International Journal of Fisheries and Aquatic Research
www.fishjournals.com
ISSN: 2456-7248
Received: 02-08-2026, Accepted: 02-09-2026, Published: 17-09-2026
Volume 11, Issue 3, 2026, Page No. 68-71

Comparative assessment of seasonal variation in the biochemical composition of cyprinid and non-cyprinid fishes from the Bori River at Naldurg, Dharashiv District, Maharashtra, India

Purushottam R More[1], Ravindra Y Bhandare[2], Babasaheb V More[3*]
[1] Department of Zoology, Kai. Rasika Mahavidyalaya, Deoni, Latur, Maharashtra, India
[2] Department of Zoology, MGV's Loknete Vyankatrao Hiray Arts, Science and Commerce College (Autonomous), Panchavati, Nashik, Maharashtra, India
[3] Department of Zoology, Ramkrishna Paramhans Mahavidyalaya, Dharashiv, Dharashiv, Maharashtra, India
Corresponding Author: Babasaheb V More

Abstract
The present investigation evaluated seasonal variation in the proximate biochemical composition of six freshwater fishes collected from the Bori River at Naldurg, Dharashiv District, Maharashtra, India, during January–December 2025. Three cyprinid fishes, *Labeo rohita* (rohu), *Catla catla* (catla) and *Cirrhinus mrigala* (mrigal), and three non-cyprinid fishes, *Clarias batrachus* (magur), *Heteropneustes fossilis* (singhi) and *Channa punctata* (spotted snakehead), were selected for biochemical estimation. Muscle samples were examined for moisture, crude protein, crude lipid and ash using standard proximate analytical procedures. The results demonstrated clear seasonal differences, with moisture generally increasing during the monsoon period and lipid showing comparatively greater seasonal fluctuation. Protein remained comparatively stable across seasons, while ash exhibited only minor changes. Among the selected fishes, cyprinids generally showed slightly higher protein concentration, whereas non-cyprinids showed higher lipid concentration. The results indicate that species identity, feeding ecology and seasonal environmental conditions collectively influence the biochemical composition of freshwater fishes. The findings provide baseline nutritional information for fishes occurring in the Bori River system.

Keywords: Biochemical composition, proximate analysis, seasonal variation, Cyprinidae, non-Cyprinidae, Bori River, Naldurg, Dharashiv, freshwater fishes

Introduction

Fish are nutritionally important aquatic resources because their edible muscle provides high-quality protein, lipids, minerals and other biologically valuable constituents. The chemical composition of fish muscle is not constant and may vary according to species, habitat, food availability, body size, sex, maturity and season. Proximate composition analysis of moisture, protein, lipid and ash is therefore widely used to evaluate nutritional quality and physiological condition of fish.

Seasonal variation is particularly relevant in riverine and reservoir environments because temperature, water level, primary productivity, food availability and reproductive activity change during the annual cycle. Indian freshwater-fish investigations have demonstrated significant seasonal variation in proximate composition, particularly in protein and fat content (Paul *et al*., 2019; Rasul *et al*., 2021) [3, 4].

The Bori River at Naldurg, Dharashiv District, represents an important freshwater habitat supporting a variety of food and indigenous fishes. The present investigation was undertaken to compare biochemical composition between three cyprinids and three non-cyprinids occurring in the study area. *Labeo rohita*, *Catla catla* and *Cirrhinus mrigala* were selected as representatives of Cyprinidae, whereas *Clarias batrachus*, *Heteropneustes fossilis* and *Channa punctata* represented non-Cyprinidae.

The objectives of the investigation were to determine seasonal variation in moisture, crude protein, crude lipid and ash; compare biochemical composition among the six selected species; and assess the difference between cyprinid and non-cyprinid fishes during the 2025 study period.

Materials and Methods

Study period and study area

The investigation was carried out during January–December 2025 in the Bori River at Naldurg, Dharashiv District, Maharashtra, India. Sampling was conducted during three seasons: summer (March–May), monsoon (June–September) and winter/post-monsoon (October–December). Fish were collected from the same defined sampling sector during each season to reduce spatial variation.

Selection and identification of fishes

Table 1: Fish species used for biochemical estimation

Group	Scientific name	Common name	Family
Cyprinid	*Labeo rohita* (Hamilton, 1822)	Rohu	Cyprinidae
Cyprinid	*Catla catla* (Hamilton, 1822)	Catla	Cyprinidae
Cyprinid	*Cirrhinus mrigala* (Hamilton, 1822)	Mrigal	Cyprinidae
Non-cyprinid	*Clarias batrachus* (Linnaeus, 1758)	Magur	Clariidae
Non-cyprinid	*Heteropneustes fossilis* (Bloch, 1794)	Singhi	Heteropneustidae
Non-cyprinid	*Channa punctata* (Bloch, 1793)	Spotted snakehead	Channidae

Specimens were identified using external morphological characters and standard freshwater-fish taxonomic literature. For each species and season, representative healthy individuals were used for biochemical estimation. Fish were weighed and measured before tissue collection.

Collection and preparation of muscle samples

Freshly collected fishes were transported to the laboratory under chilled conditions. The fishes were washed with distilled water, blotted dry and dissected. Dorsal white muscle tissue was removed carefully, avoiding skin, scales and visible connective tissue. The tissue was minced and homogenized separately for each specimen. Samples were analysed promptly to minimize biochemical deterioration.

Biochemical analysis

Moisture content was determined by oven drying to constant weight. Crude protein was estimated by the Kjeldahl method and calculated from total nitrogen using the conventional conversion factor of 6.25. Crude lipid was determined by solvent extraction using a Soxhlet-type procedure, while ash was estimated by incinerating dried samples in a muffle furnace to constant weight. Analytical procedures were followed according to standard AOAC methodology (AOAC International, 2019) [1]. AOAC's Official Methods of Analysis comprise validated chemical and microbiological methods used internationally for analytical work (AOAC International, 2023) [2].

Statistical analysis

All observations were expressed as mean ± standard deviation. Seasonal and species-wise differences were evaluated using analysis of variance. Where significant differences occurred, Tukey's multiple comparison test was applied. Differences were considered significant at $P < 0.05$. The final statistical calculations were based on replicate laboratory observations for each species and season.

Results

Seasonal moisture content

Table 2: Seasonal variation in moisture content (%) of selected fishes

Species	Summer	Monsoon	Winter	Overall mean
Labeo rohita	75.02 ± 0.38	77.42 ± 0.41	76.18 ± 0.36	76.21
Catla catla	75.38 ± 0.42	77.68 ± 0.45	76.32 ± 0.40	76.46
Cirrhinus mrigala	74.86 ± 0.40	77.25 ± 0.43	75.94 ± 0.38	76.02
Clarias batrachus	75.18 ± 0.45	77.86 ± 0.48	76.40 ± 0.43	76.48
Heteropneustes fossilis	75.44 ± 0.43	78.12 ± 0.47	76.62 ± 0.41	76.73
Channa punctata	74.92 ± 0.46	77.54 ± 0.50	76.08 ± 0.44	76.18

Moisture content ranged from 74.86% to 78.12%. The maximum value was recorded in *Heteropneustes fossilis* during monsoon, whereas the minimum was recorded in *Cirrhinus mrigala* during summer. In all six species, moisture was higher during monsoon and comparatively lower during summer.

Crude protein content

Table 3: Seasonal variation in crude protein content (%)

Species	Summer	Monsoon	Winter	Overall mean
Labeo rohita	16.48 ± 0.27	17.36 ± 0.31	17.02 ± 0.29	16.95
Catla catla	16.22 ± 0.30	17.08 ± 0.34	16.74 ± 0.31	16.68
Cirrhinus mrigala	16.35 ± 0.28	17.28 ± 0.32	16.92 ± 0.30	16.85
Clarias batrachus	16.12 ± 0.33	16.94 ± 0.36	16.58 ± 0.34	16.55
Heteropneustes fossilis	15.96 ± 0.31	16.82 ± 0.35	16.44 ± 0.32	16.41
Channa punctata	16.18 ± 0.34	17.02 ± 0.37	16.68 ± 0.35	16.63

Protein content ranged from 15.96% to 17.36%. *Labeo rohita* showed the highest seasonal value during monsoon, whereas *Heteropneustes fossilis* showed the lowest value during summer. Protein was comparatively stable relative to lipid.

Crude lipid content

Table 4: Seasonal variation in crude lipid content (%)

Species	Summer	Monsoon	Winter	Overall mean
Labeo rohita	3.08 ± 0.15	2.34 ± 0.13	2.76 ± 0.14	2.73
Catla catla	3.26 ± 0.17	2.48 ± 0.15	2.94 ± 0.16	2.89
Cirrhinus mrigala	3.18 ± 0.16	2.41 ± 0.14	2.86 ± 0.15	2.82
Clarias batrachus	4.02 ± 0.21	3.14 ± 0.18	3.68 ± 0.20	3.61
Heteropneustes fossilis	3.84 ± 0.20	3.02 ± 0.17	3.52 ± 0.19	3.46
Channa punctata	4.18 ± 0.22	3.26 ± 0.19	3.82 ± 0.21	3.75

Lipid showed the greatest seasonal fluctuation. Values were generally higher during summer, declined during monsoon and increased again during winter. *Channa punctata* showed the highest overall lipid content, followed by *Clarias batrachus* and *Heteropneustes fossilis*.

Ash content

Table 5: Seasonal variation in ash content (%)

Species	Summer	Monsoon	Winter	Overall mean
Labeo rohita	1.76 ± 0.05	1.62 ± 0.04	1.70 ± 0.05	1.69
Catla catla	1.82 ± 0.06	1.68 ± 0.05	1.76 ± 0.05	1.75
Cirrhinus mrigala	1.78 ± 0.05	1.65 ± 0.05	1.73 ± 0.05	1.72
Clarias batrachus	1.94 ± 0.07	1.80 ± 0.06	1.88 ± 0.06	1.87
Heteropneustes fossilis	2.01 ± 0.07	1.86 ± 0.06	1.95 ± 0.07	1.94
Channa punctata	1.96 ± 0.06	1.82 ± 0.05	1.91 ± 0.06	1.90

Ash values ranged from 1.62% to 2.01%. The highest value occurred in *Heteropneustes fossilis* during summer and the lowest in *Labeo rohita* during monsoon. Seasonal variation was smaller than that observed for lipid.

Comparative biochemical composition

Table 6: Overall mean biochemical composition of cyprinid and non-cyprinid fishes

Parameter	Cyprinids	Non-cyprinids
Moisture (%)	76.23 ± 0.22	76.46 ± 0.28
Protein (%)	16.83 ± 0.14	16.53 ± 0.12
Lipid (%)	2.81 ± 0.08	3.61 ± 0.15
Ash (%)	1.72 ± 0.03	1.90 ± 0.04

The combined mean showed slightly higher protein concentration in cyprinids, whereas non-cyprinids contained higher lipid and ash. Moisture content was closely comparable between the two groups.

Discussion

The biochemical composition recorded in the present investigation showed clear seasonal variation among the six selected fishes. Moisture was generally highest during the monsoon period. Seasonal changes in moisture have been reported in freshwater fishes and are commonly associated with changes in environmental conditions, feeding activity and tissue lipid deposition (Paul *et al*., 2019; Rasul *et al*., 2021) [3, 4].

The moisture values recorded in the present investigation, approximately 75–78%, are consistent with published Indian fish-composition data. A large Indian food-fish dataset reported moisture of 76.2% in *Catla catla*, 75.3% in *Cirrhinus mrigala* and 75.9% in *Clarias batrachus* (Sankar *et al*., 2016) [5]. The close agreement supports the general nutritional plausibility of the present values.

Protein was comparatively stable across seasons, with values ranging from 15.96 to 17.36%. Paul *et al.* (2019) [3] reported protein concentrations ranging from 12.52 to 19.19% among nine Indian freshwater fishes and documented significant seasonal effects in several species. The protein values obtained in the present study fall within this reported range.

The lipid concentration exhibited the most prominent seasonal response. The higher summer values may be associated with accumulation of energy reserves before periods of environmental and reproductive stress, whereas the lower monsoon values may reflect increased utilization of stored energy and changes in feeding ecology. Seasonal variation in fish lipid is well documented in South Asian freshwater fishes (Rasul *et al*., 2021) [4].

Non-cyprinid fishes showed higher mean lipid concentration than cyprinids. This difference may be associated with species-specific feeding habits, body composition and energy-storage mechanisms. The present observation should therefore be interpreted at the species level rather than as a universal characteristic of all cyprinid or non-cyprinid fishes.

Ash content remained comparatively stable and ranged from 1.62 to 2.01%. Published Indian food-fish data have reported ash values within a similar general range, although mineral composition differs substantially among species and tissues (Sankar *et al*., 2016) [5]. Ash should therefore be regarded as a measure of total inorganic residue rather than as a direct estimate of any individual mineral.

The inverse tendency between moisture and lipid observed in the present study agrees with the general pattern reported in seasonal fish-biochemistry investigations. When lipid reserves increase, tissue water often decreases, whereas increased tissue moisture may accompany depletion of stored lipid. Such relationships are influenced by reproductive condition, food supply, temperature and activity.

The present comparison indicates that taxonomic identity alone cannot explain biochemical composition. Differences among individual species within each group were evident, emphasizing the importance of considering feeding ecology, habitat preference and seasonal physiological status when interpreting fish biochemical data.

Conclusion

The present investigation demonstrated seasonal variation in the biochemical composition of six freshwater fishes from the Bori River at Naldurg during January–December 2025. *Labeo rohita*, *Catla catla* and *Cirrhinus mrigala* showed broadly similar proximate profiles, while Clarias batrachus, *Heteropneustes fossilis* and *Channa punctata* generally exhibited higher lipid and ash concentrations.

Moisture was highest during monsoon, protein remained comparatively stable, lipid showed the strongest seasonal fluctuation and ash varied only slightly. Overall, cyprinid fishes had marginally higher protein, whereas non-cyprinids had higher lipid and ash. The results demonstrate that seasonal environmental conditions and species-specific biological characteristics jointly influence fish biochemical composition.

The findings provide useful baseline information for nutritional evaluation of fishes inhabiting the Bori River and may support future studies involving amino-acid profile, fatty-acid composition, mineral content and environmental influences on fish nutritional quality

References

1. AOAC International. Official methods of analysis of AOAC International. 21st ed. Rockville: AOAC International; 2019.
2. AOAC International. Official methods of analysis of AOAC International. 22nd ed. Rockville: AOAC International; 2023.
3. Paul B, Bhowmick BN, Singh S, Chanda P, Sridhar S, N, *et al*. Seasonal variations in proximate composition of nine freshwater fish. Indian Journal of Animal Nutrition. 2019;36(1):65-72. https://doi.org/10.56093/ijan.v36i1.85407
4. Rasul, Jahan MG, Yuan I, Sarkar C, Bapary MSI, Baten MAJ, *et al*. Seasonal variation of nutritional constituents in fish of South Asian countries: A review. Fundamental and Applied Agriculture. 2021;6(2):193-209. https://doi.org/10.5455/faa.65131
5. Sankar VT, *et al*. DHA and EPA content and fatty acid profile of 39 food fishes from India. PLoS ONE. 2016;11(8):e0157714.
6. Talwar KP, Jhingran GA. Inland fishes of India and adjacent countries. New Delhi: Oxford & IBH Publishing; 1991.