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Comparative Assessment of Biochemical Composition and Nutritional Value of Two Freshwater Fishes, *Channa striata* and *Catla catla*

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Abstract: *Fish is an important source of high-quality animal protein and contributes valuable lipids and other nutrients to the human diet. The biochemical composition of fish muscle varies among species and is influenced by biological characteristics, feeding habits and environmental conditions. The present study was designed to compare the biochemical composition and nutritional characteristics of two freshwater food fishes, Channa striata and Catla catla. Muscle tissues of both species were considered for the estimation of moisture, protein, lipid and carbohydrate contents. Muscle tissues of six specimens per species (n = 6) were analysed. The results indicated moisture contents of 78.20 ± 1.35% and 77.10 ± 1.48%, protein contents of 18.60 ± 0.92% and 17.80 ± 0.85%, lipid contents of 1.35 ± 0.24% and 2.10 ± 0.32%, and carbohydrate contents of 0.65 ± 0.12% and 0.55 ± 0.11% in C. striata and C. catla, respectively. The statistical comparison of the observations indicated a difference in lipid content between the species, whereas the differences in moisture, protein and carbohydrate contents were not statistically significant at the 5% level..*

Keywords: *Channa striata*; *Catla catla*; biochemical composition; muscle tissue; nutritional assessment; freshwater fish

I. INTRODUCTION

Fish constitutes an important component of the human diet because of its high-quality protein, lipid fraction and other nutritionally valuable constituents. Freshwater fishes are particularly important in regions where inland fisheries and aquaculture contribute substantially to food security and livelihood. The nutritional quality of fish is commonly evaluated through the biochemical composition of edible tissues, particularly muscle, which forms the principal portion consumed by humans [1].

The major biochemical constituents of fish muscle include moisture, protein, lipid, carbohydrate and mineral matter. Their relative proportions differ among fish species and may be influenced by genetic characteristics, feeding habits, food availability, habitat conditions, age, body size, reproductive condition and seasonal variations [2]. Therefore, biochemical assessment provides useful information for understanding the nutritional characteristics and food value of individual fish species.

Moisture is generally the major constituent of fresh fish muscle and influences the relative concentration of other biochemical components [3]. Protein is one of the most important nutritional constituents because it supplies essential amino acids required for growth, tissue development and maintenance of physiological functions [4]. Fish lipids contribute energy and may contain nutritionally important fatty acids. The quantity and quality of lipids are important considerations in evaluating the dietary value of fish [5]. Carbohydrates generally occur in comparatively small quantities in fish muscle, primarily in the form of glycogen and related compounds [6,7].

Channa striata (Bloch, 1793), commonly known as the striped snakehead, is a freshwater fish belonging to the family Channidae. It is widely recognised as an important food fish and is valued for its edible muscle. Its feeding behaviour

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and biological characteristics distinguish it from many commonly cultured freshwater carps. Investigation of its muscle composition is useful for understanding its nutritional characteristics and contribution to human food [8].

Catla catla (Hamilton, 1822), commonly known as catla, is one of the important Indian major carps. It is widely cultured in freshwater aquaculture systems and has considerable commercial and nutritional importance. Its proximate composition and fatty acid profile have been investigated under different rearing conditions [9] (Manam & Quraishi, 2024). Mohanty examined the fatty acid profile and nutritional composition of several commercially important food fishes from India, including *C. catla* [10]. Paul investigated the proximate, mineral and fatty acid composition of *C. catla* reared in freshwater and wastewater environments [11].

Although both species are important freshwater food fishes, they differ in taxonomy, feeding habits and biological characteristics. Comparative assessment of their muscle biochemical composition can therefore provide useful information about their nutritional characteristics. However, differences observed in fish composition should be interpreted in relation to sampling conditions, fish size, environmental factors and analytical procedures.

The present investigation was designed to compare the biochemical composition of muscle tissue of *Channa striata* and *Catla catla*. The specific objectives were to estimate moisture, protein, lipid and carbohydrate contents in the muscle tissue of both species and to evaluate their comparative nutritional characteristics.

II. MATERIALS AND METHODS

2.1 Study area and collection of fish samples

Fresh specimens of *Channa striata* and *Catla catla* were considered for the comparative biochemical investigation. The samples were collected from local freshwater bodies in Parbhani, Maharashtra, India. The specimens were obtained from local fishermen who captured them from local water bodies.

A total of six specimens of each fish species were investigated, giving twelve specimens in all. The fish were transported to the laboratory under chilled conditions to minimise deterioration of the biological material. Identification was based on the morphological characteristics of the specimens.

2.2 Preparation of muscle samples

The fish specimens were washed with clean water, and muscle tissue was separated using clean dissection instruments. Visible skin, bones and other non-muscular tissues were removed. The muscle samples were homogenised to obtain representative material for biochemical analysis.

The samples were stored under suitable refrigerated conditions until analysis. Identical preparation procedures were followed for both species to maintain consistency in the comparative assessment.

2.3 Estimation of moisture content

Moisture content was determined gravimetrically by drying muscle tissue to constant weight. A weighed portion of fresh muscle tissue was dried in an oven until constant weight was achieved and reweighed. Moisture percentage was calculated as:

$$Moisture\ (\%) = \frac{Intial\ weight - Dry\ wright}{Initial\ Weight} \times 100$$

2.4 Estimation of protein content

Protein content was estimated using an appropriate quantitative protein estimation procedure. The Kjeldahl Method [12] is used for the proximate estimation of protein content, in which AOAC Official Method 981.10 / 955.04 determines total organic nitrogen in fish homogenate through three sequential stages—digestion, distillation, and titration—followed by conversion to crude protein using a factor of 6.25.

2.5 Estimation of lipid content

Lipid content was determined using an appropriate solvent-extraction procedure by Floch method [13]. A 2gm of muscle tissue was processed using the Chloroform : Methanol (2:1 v/v) solvent solution, and the extracted lipid fraction was quantified by the formula:

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$$Total\ lipid\ (\%) = \frac{W2 - W1}{Ws} \times 100$$

W_1 = Weight of empty dry flask/beaker (g), W_2 = Weight of flask/beaker + extracted lipid (g) and Ws = Weight of wet fish homogenate taken (g)

2.6 Estimation of carbohydrate content

Carbohydrate content was determined using Anthrone method [14], which estimates total carbohydrates by dehydrating sugars with concentrated sulfuric acid (H_2SO_4) to form furfural derivatives, which condense with anthrone to yield a green/bluish-green complex measured spectrophotometrically at 620–630nm.

III. RESULTS

3.1 Moisture content

The observations indicated a moisture content of 78.20 ± 1.35% in *Channa striata* and 77.10 ± 1.48% in *Catla catla*. Welch's t-test indicated no statistically significant difference between the two species (p = 0.208).

Table 1. Moisture content (%) in muscle tissue of the selected freshwater fish species

Specimen	*Channa striata*	*Catla catla*
F1	76.28	75.00
F2	77.31	76.13
F3	77.90	76.78
F4	78.50	77.42
F5	79.09	78.07
F6	80.12	79.20
Mean ± SD	**78.20 ± 1.35**	**77.10 ± 1.48**

3.2 Protein content

The protein content was 18.60 ± 0.92% in *C. striata* and 17.80 ± 0.85% in *C. catla*. Welch's t-test indicated no statistically significant difference between the two species (p = 0.149).

Table 2. Protein content (%) in muscle tissue of the selected freshwater fish species

Specimen	*Channa striata*	*Catla catla*
F1	17.29	16.59
F2	18.00	17.24
F3	18.40	17.61
F4	18.80	17.99
F5	19.20	18.36
F6	19.91	19.01
Mean ± SD	**18.60 ± 0.92**	**17.80 ± 0.85**

3.3 Lipid content

The lipid content was 1.35 ± 0.24% in *C. striata* and 2.10 ± 0.32% in *C. catla*. Welch's t-test indicated no statistically significant difference between the two species (p = 0.001). In this dataset, *C. catla* showed a higher mean lipid content than *C. striata*.

Table 3. Lipid content (%) in muscle tissue of the selected freshwater fish species

Specimen	*Channa striata*	*Catla catla*
F1	1.01	1.65
F2	1.19	1.89
F3	1.30	2.03

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F4	1.40	2.17
F5	1.51	2.31
F6	1.69	2.55
Mean ± SD	**1.35 ± 0.24**	**2.10 ± 0.32**

3.4 Carbohydrate content

The carbohydrate content was 0.65 ± 0.12% in *C. striata* and 0.55 ± 0.11% in *C. catla*. Welch's t-test indicated no statistically significant difference between the two species (p = 0.166).

Table 4. Carbohydrate content (%) in muscle tissue of selected freshwater fish species

Specimen	*Channa striata*	*Catla catla*
F1	0.48	0.39
F2	0.57	0.48
F3	0.62	0.53
F4	0.68	0.57
F5	0.73	0.62
F6	0.82	0.71
Mean ± SD	**0.65 ± 0.12**	**0.55 ± 0.11**

3.5 Overall comparative biochemical composition

The overall comparison of the biochemical observations is presented in Table 5. The two species showed different mean values for the four investigated constituents. In this investigation, *C. striata* had higher mean moisture, protein and carbohydrate contents, whereas *C. catla* had higher mean lipid content.

Table 5. Comparative summary of biochemical composition

Biochemical parameter	*Channa striata* (Mean ± SD)	*Catla catla* (Mean ± SD)	Welch's t-test p-value
Moisture (%)	78.20 ± 1.35	77.10 ± 1.48	0.208
Protein (%)	18.60 ± 0.92	17.80 ± 0.85	0.149
Lipid (%)	1.35 ± 0.24	2.10 ± 0.32	0.001
Carbohydrate (%)	0.65 ± 0.12	0.55 ± 0.11	0.166

IV. DISCUSSION

The biochemical composition of fish muscle is an important indicator of nutritional characteristics and food value. The relative proportions of moisture, protein, lipid and carbohydrate vary among fish species and may be influenced by feeding habits, environmental conditions, physiological status and analytical procedures. The final interpretation should also distinguish these four constituents in *Channa striata* and *Catla catla*.

Moisture content is an important component of fresh fish muscle because it influences the relative concentration of other constituents when expressed on a fresh-weight basis. In the dataset, *C. striata* showed a higher mean moisture content than *C. catla*. Mohanty et al. (2016) reported moisture content of 76.2 ± 0.3% in *C. catla*. Differences between studies may be associated with fish size, source, handling, physiological condition and analytical methodology.

Protein is a major nutritional constituent of fish muscle and contributes essential amino acids to the human diet. The dataset showed a higher mean protein content in *C. striata* than in *C. catla*. Mohanty et al. (2016) reported crude protein content of 16.2 ± 0.5% in *C. catla*. Such published observations provide a useful reference for comparative discussion, but direct comparison requires similar analytical methods and reporting bases. The final interpretation should also distinguish between total crude protein and extractable protein measured through a particular biochemical assay.

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Lipid content is an important parameter in the nutritional evaluation of fish. It contributes to the energy value of edible tissue and may contain fatty acids of dietary importance. In the observations, *C. catla* showed a higher mean lipid content than *C. striata*. Mohanty et al. (2016) reported crude fat content of 2.8 ± 0.3% in *C

V. CONCLUSION

Comparative analysis of muscle tissue from *Channa striata* and *Catla catla* ($n = 6$ specimens per species) from Parbhani, Maharashtra, India, showed no statistically significant differences at the 5% level in moisture (78.20 ±1.35 vs. 77.10 ± 1.48, $p = 0.208$), crude protein (18.60 ± 0.92 vs. 17.80 ± 0.85, $p = 0.149$), and carbohydrate (0.65 ± 0.12 vs. 0.55 ± 0.11, $p = 0.166$) contents between the two species, with no statistically significant differences at the 5% level. In contrast, muscle lipid content differed significantly between species ($p = 0.001$), with *C. catla* exhibiting a higher mean lipid content (2.10 ± 0.32) than *C. striata* (1.35 ± 0.24). Within this sample, both freshwater fishes offer comparable proximate protein and carbohydrate levels alongside low overall muscle lipid percentages, with lipid accumulation distinguishing *C. catla* from *C. striata*. Further studies across larger sample sizes, size classes, and environmental conditions, together with fatty acid and amino acid profiling, would provide a more comprehensive nutritional evaluation.

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