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Comparative analysis of hematological parameters of *Schizothorax niger* and Schizothorax esocinus

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Abstract

The blood of fish from various water bodies was screened for various hematological parameters. Before the collection of the blood sample, the length and weight of fish were also noted. During the present study mean weight varied from 95g to 260 g. The mean weight at Beerwa of *Schizothorax niger* was 190±0.86, at Akad was 293±110.5, at Kokernag was 262.5±53.93.Where as that of *S. esocinus* was 214.08±2.28, 221.2±80.92 and 267.8±119.3 respectively. The mean hemoglobin value in the fish varied from 9.65±0.91 (lowest) to 10.43±0.10 (highest). *S.niger* reared at Beerwa has shown 10.03±0.3, at Akad it was 9.16±0.63 and at Kokernag it was 8.78±0.31. Where as *S.esocinus* has shown 10.43±0.10,9.28±0.52 and 10±0.12 respectively. The RBC value of the spring fish was found to be comparatively lower than the RBC value of fish from stream. The mean RBC value was 1.14±0.02. *S.niger* reared at Beerwa has shown 1.14±0.02, at Akad it was 2.03±0.21 and at Kokernag it was 1.71±0.26. Where as *S. esocinus* has shown 137±0.01, 2.056±0.17 and 2.18±0.12 respectively.

The mean packed cell volume was found to be 21.09±0.81 (lowest), while it was 26.61±0.55 (Highest). *S. niger* reared at Beerwa has shown 21.09±0.81, at Akad it was 28.2±2.65 and at Kokernag it was 2.83±0.50. Where as *S.esocinus* has shown 26.61±0.55, 29.0±2.35 and 31.3±2.05 respectively. Leucocytes are the defense cells of the body which provide protection to the organism against environmental as well as anthropogenic stress. The WBC count of river fish was higher than the fishes collected from other water bodies. The mean WBC count in the fish was 55.10±2.51. *S. niger* reared at Beerwa has shown 5.10.09±2.51, at Akad it was 4.67±0.36 and at Kokernag it was 2.83±0.50. Where as *S. esocinus* has shown 40.34±1.07, 2.39±0.65 and 2.12±0.59 respectively

Keywords: hematological parameters, *schizothorax niger*

Introduction

The State of Jammu and Kashmir is rich in streams, lakes and water reservoirs. The Himalayas are the main watersheds in the Indo-Gangetic Region, having numerous rivers, lakes and reservoirs. Most fish species inhabiting the Himalayan region are of small size. Their distribution depends on the environmental conditions such as water current velocity, nature of substratum, and the availability of food. Schizothoracinae the cyprinids (also called snow trout‟s) are believed to have migrated into lakes and streams of Kashmir from central Asian watersheds (Sehgall, 1999), bordered by inner and southern slopes of Hindukush, Korakoram and inner ends of North Western Himalayas and Suleiman Ranges. These fishes got isolated in the Kashmir region by land upheavals and evolved into a large number of species now regarded as endemic in valley. (Raina and Peter, 1999). In most water bodies of Kashmir like Dal Lake, River Jhelum, Manasbal, etc. Schizothoracinae are declining due to various reasons like pollution, habitat degradation, introduction of carp, removal of sand and gravel etc.

The fresh water bodies, whether lotic or lentic provide a great seasonal diversity in their physical, chemical and biological conditions from season to season. The vast stretches of inland waters support many and varied forms of fresh water life including fish. Water in the water bodies of Kashmir is cold, crystal clear and provide habitat for peculiar type of fish fauna. Fishes being one of the most important protein constituents of diet. In fact 62-68% people of the valley obtain their protein from this source. The fish fauna in the valley is peculiar in having the dominance of *Schizothorax*. Because of the geographical barriers the *Schizothorax* group has evolved a number of endemic species in the valley. *Schizothorax* is commonly known as “Snow Trout” because it inhabits the snow fed streams and rivers of Kashmir valley where temperature ranges from 10-18°c. It is a delicate fish which loves cold, well oxygenated and pollution free waters.

The fishes were collected from 2010-2014 and cultured at various hatcheries in collaboaration with the fisheries Department Kashmir. Focus was made on hematology in particular besides other parameters. The results obtained were from natural waters as well as those cultured in artificial diet.

Results

The blood of fish from three water bodies was screened for various hematological parameters. Before the collection of the blood sample, the length and weight of fish were also noted. The fish samples collected during the present study varied in mean weight from 95g to 260 g. The mean weight at Beerwa of *Schizothorax niger* was 190±0.86, at Akad was 293±110.5, at Kokernag was 262.5±53.93.Where as that of *S. esocinus* was 214.08±2.28, 221.2±80.92 and 267.8±119.3 respectively. Controlled fishes have shown slightly lower results than the other cultured fishes.

Hemoglobin (g/dl)

The mean hemoglobin value in the fish varied from 9.65±0.91 (lowest) to 10.43±0.10 (highest). *S.niger* reared at Beerwa has shown 10.03±0.3, at Akad it was 9.16±0.63 and at Kokernag it was 8.78±0.31. Where as *S.esocinus* has shown 10.43±0.10,9.28±0.52 and 10±0.12 respectively.

RBC Count (106/mm3)

The RBC value of the spring fish was found to be comparatively lower than the RBC value of fish from stream. The mean RBC value was 1.14±0.02. *S.niger* reared at Beerwa has shown 1.14±0.02, at Akad it was 2.03±0.21 and at Kokernag it was 1.71±0.26. Where as *S. esocinus* has shown 137±0.01, 2.056±0.17 and 2.18±0.12 respectively.

Packed cell volume (PCV %)

PCV or Haematocrit (Hct) expresses the volume of RBCs in 100 ml of whole blood. Any deviation from its normal values can lead to various pathological conditions. The mean packed cell volume was found to be 21.09±0.81 (lowest), while it was 26.61±0.55 (Highest). *S. niger* reared at Beerwa has shown 21.09±0.81, at Akad it was 28.2±2.65 and at Kokernag it was 2.83±0.50. Where as *S.esocinus* has shown 26.61±0.55, 29.0±2.35 and 31.3±2.05 respectively.

WBC: (104/mm3)

Leucocytes or white blood cells (WBCs) are the defense cells of the body which provide protection to the organism against environmental as well as anthropogenic stress. The WBC count of river fish was higher than the fishes collected from other water bodies. The mean WBC count in the fish was 55.10±2.51. *S. niger* reared at Beerwa has shown 5.10.09±2.51, at Akad it was 4.67±0.36 and at Kokernag it was 2.83±0.50. Where as *S. esocinus* has shown 40.34±1.07, 2.39±0.65 and 2.12±0.59 respectively.

Mean Corpuscular Volume (MCV µm3)

MCV is the measure of average volume of RBCs in the whole blood. While increase in MCV indicates red blood cell swelling (macrocytosis), its decrease depicts RBC shrinkage (microcytosis). The mean MCV value in the fish was 178.87±13.22. *S. niger* reared at Beerwa has shown 178.87±13.22, at Akad it was 1.71±1.15 and at Kokernag it was 3.7±1.94. Where as *S. esocinus* has shown 194.27±1.49, 2.00±1.05 and 1.8±1.03 respectively.

Mean Corpuscular Hemaglobin (MCH µg)

MCH is the average hemoglobin content in a red blood cell. The MCH value of lake fishes is usually higher than the stream fishes. The mean MCH value was 88.16±1.94. *S.niger* reared at Beerwa has shown 88.16±1.94, at Akad it was 138.65±4.39 and at Kokernag it was 152.64±21.20. Where as *S.esocinus* has shown 75.89±0.72, 152.64±21.20 and 143.83±4.86 respectively.

Mean Corpuscular Hemoglobin Concentration (MCHC %)

MCHC is the measure of average concentration of hemoglobin in a given volume of blood. The mean MCHC value of *S. niger* was highest as compared to stream fishes.

DLC

Lymphocytes are the most abundant and constitute about 64-71% of the Total Leucocytes and provide protection against entry of various antigens by production of antibodies. Any increase (lymphocytosis) or decrease (lymphophenia) in their normal values is indicative of infection. The mean Lymphocyte content was 64.16±4.62. The mean neutrophil content was 30.5±3.93 Monocytes, eosinophil and basophil contributed about 4 to 6% of the total WBC count.

Fishes cultured under control has shown slightly lower values of all the parameters as compare to the fishes reared on artificial diet. But the variation was very low.

Results

Table 1: Hematological parameters of *S. niger at Beerwa Hatchery*

Parameters	Range	Mean±S.D	Control
Body Length (mm)	80 - 97	90±6.2	85±6.2
Body Weight (g)	168.06 - 210	190±0.86	190±0.86
Hb (g/dl)	9.5 - 10.52	10.03±0.35	9.03±0.35
RBC (106/mm3)	1.11 - 1.17	1.14±0.02	1.12±0.02
PCV (%)	19.9 - 22.1	21.09±0.81	20.09±0.81
WBC (104/mm3)	51.92 - 58.32	55.10±2.51	53.10±2.51
MCV (µm3)	160.2 - 199.09	178.87±13.22	173.87±13.22
MCH (µg)	85.58 - 90.52	88.16±1.94	85.16±1.94
MCHC (%)	42.98 - 48.54	46.08±2.42	44.08±2.42
DLC Lymphocyte (%)	59 - 70	64.16±4.62	62.16±4.62
Monocyte (%)	2 - 4	2.83±0.75	3.83±0.75
Neutrophil (%)	25 - 35	30.5±3.93	27.5±3.93
Basophil (%)	0 - 3	1.5±1.04	1.0±1.04
Glucose	45 - 60	60±2.11	55±2.11

Table 2: Hematological parameters of *S. esocinus at Beerwa Hatchery*

Parameters	Range	Mean± S.D	Control
Body Length (mm)	115 - 130	124.3±5.8	123.3±5.8
Body Weight (g)	211.2 - 216.5	214.68±2.28	212.68±2.28
Hb (g/dl)	10.3 - 10.6	10.43±0.10	10.25±0.10
RBC (106/mm3)	1.35 - 1.39	1.37±0.01	1.35±0.01
PCV (%)	25.8 - 27.5	26.61±0.55	26.21±0.55
WBC (104/mm3)	38.9 - 41.8	40.34±1.07	40.0±1.07
MCV (µm3)	192.21 - 196.36	194.27±1.49	195.27±1.49

MCH (µg)	74.6 - 76.61	75.89±0.72	75.0±0.72
MCHC (%)	38.25 - 40.1	39.16±0.58	39.0±0.58
DLC Lymphocyte (%)	64 - 78	71±5.86	76±5.86
Monocyte (%)	1 - 3	1.66±0.81	1.26±0.81
Neutrophil (%)	20 - 30	25.33±3.88	22.33±3.88
Basophil (%)	0 - 3	1.83±1.16	1.53±1.16
Eosinophil (%)	0 - 2	1.00±0.89	1.00±0.89

Discussion

Total erythrocyte count (TEC/RBC) (106/mm3) 103 During the present study erythrocyte count of *S.niger* reared at Beerwa had shown 1.14±0.02, at Akad it was 2.03±0.21 and at Kokernag it was 1.71±0.26.Whereas *S.esocinus* has shown 1.37±0.01, 2.056±0.17 and 2.18±0.12 respectively. The normal range of erythrocytes in *S.niger* and *S.esocinus* was 1.10±2.80 (106/mm3) *S. esocinus* has shown higher percentage of erythrocytes than *S.esocinus*. Montero *et al.* (1999) [5] observed that Red blood cells of *Sparus aurata* were significantly higher at high stocking density (3.36x106/mm3) as compare to those fishes held at low stocking density (2.82x106/mm3). This effect has been described as a strategy for increasing oxygen carrying capacity of blood during periods of high energy demand (Ruane *et al.* 1999).

Results indicated that increased stocking density caused decrease in pH and increase in acidity. Kapila *et al.* (2007) in *Schizotharax richardsonii* (Gray) also found that Red blood cells are significantly higher at low pH than control group at pH 7.0.

The leucocyte count at Beerwa was5.10.09±2.51, at Akad it was 4.67±0.36 and at Kokernag was 2.83±0.50. Where as *S. esocinus* has shown 4.34±1.07, 2.39±0.65 and 2.12±0.59 respectively. The normal range of leucocytes in *S.niger* and *S.esocinus* was 2.10±0.65 (104/mm3) *S. esocinus* has shown higher percentage of leucocytes than *S.niger*. White blood corpuscles show fluctuation with the change in external environment particularly pollution and infection. Ruane *et al.* (2001) who subjected common carp to net confinement observed decrease in white blood cells. *Cyprinus carpio* during physiological response (Ruane *et al.* (2002) [6, 14] reported increasing stocking density causes reduction in white blood cells. Sakthivel and Sampath (1989) [15]. Studied white blood cells and differential leucocyte count reduced significantly in C*yprinus carpio* during pyridoxine fed diet.

Physical injury was less at lower stocking density than higher density groups. Pickering and Pottinger (1987) reported that increasing stocking density can cause hematological changes impairing defenses against physical injury and infection. Pedro *et al.* (2005) observed that total and differential types of leucocytes showed significant fluctuations depending on season or type of leucocytes studied. Lymphocytes were found decreased in number with increasing stocking density. This is in confirmation with the observation Pickering and Pottinger they noticed that crowding causes reduction in lymphocytes. Wendelaar (1997) observed that stress generally causes reduction in circulating lymphocytes.

S.niger reared at Beerwa had shown haemoglobin value of 10.03±0.3, at Akad it was 9.16±0.63 and at Kokernag was 8.78±0.31. Where as *S.esocinus* has shown 10.43±0.10, 9.28±0.52 and 10±0.12 respectively. The hemoglobin value of *S.niger* and *S.esocinus* range between 9.5-10.52mg/dl. with standard deviation from 10.03±0.35.The haemoglobin value of *S.niger* was slightly lower than the *S.esocinus*. According to Pamila *et al*., (1991) [3, 13] the reduction in hemoglobin content in a fish exposed to pollutant could be due to the inhibitory effect of those substances on the enzyme system responsible for synthesis of hemoglobin. The pollutant entering into fish system is slowly eliminated (Newman and Mitz, 1988; James and Sampath, 1996 and James *et al.* 1996), and hence the blood parameters get affected on account of pollutant toxicity. Similar results were reported by Engel and Davis (1964) and Rambhaskar and Srinivasa Rao (1986). Eisler (1965) suggested that there was a correlation between hemoglobin concentration and activity of fish. The more active fishes tend to have higher hemoglobin values than the more sedentary ones. Consequently, *Pleuronectes annectens* being a relatively quiet and sedentary species (Okafor, 2006) has a slightly lower hemoglobin concentration than more active African teleosts such as *Clarias buthupogon* whose mean hemoglobin concentration is as high as 9.88g/dl (Kori-Siakpero and Egor, 1997). Haematocrit value of *S.niger* reared at Beerwa Hatchery was 21.09±0.81, at Akad it was 28.2±2.65 and at Kokernag was 28.3±0.50. Where as *S.esocinus* has shown 26.61±0.55, 29.0±2.35 and 31.3±2.05 respectively. Normal range of haematocrit in *S.niger* and *S.esocinus* was 25-40%. Sniger has shown slightly lower values of heamatocrit than S.esocinus. The change could be attributed to the fact that change in environment has direct effect on the hematology of the fish. Montero *et al.* (1999) [5] reported that haematocrit in gilthead sea bream (*Sparus aurata*) were significantly higher in fish held at high stocking density (43.87%) compared to those fish held at low stocking density (37.21%). This direct relationship is supported by Montero *et al.* (1999) [5], while working on *Sparus aurata* found significant higher levels of haematocrit at high stocking density of (43.87%) compared to low stocking density of (37.21%). Ruane *et al.* also noted during physiological response to increased stocking density that haematocrit are often elevated during stress situations to increase oxygen carrying capacity and oxygen supply to the major organs in response to higher metabolic demands. Urbinati *et al.* (2004) also found that juvenile matrinxa (*Brycon caphalus*) showed increase in haematocrit during loading and transport at various densities. Dobroviskova *et al.* also found that long distance transportation of common carp (*Cyprinus carpio* L.) increased significantly haematocrit level. 106

Menezes *et al.* (2006) reported increase in haematocrit level in *Pirarucu Arapaima gigas* during physiological responses to net culture, pH also decreased with increase in stocking density leading to acidification. Rehulka and Adamec (2004) [18] studied that haematocrit is significantly higher in rainbow trout (*Onchorhynchus mykiss* walbaum) reared in cage and Raceway culture. Giles *et al.* (1984) [19] also reported increase

in haematocrit in rainbow trout (*Salmo gairdneri*) extended to environmental acidification.

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