

Biochemical Study of Indigenous Barilius Sp. in Relation to Physico-Chemical Properties of Water of International Transboundary River at Downstream.

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Abstract

The stream Jaldhaka is an icy mass feed torrential transboundary waterway of India, Bhutan and Bangladesh originate from Bitang Lake in Sikkim. Fishes are significant biologically just as a modest wellspring of protein. Moderating protein insufficiency creating nations like India. This stream starts and incompletely courses through the eastern Himalaya biodiversity hotspot thus wealthy in ichthyodiversity. A significant piece of stream water is, for the most part, preoccupied with the water system reason in the side-lying agricultural fields up and down its length of the studied zone. An investigation was completed from October 2019 to November 2019 to manage documentation of a Barilius Species alongside Physico-chemical properties in the downstream of the stream coursing through the Coochbehar area of West Bengal, India. The fishery of the stream is of subsistence nature and is under the intense pressure of anthropogenic exercises. The Physico-chemical parameters recorded during the examination time frame in the timeperiod are water temperature (25.9^oC-28.7^oC), TDS (63mg/l-67 mg/l), pH (7.2-7.4), DO (7.2mg/l-7.5 mg/l), Total hardness (45 mg/l-67 mg/l), turbidity (0.93-8.82 NTU), BOD(1.9mg/l-2.0mg/l), chloride (5.76mg/8.84 mg/l), total alkalinity(47mg/l-63mg/l) Conductivity(84.52 us/cm-147.9 us/cm), Nitrate (0.38 mg/l-0.59mg/l), phosphate(0.018mg/l-0.02mg/l). This investigation is useful for detailing new conservation protection and the board management policy. Genus Barilius, an interesting group of Cyprinid fish, is mostly a resident of the hill streams. The present work is an attempt to document a systematic account of morphomeric character of a species namely Barilius bendelisis under the genus Barilius from the northern part of West Bengal under Indian region along with proper illustrations and to reevaluation the general taxonomy of the Indian bariliine cyprinids in the beam of accessible information. A complete study on the biochemical composition of usually consumed and obtainable Barilius species of Jaldhaka river was done to estimate their nutritive assessment. Most significant biochemical nutrient composition of Barilius bendelisis like protein, lipid, moisture, ash calculated by standard 'AOAC' procedures (AOAC, 2005).The crude protein content in the range of 17.6-14%, the lipid content varied from 7% to 5.4%.Moisture content showed from 70.39% to 75.2% the ash content changed from 2.6% to 3.8%. Present work clearly indicates that Barilius bendelisis is the economically rich source of quality protein which can offer nutritional security, source of revenue generation and can resolve the protein requirement of the locality. Improvement of the production by aquaculture and use of small fishes encouraged the locality for a better approach to meet up protein hunger of this area.

Keywords: Jaldhaka, Physico-chemical, Nutritive value, Biochemical, Barilius bendelisis

Introduction

India is an amazing hotspot of freshwater fish variety with a very high endemism contributing to the World's biological assets. An effort has been made to gain information on the conservation position of freshwater fishes of Cooch Behar district of West Bengal, India. The Cooch Behar district is exceptional with many torrent freshwater rivers which can thus demand appropriate management through scientific monitoring as well as judicious restoration. Actually, inappropriate exploitation of impounding water, unscientific waste disposal, reckless pesticide contagion from the adjacent agricultural fields, irresponsible harvesting of fishes etc. are the main concerns of threats which require instant consideration. To implement suitable management practice, assessment on the present position of the specific water body is necessary. The study was carried out on the Jaldhaka (Mansai) river flowing through the Cooch Behar district from October, 2019 to November, 2019 for the documentation of the physico-chemical parameters. The parameters monitored included water temperature, turbidity, pH, total dissolved solid, conductivity, dissolved oxygen, biological oxygen demand, total alkalinity, hardness, phosphate and Chloride. Our present study is on the spot of the river Jaldhaka(Mansai), that's flows beside the Mathabhanga Subdivision town of district Cooch Behar of West Bengal, India. The basin of this river sustains life and livelihoods of farmers, fishermen . As a consequence the physical, chemical and biological characteristics of the river water are gradually altering and producing the unsafe effect on aquatic biota and thereby human beings owing to biomagnification. Physico-chemical variables of the water along with the density and the diversity of the Ichthyofauna were considered to get an proper knowledge of their oscillating rhythmic phenomena, and to understand the environment of the system.²

A considerable amount of research has been carried out on the physicochemical parameters of riverine water and their impact on aquatic biota in India.^{14,20,21,25} However, this type of study has not been carried out in respect in Jaldhaka(Mansai) river of West Bengal. The objectives of this study is to document the physical and chemical properties of this river water and to examine the biochemical parameter of a particular fish species, *Barilius bendelisis*.

Barilius bendelisis(Hamilton), is a highlands water fish of South East Asia region which belongs to the Cyprinidae family which lives in low, clear and chilly water.³⁰ There is a concern that the species is extremely widespread besides endangered in of Himalayan region rivers.³ Hamilton-Buchanan who proposed the genus *Barilius* and documented 12 species of the Gangetic system, India.²⁷ McClelland proposed *Opsarius* based on features like broad mouth, spots on the body, anal fin elongated and lower edge of the body extra arched than the upper portion, small dorsal fin placed behind the middle part.³⁵ Latter on Hora pointed out that Hamilton preserved no specimens and his drawings are the source of information of various species of genus *Barilius*.¹

The small indigenous fish species (SIS) can assume a crucial job in prevention of micro-nutrient inadequacies and associated diseases.^{4,11,26,31} Fish as the slightest expensive wellspring of efficiently digestible animal protein demonstrates a significant offer in the worldwide diet bin and clearly, the effective development is simple in the utilization of fish which meet the protein hunger, employment and nutritional security in the future.¹⁵ Small fishes are vital source of micro-nutrients, low-cost sources of good quality animal proteins, a noteworthy piece of captured and cultured inland fisheries and contribute livelihood protection of the rural population.⁶ West Bengal has major importance with respect to per capita fish consumer amongst the states of India with nearly ninety six population being the fish eater. Small fishes are nutrient-rich but usually unnoticed in developing countries.⁸ The biochemical analysis of principle constituents namely; protein, lipid, ash, and moisture varies greatly for different species

and in between the same species depending on dissimilar factors like age, sex, environment condition and also seasonal difference.¹⁰ The biochemical constituents of fishes are intimately linked to feeding intake, migratory factor and sexual changes in the connection with spawning.³⁴ Fish growth is controlled by a number of factors such as food, space, temperature, the salinity of water, seasonal variation and diverse human activity. Data on the biochemical constituents will make possible a processing technologist to identify the perfect preparing and capacity conditions with the aim that the quality protected to the maximum degree as fish is an efficiently transitory product and deteriorating in quality is because of the progressions happening in the proximate composition. Cnsciousness has already stretch among the people about well food and fish is finding extra acceptances because of its sole nutritional qualities. A suitable thoughtful of the biochemical constituents of fish has become a primary necessary for the nutritionists as well as dieticians. Lack of rational data on biochemical composition of fish from rivers of the northern part of West Bengal, India hence the consumer and fishery workers are left with inadequate information's on the importance of few fish species in their daily diets.³² The present study has a justification to provide a piece of important information on the biochemical composition of some species marketed in this locality. Considering the importance of the small indigenous fishes and very few published information is obtainable on the biochemical composition on the small indigenous fish species of West Bengal, the aim of this study was to determine the biochemical composition of some indigenous small fishes found in Jaldhaka(Mansai), the heart of Coochbehar District of West Bengal, India.

Materials and methods:

Table-1: Administrative Parameters of the Surveyed Spot.

Spot No.	Name of the spot/ Mouza	GPS readings	Elevation (ft)	Location of Survey spot	
				Block	GP / Municipality
SJ	Tekonia	26°19'10"N ,89°14'23"E	157	Mathabhanga-I	Pachagar GP

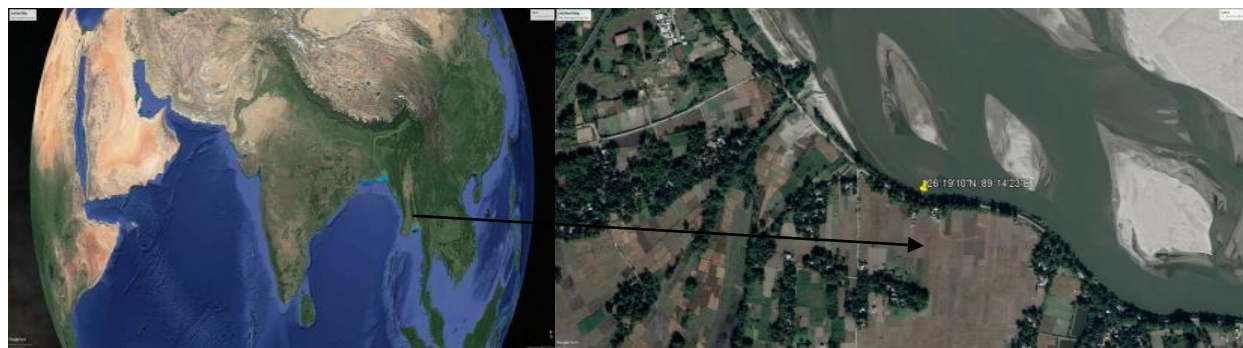
The sampling spot (Fig-1) was selected in Jaldhaka(Mansai) river to collect water samples and to record

the captured fishes with the help of expert local fishermen, adjacent to the Mathabhanga subdivision

town area (SJ), Its latitude, longitude, and elevation along with the administrative parameters is presented in the Table-I.

Fig.I: Location of survey spot under Mathabhanga sub-division of Cooch Behar district of West Bengal.

(Courtesy: Google earth surfed on November 18, 2020 at 8.00 pm)



Twelve physico-chemical parameters of the collected water were measured for the study of the water quality for the understanding its effect on the species of our interest. Fortnightly the water was collected from the mentioned spot at the depth of 8" - 1 ft from the surface within 6.30 am to 8.30 am. Water samples were collected in duplicate in two glass DO (Dissolved Oxygen) bottles with a capacity of 150 ml each and one large PVC of one liter capacity bottle. Water of one bottle were fixed with manganus sulfate on the spots for the evaluation of DO and all samples were transferred to our laboratory immediately for all physico-chemical experiments except the air, water temperature, pH, conductivity and total dissolved solid (TDS) which were calculated at the spot(SJ). The water temperature was calculated with a mercury thermometer by insertion it inside the water at the depth of 1 ft. Other physico- chemical parameters were analyzed in the laboratory in the same day within 2-3.5 hours except biological oxygen demand. Digital meter were used to record the pH, conductivity and TDS (Model-171 of Electronics India). The total suspended solid (TSS) was measured by evaporation method. The dissolved oxygen, BOD, chloride, hardness and total alkalinity, nitrate and phosphate were measured in the laboratory as per recommended by APHA (1995).²³

Fig.2: View of the Jaldhaka(Mansai) river survey spot under Mathabhanga sub-division of Cooch Behar district of West Bengal.



Materials for the present investigation are the species namely *Barilius bendelisis* under the genus *Barilius*, occurring from the Jaldhaka (26°19'10"N & 89°14'23"E) river of Coochbehar district of

West Bengal, Indian water. Few live specimens were preserved in formaldehyde solution (10%) for further studies. In the laboratory, the fish samples identified using the taxonomy keys, the color, color patterns, spots, and their picture captured by a DSLR camera. The fishes were identified by studying their morphometric and meristic characters and by considering the literature of Talwar and Jhingran, 1991 and Jayaram, 1999 and 2006.^{7,19,24} The distinguished samples were then set apart in triplicates. Standard length, absolute length, and weight of fish sample recorded. The proximate constituents of *Barilius bendelisis* analyzed by standard 'AOAC' procedures (AOAC, 2005).¹⁶

Fig.3: Species (*Barilius bendelisis*) which is studied during the present study for proximate analysis.



Ethical issues

The examination was as per the Declaration of Helsinki and guidelines on good clinical practice locally available. It was likewise endorsed by the institutional ethics board and morals committee.¹⁸

Results and Discussion

The Jaldhaka River is a transboundary river. The sampling location is situated very nearby to Mathabhanga subdivision town of Coochbehar district of West Bengal, India. The average Physico-chemical properties of the sampling location were water temperature- 27⁰ C, pH- 7.3, conductivity- 116.21 μ s/cm and dissolved oxygen- 7.3. TDS-65, Turbidity (NTU unit) -4.87, Hardness-56, Total alkalinity-55, Chloride-7.3, Nitrate-0.48, phosphate-.019. The downstream of the river is extremely troubled due to anthropogenic actions e.g. boating, bathing, washing, construction activities, unscientific fishing, fishing with poison and electric shock, etc.

Table2. Physico-chemical Parameters of water at sampling station of Jaldhaka(Mansai) River

Month/Year	Water Temperature(°C)	pH	Conductivity (µs/cm)	Total dissolved solid (mg/l)	Turbidity(NTU)	BOD (ppm)	Dissolved Oxygen (ppm)	Hardness (Total)	Total alkalinity (ppm)	Chloride (ppm)	Nitrate (ppm)	Phosphate (ppm)
October,19	28.7	7.2	147.9	67	0.93	2.0	7.5	45	47	8.84	0.59	0.018
November,19	25.9	7.4	84.52	63	8.82	1.9	7.2	67	63	5.76	0.38	0.02
Average	27.3	7.3	116.21	65	4.87	1.9	7.3	56	55	7.3	0.48	0.019

The results of physico-chemical study is presented in Table-1. Health of an aquatic system depends on the physico-chemical properties as well as sustainable biota. The physiological activities and distribution of biota is controlled by the temperature, an important physico-chemical parameter. The water temperature varied in between 25.8-28.7°C at the sampling site. Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulates as well as mix up the additional colour due to excess decomposition of biota or by the discharge of sewage. Turbidity is considered as a good parameter for measuring the quality of water as it controls the penetration of light therefore have an inverse effect on the population of macrophytes of the water body. Large amounts of silt, unusual microorganisms, plant fibers, sawdust, wood ashes, chemicals and coal dust increases the turbidity. Excessive plankton and soil erosion from logging, mining may increase turbidity. Study recorded average turbidity 4.87. The recorded mean pH showed alkaline nature of water. The solid substances present in the water body are either in smaller dissolved or lighter suspended forms. The TDS values of water ranged from 63 to 67 mg/l at the sampling site. Electrical conductivity (EC) is mostly affected by concentration of ions and nutrients and variation of dissolved solids present in water body. The EC values of water samples ranged from 84.52 to 147.9(µs/cm) at the sampling site. The variation of conductivity value indicates the irregular incidence of un-ionized chemical substances and due to lack of proper irrigation supervision, addition of minerals from rain water overflow and other illogical discharges.⁹ Dissolved oxygen is an important factor which is necessary for the metabolism of all aquatic aerobically respired biota and also an indicator of water quality and diversity of living organisms. The value ranged from 7.2 to 7.5 ppm. The quantity of biodegradable organic matter present in an aquatic system which is subjected to aerobic decomposition by microorganisms is indicated by the biological oxygen demand (BOD) value which provides a direct measurement of the status of aquatic pollution. The value of BOD recorded from 1.9 to 2.0. Chloride concentration varied from 5.76 to 8.84. Total reactive phosphorus is the ionized form of orthophosphoric acid. The higher the pH, the more PO_4^{3-} will form the deprotonation of HPO_4^{2-} . Phosphates are less soluble and less volatile. It can form salts with calcium and magnesium and precipitated out of solution and settled as sediment. Plants,

bacteria and all living biota consume phosphate as it is an essential nutrient. Inorganic phosphate can promote dense growth of macrophytes in water body, ranged from 0.018 to 0.02. This may be due to the domestic discharge and agricultural overspill where phosphate containing fertilizers are widely used. To access the water quality of Jaldhaka(Mansai) river, three major nutrient parameters were chosen. Among them Nitrate (NO_3^-) is one of the vital in any water body. Nitrite (NO_2^-) is oxidized to nitrate after entering in an aerobic system. At the same time plants and microorganisms reduce nitrate into nitrite but nitrite ion is quickly oxidized back to nitrate once it re-enters the aquatic system. Natural sources of nitrate are plant decay and animal waste including fish, wild animals and bird, discharges from car exhausts. Nitrate provokes the growth of plankton and water weeds that contribute food for fish which may increase their population. But if algal growth is excessive, the dissolved oxygen levels will be decrease during early morning and fishes will die due to shortage of DO. In the present study, the nitrate concentration ranged from 0.38 to 0.59 ppm

Proximate composition of *Barilius bendelisis* shown in Table 3. The outcomes from the present examination uncovered that moisture, protein, lipid and ash content of *Barilius bendelisis* fish species.

Table.3 Protein, Lipid, Ash, Moisture (% wet weight basis) of *Barilius bendelisis* fish species of Jaldhaka(Mansai) river of Coochbehar district of West Bengal, India.

Scientific name	Total Moisture (%) Range	Total Moisture (%) * Mean	Total Protein (%) Range	Total Protein (%) *Mean	Total Lipid (%) Range	Total Lipid (%) * Mean +	Total Ash (%) Range	Total Ash(%) *Mean ± standard error
<i>Barilius bendelisis</i>	75.20 - 70.39	72.8±1.2	17.6-14.0	15.8±0.9	7.0-5.4	6.2±0.4	3.8-2.6	3.2±0.3

* Approx. 95% of the data lies between $\pm 2SD$

The results obtained regarding the proximate analysis of some indigenous fish showed few similarities with the evaluation made by other researchers in this field.¹² However, differences with other researchers may be attributed to different physiological conditions of different spots, season, and age of fish including length during the time of sampling. Fish comprises a noteworthy source of protein in our eating routine.³⁶ A wide scope of proteins happen which are twenty number of amino acids joined in an alternate plan. The protein content of fish mussel showed a range of 14% to 17.6% .Protein is valuable for the upkeep of good wellbeing.¹³ In fish, the muscle protein content, for the most part, stays higher than every single other supplement.⁵ Fish food organism in the water may change the protein content of the mussel. Distinctive agro-climatic conditions in various topographical regions have a more prominent impact in aquatic plankton diversity, density, and accessibility to the fishes. The findings on lipid content regarding the low value of lipid content have relevance with other reported data.³³ The Lipid content gradually increases with age and size of the small fishes.³⁰ Lipids in fishes are significant for energy to save. It fills in as prescient evaluations of fish condition.¹⁷ As the fat

substance rises, the water content falls and the other way around. The present study showed that the whole of fat and moisture for any of the studied fishes approximates 80%.²⁸ Prior investigation archived that the lipid substance of SIS ran from 1.54 to 6.28% which has a pertinence to our findings. Water is crucial for transportation for food substances like fat, protein, etc. to the cells, organs, and various parts of the fish for proper co-ordination. Body fluids transport nutrients, metabolites, etc. and water is the major component in these fluids. Water is attached to the proteins and in the free form which has well defined biological roles.²² A larger amount of ash prompts having a more elevated amount of mineral in bones.²⁹

Conclusion

The fish represent one of the most important food, stable diet and supplement of proteins. The data observed from the present investigation shall be supportive in future supervision of the river Jaldhaka (Mansai) of Coochbehar District. The spot seems to be more inductive to the fish density might due to high food resources as it is located at the downstream with greater number of niches for the fish species of our interest. The records of the *Barilius bendelisis* fishes (as it is an environmental indicator species) is one of the preconditions for adopting the suitable conservation strategies of fish fauna. Till date the Jaldhaka(Mansai) river of Mathabhanga subdivision of Coochbehar district has not acknowledged any consideration from the ichthyological aspects as well as nutritional analysis of *Barilius bendelisis* species. This study gains significance as the Jaldhaka(Mansai) river has been described as one of the most important lifeline of the said locality. The Physico-chemical parameters are also provide supportive environment to live for the *Barilius bendelisis* species.

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