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Studies on the Blood Parameters of Two Indian Air Breathing Fishes - *Anabas Testudineus* (Bloch, 1785) and *Channa marulius* (Hamilton, 1822)

Dr. Pabitra Sarmah
Department of Zoology, Silapathar Science College, PO- Amritpur, Silapathar, District - Dhemaji (Assam), India.

(Corresponding author: Dr. Pabitra Sarmah)
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ABSTRACT: The blood parameters like red blood cells count, haemoglobin content, packed cell volume, mean corpuscular value, mean corpuscular haemoglobin concentration and oxygen capacity have been estimated in *Anabas testudineus* and *Channa marulius* with a view to correlation of these parameters. In these two species of fishes, the red blood cell counts, haemoglobin content and packed cell volume increase with increasing body weight but these values per gram body weight decrease with increasing body weight but mean corpuscular value, mean corpuscular haemoglobin concentration and mean corpuscular haemoglobin values could not give any specific trend. Statistical relationship between body weight Vs red blood cell counts and haemoglobin content have also been established in these two species of fishes taken into account in the present investigation. In these two cases, the values of correlation coefficient (r) were calculated to be very high which is indicative of the fact that these parameters are highly correlated. Total red blood cell counts, red blood cell counts/g body weight, total haemoglobin content/g body weight, packed cell volume and oxygen capacity values were highest in *Anabas testudineus* than *Channa marulius.*

Keywords: Air breathing fishes, blood parameters, body weight, haemoglobin, oxygen capacity.

INTRODUCTION

Studies on blood parameters like RBC counts, haemoglobin content, haematocrit values (PVC), mean erythrocyte haemoglobin content and oxygen capacity etc. have revealed adaptive features correlated with the relative importance of air and water breathing. Purely aquatic breathers have been shown to possess generally low values of Hb content and oxygen capacity in contrast to the air breathing fishes (Lombolt and Johansen 1976). A definite tendency of haemoglobin content and oxygen capacity to be higher in air breathing teleost has been disclosed by the studies of Lenfant and Johansen (1972). The number of species of air breathing fishes so far studied on this aspect is too small (Pandey *et al*., 1976; Chaturvedi, 2007) compared to large number of such species. Attempts therefore is being made in the present investigation to estimate the blood RBC count, haemoglobin contents, PVC, MCHC, MCH and oxygen capacity etc. in *Channa marulius* (Hamilton,1822) and *Anabus testudineus* (Bloch,1785) also to correlated these parameters with their air breathing habitat.

1. *Anabus testudineus* (Bloch, 1785) belongs to the family Anabantidae of order - Perciformes. It is distributed in the fresh water, swamps of India, Pakistan, Burma, Ceylon, Malaya archipelago, Siam, Indo-China, China, Philippines and Polynesia. It is an obligate air breathing fish.

2. *Channa marulius* (Hamilton, 1822) belongs to the family Channidae (Ophiocephalidae) of the order Channiformes (Ophiocephaliformes). It is commonly known as snake-headed air breathing murrels. It is distributed in the fresh water tanks, ponds, chaired and swamps of West Bengal Deccan, Mysore, Ahmedabad, Uttar Pradesh, Bihar, Assam and more or less in the NE states. It is also an obligate air breathing fish.

Literature Survey. Haematology plays an important role in the diagnosis of diseases in fishes and also an assessment of the effects of pollution on fish (Mc Cathy *et al.,* 1973). Haematological parameters are closely related with the response of the animals to its environment (Haider, 1970; Johansen *et al*., 1972). A study of literature on haematological parameters of fishes reveals a very controversial situation and one is left with the impression that specific biological characters and variety of fish species make the comparison of haematological indices exceptionally difficult. Very few attempts have been made to study the changes in different blood parameters in relation to body size. Preston (1960) has reported an increase in the RBC counts and Hb content in the blood with the increase in the body size in *Pleuronectes platessa*. Similar increase in the blood constituents with body weight have been reported by Haws and Goodnight (1962) in two species of cat fishes. Dube and Munshi (1973) in *Anabas testudineus* and Pandey *et al*. (1976a) in *Heteropneustes fossils* have also reported an increase in different blood parameters with the increasing body

weight in these species. No such data is at present available for these two species as such this account has been incorporated in this investigation.

Objectives:

— To estimate the RBC counts, Hb content, PCV, MCV, MCHC, oxygen capacity and MCH of *Anabas testudineus* and *Channa marulius.*

— To reveal the relationship of RBC counts and Hb content in blood with the increase in body weight.

— To determine the correlation coefficient (r) between RBC counts and Hb content vs. body weight.

MATERIAL AND METHODS

A. Procurement of Fishes and their Maintenance

Live specimens of the two species of fishes were procured from local fish market at Silapathar, Dhemaji, Assam, India. In laboratory of Silapathar Science College, Dhemaji, Assam, India, the fishes were transferred to big glass aquaria (50l). The fishes were kept in these aquaria for about a week for proper acclimatization prior to experiments. In the laboratory, the fishes were fed daily with small pieces of earthworm and pieces of goat liver. The unhealthy specimens were rejected.

B. Haematological Parameters

The blood sample was collected directly from the heart of fishes with the help of hypodermic needle. Sodium citrate (3.8%) solution was used as anticoagulant. The RBC count per mm^3 blood was determined by Naubauer double haemocytometer (Germany) for which Hayden's solution was used as diluting fluid. The haemoglobin content per 100ml of blood was determined by Sahli's haemometer (Germany). The haematocrit value or packed cell volume was determined with micro-haematocrit pipette after Van Allen (USA). The haematocrit pipette was centrifuged for 30 minutes at 4000 rmp.

From the above data mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) were calculated the following formula

$$MCV = \frac{\text{Volume of packed cells in ml per litre of blood}}{\text{Erchrocytes in million per cubic mm of blood}}$$

and it is expressed in cubic micron.

$$MCH = \frac{\text{Haemoglobin in gram per litre of blood}}{\text{Erchrocytes in million per cubic mm of blood}}$$

and it is expressed in micro gm.

$$MCHC = \frac{\text{Haemoglobin in gram per litre of blood}}{\text{Volume of packed cells in ml. per 100 ml of blood}}$$

and it is expressed in percent.

C. Estimation of Oxygen Capacity

Estimation of oxygen capacity of blood has been computed by multiplying the haemoglobin content with the oxygen combing power of 1.25ml of oxygen per gram of haemoglobin (Johansen, 1970). It is expressed in volume percent (vol%).

D. Statistical Methods

Log linear relationship between the independent and dependent variables have been calculated by least square regression method using the following general equation –

Iog y = log a + b log w

or

y = aw b

Direct linear relationship has been established by using the following general equation

y = a + bx

RESULTS

The values of blood parameters for *Anabas testudineus* (Bloch, 1785) and *Channa marulius* (Hamilton (1822) are given respectively in Table 1 and 2. Comparative mean data of various blood parameters in two species of above noted have presented in Table 3. The equation and correlation co-efficient showing statistical relationship between body weight Vs RBC count and Hb content in above noted two species are recorded in Table 4.

Table 1: Values of blood parameters of *Anabas testudineus* (Bloch, 1785). N = 6 (for each weight group), water temperature is 28.5°C ± 1.0°C.

Sr. No.	Body weight (gm)	RBC count 106 /mm 2		Hb content (g%)		PCV (%)	MCV um3	MCHC (%)	Computed oxygen capacity (vol%)	MCH (Pg)
		Total RBC count	RBC count g body wt.	Total Hb	Hb/g body wt					
1.	8.0	3.34	0.422	10.0	1.25	25.0	74.8	40.0	12.50	29.9
2.	14.3	3.83	0.267	11.0	0.77	26.9	70.2	40.9	13.75	28.7
3.	24.5	3.99	0.163	12.9	0.53	28.1	70.4	46.0	16.12	32.3
4.	36.5	4.97	0.136	15.8	0.43	35.0	70.4	45.1	19.75	31.8
5.	43.8	4.54	0.104	16.0	0.36	32.0	70.4	50.0	20.00	35.2
6.	55.1	5.16	0.094	17.5	0.32	36.3	70.4	48.2	21.87	33.9
7.	65.7	5.66	0.086	18.1	0.27	39.8	70.3	45.5	22.62	32.0
8.	73.7	6.48	0.088	20.7	0.28	45.6	70.3	45.4	25.87	31.9
9.	84.0	5.43	0.065	19.3	0.23	38.5	70.9	50.1	24.12	35.5
10.	92.0	7.06	0.077	19.8	0=21	49.7	70.3	39.8	24.75	28.0
AV	49.76	5.046	0.150	16.11	0=465	35.69	70.83	45.1	20.13	31.92

Table 2: Values of blood parameters of C*hanna marulius (*Hamilton, 1822), N=6 (for each weight group). Water temperature is 28.5°C ± 1.0°C.

Sr. No.	Body weight (gm)	RBC count 106 /mm 2		Hb content (g%)		PCV (%)	MCV um 3	MCHC (%)	Computed oxygen capacity (vol%)	MCH (Pg)
		Total RBC count	RBC count g body wt.	Total Hb	Hb/g body wt					
1.	14.5	2.67	0.187	10.8	0.74	24.0	89.9	45.0	13.50	40.4
2.	23.7	3.48	0.147	12.8	0.54	31.2	89.6	41.0	16.00	36.8
3.	33.8	3.52	0.104	13.3	0.39	31.5	89.5	42.2	16.62	37.8
4.	43.0	3.60	0.084	13.6	0.31	32.3	89.7	42.1	17.00	37.8
5.	52.3	3.84	0.073	14.0	0.26	34.5	89.8	40.6	17.50	36.4
6.	68.4	3.81	0.056	15.0	0.21	34.2	89.8	43.8	18.75	39.4
7.	75.0	3.98	0.053	15.8	0.21	35.8	89.9	44.1	19.75	39.7
8.	84.5	4.10	0.485	15.3	0.18	36.8	89.7	41.6	19.12	37.3
9.	96.3	4.02	0.362	15.5	0.16	36.2	89.6	42.8	19.09	38.2
10.	105.0	4.01	0.381	15.8	0.15	36.0	89.8	43.9	19.75	39.4
AV	59.65	4.07	0.193	14.19	0.315	33.25	89.7	42.71	17.71	38.44

Table 3: Showing comparative mean values of some blood parameters in two species of air breathing fishes; N=6.

Sr. No.	Species Mean body weight in gm	RBC count 106 /mm 2		Hb content (g%)		PCV(%)	MCV um3	MCHC (%)	Computed oxygen capacity (vol%)	MCH (Pg)
		Total RBC count	RBC count g body wt.	Total Hb	Hb/g body wt					
1.	*Anabas testudineus* (49.76g)	5.046±0.12	0.150	16.11± 1.3	0.465	35.69±2. 14	70.83	45.1	20.1	31.92
2.	*Channa marulius* (59.65g)	4.07±0.15	0.193	14.19± 1.10	0.315	33.25±1. 53	89.7	42.71	17.71	38.44

Table 4: Equation and correlation coefficient showing relationship between RBC counts and Hb content Vs body weight in two species of air breathing fishes

Name of the fishes	Parameters	Equation y=a+bx	Correlation Coefficient (r)
Anabas testudineus	Body wt. vs RBC counts	logy = log 1.80x10 6+0.2734 logx	0.9044
	Body wt. vs Hb content	logy=log5.0+0.3086logx	0.9858
Channa marulius	Body wt. vs RBC counts	logy=log0.29+0.16logx	1.0
	Body wt. vs Hb content	logy=log0.85+0.16logx	1.0

Average values of total RBC count and RBC counts/g body weight, total Hb content, Hb/g body weight, PCV, MCV, MCHC, oxygen capacity and MCH were respectively 5.046, 0.150, 16.11, 0.465, 35.69, 70.83, 45.1, 20.13 and 31.92 in *Anabas testudineus (*Table 1). Such values were respectively 59.65, 4.07, 0.193, 14.19, 0.315, 33.25, 89.7, 42.71, 17.71 and 38.44 in *Channa marulius* (Table 2).

Comparative data of mean values of above-mentioned blood parameters in two species of air breathing fishes have been presented in Table 3. A perusal of this table indicates that total RBC counts, total Hb content, Hb/g body weight, PCV and oxygen capacity values were highest in *Anabas testudineus* than *Channa marulius* (Table 3). On the other hand, RBC counts/g body weight, MCV and MCH values were recorded highest in *Channa marulius* (Table 3).

The equation and correlation coefficient showing relationship between body weight Vs RBC counts and Hb content in two species of fishes have been summarized in Table 4. A perusal of this table indicates that with unit increase in body weight the RBC counts increases by a fractional power of 0.2734 in *Anabas testudineus* and 0.16 in *Channa marulius*. Similarly, perusal of the same table indicates that with unit increase in body weight Hb content increase by a fractional power of 0.3086 in *Anabas testudineus* and 0.16 in *Channa marulius.* In all the cases values of correlation coefficient (r) were calculated to be very high (0.9044 - 1) in the Table 4 which is indicative of the fact that these blood parameters are highly correlated.

DISCUSSION

Preston (1960), Haws and Good Night (1962); Dube and Munshi (1973) noticed an increase in the haemoglobin percentage and erythrocyte number in the blood of *Pleuronectes platessa, Ictalurus* and *Anabas testudineus* respectively with increasing body weights. Pandey *et.al*. (1976a) have also reported an increase in Hb content, RBC number, PVC and leucocytes counts in H. fossils with the increase of body weight. In the present study also it has been observed that the concentration of Hb, RBC and WBC counts in the blood of *Anabas testudineus* (Table 1) and *Channa marulius* (Table 2).

It is interesting to note that in *Channa punctatus* the RBC counts increases by a fractional power of 0.16 (Singh, 1982) with the unit increase of the body weight. Such power function (b value) has been reported in this present investigation to be 0.16 in *Channa marulius* and 0.2734 in *Anabas testudineus* (Table 4). It seems that

the pattern of increase in RBC number in relation to body weight is almost similar in both the cases. The analysis of data revealed that Hb content in *Channa marulius* also increases by a fractional power of 0.16 (similar to RBC) with unit increase in body weight. Such power functions have been reported to be 0.3086 in *Anabas testudineus* (Table 4).

The erythrocyte counts, Hb content and PVC per gram body weight have been higher (Table 1 and 2) in smaller fish but as the fishes grow in size these parameters decrease gradually. This observation is consistent with the findings of Dube and Munshi (1973) in *Anabas testudineus*, Pandey *et al*. (1976a) in *H. fossils* and Kaur (1996) in *Rita rita*. It is well established fact that the metabolic rates in young fishes are higher. Therefore, higher values obtained for RBC counts, Hb content and PCV per gram body weight for younger fishes than the older ones is meaningful.

The haemoglobin content in fishes varies from 3.5% (Groggy, 1967) to 37% (Prosser, 1952). In the present investigation of Hb content in two species of air breathing fishes have been found to vary from 10.0 % to 19.8%. This value is within the range reported by Pradhan (1961) in the species studied by him. PCV values in fishes have been found to vary from 21.3% to 52% (Pandey *et al*., 1976a). In the present investigation the PCV values have been found to vary from 25.0% to 49.7% in *Anabas testudineus* (Table 1) and 24.0% to 35% in *Channa marulius* (Table - 2). These values are close to that reported for *Labor capensis* (Hattingh,1972). The range of absolute values such as MCH, MCHC and MCV are well within the range reported by other investigators (Pandey *et al*., 1976a; Mishra *et al*., 1977; Yasmin *et al.*, 1993; Kaur, 1996). Karuppiah (1996) calculated the oxygen capacity of blood of *Channa striatus* to be 8.70 volume %. In the present investigation average oxygen capacity has been found to be 20.13 volume % in *Anabas testudineus* (Table 1) and 17.55 volume% in *Channa marulius* (Table 2) which is found to be higher than that reported by Karuppiah (1996).

CONCLUSIONS

Studies on blood parameters like RBC counts, haemoglobin content, PCV, MCHC and oxygen capacity etc. have revealed adaptive features correlated with the relative importance of air and water breathing. Purely aquatic breathers have been reported to possess generally lower values of Hb content and oxygen capacity in contrast to the air breathing fishes. Environmental factors play an important role in the physiology of poikilothermic animals. The changes in environmental factors are reflected in haematological parameters and other physiological processes of the body in the animals. The estimation of haematological parameters in animals is of great significance in ascertaining the physiological conditions associated with a loss or gain of fluid by the body. Several environmental, physiological and pathological conditions are responsible for the haematological parameters of animals.

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