	Total	%
8.2	0.263	0.032	0.067	0.008	0.360	0.369	4.5	0.330	4.02
14.6	0.418	0.028	0.112	0.008	0.614	0.596	4.2	0.530	3.63
22.5	0.616	0.027	0.184	0.008	0.949	0.954	4.2	0.800	3.55
34.2	0.972	0.028	0.248	0.007	1.393	1.43	4.2	1.220	3.56
45.1	1.084	0.024	0.306	0.007	1.754	1.72	3.8	1.390	3.08
56.0	1.365	0.024	0.385	0.006	2.103	2.07	3.7	1.750	3.10
Pooled SEM						±0.125	±0.33	±0.08	±0.29

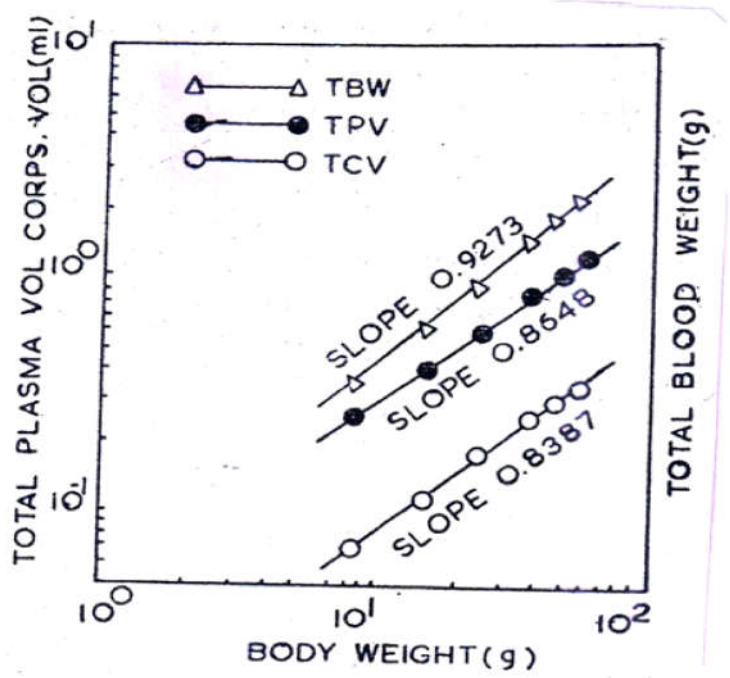

Fig1. : Showing the log-log graph of the plasma volume, corpuscular volume and blood weight in relation to body weight in *Mystus cavasius* at 25.5±1^{0}C

REFERENCES

Conte, F.P., Wegner, H.H. & Harris, T.O. 1963. Measurement of blood volume in the fish, *Salmo gairdneri* - *Am. J. Physiol.,* 205 : 533-540.

Hyde, I.H. 1908. The effect of salt solution on the respiration, heart beat and blood pressure in skate.-*Am. J. Physiol.,* 23 : 203-213.

Korzhuyev, P.A. & Nikolskaya, I.S. 1951. Obem krovi nekotorych morskich I presnovodnych ryb. - *Dokl. Akad. Nauk, SSS,* 80 : 989-992.

Kumari, Jyotsna. 2018. Studies on total blood, plasma and corpuscular weight in relation to body weight in an air breathing fish, *Channa gachua* (Ham.). *Proc. Zool. Soc. Indi.* 17(2) : 45-50.

Martin, A.W. 1950. Some remarks on the blood volume of fish. In studies Honourling Trevor Lincaid, ed. M.H. Hatch, Seattle, University of Washington, pp. 125-140.

Mc Carthy, J.E. 1967. Vascular and extravascular fluid volume in Pacific hagfish (*Eptatretus sloutii,* Lockington).- *M.A. Thesis,* Oregon state University, U.S.A.

Munshi, J.S.D., Pandey, P.K. & Mishra, N. 1975. Measurement of blood volume in the Indian Mud eel, *Amphipnous cuchia* (Ham.) - *Folia haematol, Leipzig,* 102(4) : 438-447.

Pandey, B.N. 1977. Haematological studies in relation to environmental temperature and different periods of breeding cycle in an air breathing fish, *H. fossilis* - *Folia haematol.,* 104 : 69-74.

Pandey, B.N; Pandey, P.K; Choubey, B.J; Munshi, J.S.D. & Hughes, G.M. 1976. Quantitative measurement of blood in an air breathing siluroid fish, *H. fossilis* in relation to body weight and respiratory surface areas - *Matsya,* 2, 1-12.

Pandey, P.K; Pandey, B.N; Choubey, B.J & Munshi J.S.D. 1975. Total plasma and corpuscular volume in relation to body weight of an air-breathing siluroid fish, *H. fossilis* (Bloch).- *Zool. Anz. Jena,* 194(5/6) : 317-392.

Smith, L.S. 1966. Blood volume of three samonids - *J. fish. Res. Bd. Can.,* 23 : 1439-1446.

Thorson, T.B. 1958. Measurement of fluid compartments of four species of marine chondrichthyes. - *Physiol. Zool.,* 31 : 16-23.

Thorson, T.B. 1961. The partitioning of body water in Osteichthyes; phylogenetic and ecological implications in aquatic vertebrates. - *Bull. mar. boil. Lab.* (Wood Hole), 120 : 238-254.

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