JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

"Seasonal Variations in the Proximate Composition of Edible Fishes (*Channa striata*) from Wan River Basin, Parli, Beed, Maharashtra, India."

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Abstract: This study regards *Channa striata* as a potential meal due to its reputation for healing wounds, easing pain, and boosting vitality while unwell. Rural residents always consume this fish due to its advantageous therapeutic properties. The purpose of this research was to determine the four main components observed for *Channa striata* (Bloch, 1793). We extract proteins, moisture, lipids, carbohydrates, and ash, among others. The exploration of *Channa striata* reveals that it plays a significant role not only as a staple food source but also as a remarkable contributor to traditional medicine. Its applications in wound treatment, pain reduction, and energy enhancement during illness highlight the fish's potential to improve health outcomes, particularly among rural communities that rely on its medicinal benefits. This study examines the main components of *Channa striata* and emphasizes the importance of utilizing these natural resources in modern healthcare, thereby linking traditional knowledge with scientific research. Ultimately, recognizing and harnessing the multifaceted benefits of *Channa striata* could pave the way for innovative approaches to nutrition and medicine alike.

Keyword: Proximate Composition, *Channa striata*, Nagapur Dam.

Introduction: India is an around-the-world biodiversity hotspot, with over 10% of the world's fish variety, making it one of the most nutritious and economical food sources (Ayyappan and Diwan, 2007; Mathana, P 2012). A nutritious diet is crucial for optimal growth and health in humans. The issue of food scarcity is among the most critical challenges, and our nation is confronting it as well. An unbalanced diet leads to several irregularities and illnesses. We must investigate the available natural resources to effectively address and resolve this issue while meeting the essential criteria of a balanced diet. Aquatic areas readily yield fish, a valuable natural resource that plays a significant role in human nutrition. Increasing the availability and intake of fish could potentially alleviate the current protein deficiency in this country (P. V. Jabde 1985).

The (Kode 2023) studied data on the proximate composition of fish and fisheries products, which is crucial for evaluating their energy worth and for strategizing the most suitable manufacturing and commercial goods. The distinctiveness of diverse combinations of biomolecular proteins, lipids, ash, vitamins, and minerals renders fish a very nutritious product. The consumable proportion of fish organs fluctuates according to age, size, sex, and species attributes (Panchakshari et al., 2016), typically constituting 50-60% of the total body mass (Krishna et al., 2017). The diet, age, and sex of the fish primarily influence the lipid composition of its muscle. Increased water content correlates with low-fat seasons and vice versa, as documented by (Krishna and Sreeramulu 1999). (Nature Ghafouri et al. 2019) examined the population genetics of *Catla catla*, whereas (Rao 2001) investigated the biological resources of Aphanius species in the Ganga. The proximate composition of various marine, freshwater, and brackish water fish has been identified by (Suhendi et al. 2020), (Baehaki et al. 2020), (Tiralongo et al. 2020), and (Ullah et al. 2022).

Freshwater fish provide a significant source of nutrition and are a crucial element of aquatic ecosystems (Bene et al., 2007; Dwivedi, 2009). Fish flesh has exceptional nutritional content (Nargis, 2006) and serves as a vital supply of critical nutrients for humans (Ayoola, 2010). The biochemical composition of fish serves as a dependable predictor of nutritional quality (Sonavane et al., 2017), physiological state, and environment (Shamsan and Ansari, 2010). (Setiawan et al. 2024) say that when an acid solvent was heated to 50°C, the levels of total soluble protein (TSP), albumin, and albumin percentage were all much lower than when the solvent wasn't cooked. Additionally, the small number of protein bands seen shows that both the acid liquid and heating treatment together were equally harmful. We found that albumin was present in SFC at a rate of 32% after extraction with a water solvent without heat treatment. This value was the highest level ever seen using the BCP test. These two bands, at 40 kDa and 47 kDa, made up 57% and 16% of the total protein we tested, respectively. We used densitometric analysis and SDS-PAGE to look for possible albumin-related bands. (Dewita et al. 2022) conducted this study the findings indicated that the snakehead fish flesh from the Riau seas was in a fresh state. The meat's anatomical section constituted 37.38% of the overall weight. The flesh of snakehead fish has 1.96% ash and 16.99% protein, based on its chemical composition. Moreover, leucine (0.539%) and glutamic acid (1.446%) were the most prevalent amino acids identified in snakehead fish flesh. Zn made up 2.235% and Fe 6.217% of the minerals found in snakehead fish meat, respectively. The immune system and wound healing process are profoundly influenced by the amino acids leucine and glutamic acid, as well as the minerals iron and zinc.

The (Dutta & Dutta in 2020) study of biochemical composition and his investigation determined that the gonads mobilize stored lipids and fatty acids for their development during the reproductive season, known as the monsoon. This analysis indicates that the total lipid and fatty acid content in the edible portion reaches its lowest point in July, as expected during the mating season. *C. striata* has a higher concentration of MUFAs (64.34%) and PUFAs (16.21%), which are beneficial for human health, compared to SFAs (12.5%), which are the most detrimental. Notwithstanding several disadvantages, *C. striata* may unequivocally be classified as a cost-effective, nutritious food source. Future investigations concerning this species in the domains of structured agriculture, conservation, and the maintenance of regional biodiversity will surely profit from our efforts. A study conducted by (Rosmawati et al. 2018) Furthermore, their work came to the conclusion that the use of snakehead fish as a health food is associated with an increase in the production of skin and bone byproducts. This research is being conducted with the intention of determining the chemical composition, collagen content, and amino acid composition of the skin and bone of snakehead fish to provide direction for future uses. We used the skin and bones of snakehead fish weighing between 900 and 1,000 grams for this experiment. Some of the properties of snakehead skin and bones include their chemical composition and the amount of amino acids they contain. On the other hand, bone has more fat and ash, while the skin contains a greater proportion of water and protein. The presence of hydroxyproline in the skin of snakehead fish led to the production of collagen. Glycine and proline, on the other hand, constituted the biggest proportion of amino acids in the skin and bone, respectively.

According to (Mustafa et al.'s 2013) research, *Channa striata* is considered a potential food source due to its usefulness in wound healing, pain alleviation, and enhancing energy during illness. Rural inhabitants consistently consume this fish due to its advantageous medicinal attributes. Nonetheless, it is vital to examine how these advantages may manifest. This study aimed to determine the amino acid content and nutritional value of Pasurua *Channa striata* extract (CSE). The Pasuruan CSE includes copper, iron, calcium, zinc, and total protein with respective values of 0.01±0.001 mg/100 ml, 5.78±0.015 mg/100 ml, 2.26±0.020 mg/100 ml, 0.41±0.010 mg/100 ml, and 5.524±0.020 g/100 ml. A minimum of 17 amino acids were identified in this sample. The main amino acids found in the extracts are glutamate (1.494 ± 0.004 g/100 g), lysine (1.152 ± 0.0006 g/100 g), leucine (0.956 ± 0.0002 g/100 g), asparagine (0.911 ± 0.010 g/100 g), alanine (0.725 ± 0.0005 g/100 g), arginine (0.624 ± 0.0002 g/100 g), and valine (0.606 ± 0.0009 g/100 g). The conclusion is that the CSE diet may encompass all necessary and non-essential amino acids in a balanced and complete manner. (Aliyu-Paiko et al. 2012) examined the lipid and amino acid content of juvenile *Channa striata* (Bloch 1793) from farms and the wild in Malaysia. The moisture content ranged from 68.1% to 70.8%, crude protein from 52.7% to 55.4%, crude fat from 16.2% to 20.9%, and ash from 15.1% to 21.0% in both wild and cultured samples. The most common n-6 FA was arachidonic acid (20:4n6), whereas EPA (22:6n3) was a common n-3 FA. PUFAs were also abundant in the FA classes studied. AA analysis of test samples showed glutamic acid. Glycine and aspartic acid are most abundant. Each important amino acid was abundant in raised and wild fish. The study found no significant difference ($P < 0.05$) in the total body contents of FA and AA in reared and wild juvenile *C. striata*. It appears that both samples match the nutritional demands of Asian-Pacific fish, which are widely reared and eaten.

Recognizing the significance of fish as a dietary source, it is crucial to understand its nutritional content and the differences associated with spawning, maturity, sex, and fish development. We must determine the biochemical compositions of a fish's body components, including protein, fat, glycogen, and water. All these biochemical elements experience variations based on the seasons, diet, sex, maturity stage, growth of fish, and their geographical location. These variations can significantly affect the flavour, texture, and overall quality of the fish, influencing not only culinary applications but also health benefits for consumers. Consequently, it is essential to assess the nutritional content and determine the quality of the fish (Azam et al., 2004). Therefore, ongoing research into the factors affecting these biochemical compositions is essential for optimizing fish farming practices and ensuring sustainable fishing methods (Bruce, J. R. 1924).

RESEARCH METHODOLOGY:

We brought the newly collected fish to the Department of Zoology laboratory at Mrs. K.S.K. College, Beed. During the June 2023–May 2025 season. We selected only healthy fish for each instance. We removed the fish's surface moisture using blotting paper. After identifying the fishes' random sex by cutting them up, we looked at their guts and muscles. When muscles were removed, care was taken to prevent skin, scales, and bone fragments from being contaminated. We placed watch glasses over the tissues to prevent any potential moisture loss. We precisely weighed each tissue sample and then dried it in an oven at 80°C until its weight remained consistent. We used a mortar and pestle to grind the dry samples into a powder for chemical analysis in accordance with (A.O.A.C. 1950). We determined each chemical composition value using wet weight. The following lists the experimental techniques used to analyses different biochemical compositions:

- **Fish Gut Protein Extraction Method:** Proteins in fish guts can be extracted using the Kjeldahl method, which involves digesting the sample in sulfuric acid to convert nitrogen into ammonium sulphate. This is then distilled and titrated to determine the total protein content (AOAC, 2005).
- **Fish Gut Moisture Extraction Method:** Moisture is determined by drying the fish gut sample in an oven at 105°C until a constant weight is achieved. The difference in weight before and after drying indicates the water content (AOAC, 2005).
- **Fish Gut Lipids Extraction Method:** Lipids are extracted using a Soxhlet extractor with organic solvents like petroleum ether. The solvent dissolves the fats, which are later separated and measured after evaporation (Bligh & Dyer, 1959).
- **Fish Gut Carbohydrates Extraction Method:** Carbohydrates are estimated by difference, subtracting the sum of protein, lipid, moisture, and ash content from the total sample weight. In some studies, colorimetric methods like the phenol-sulfuric acid assay are also used (Dubois et al., 1956).
- **Fish Gut Ash Extraction Method:** Ash content is measured by incinerating the sample in a muffle furnace at 550°C for several hours. This burns off organic matter, leaving behind mineral residue (AOAC, 2005).

IV. RESULTS AND DISCUSSION

Figure.1: Seasonal Changes in Biochemical Composition of *Channa striata* (Bloch 1793) June, July and August, September 2023.

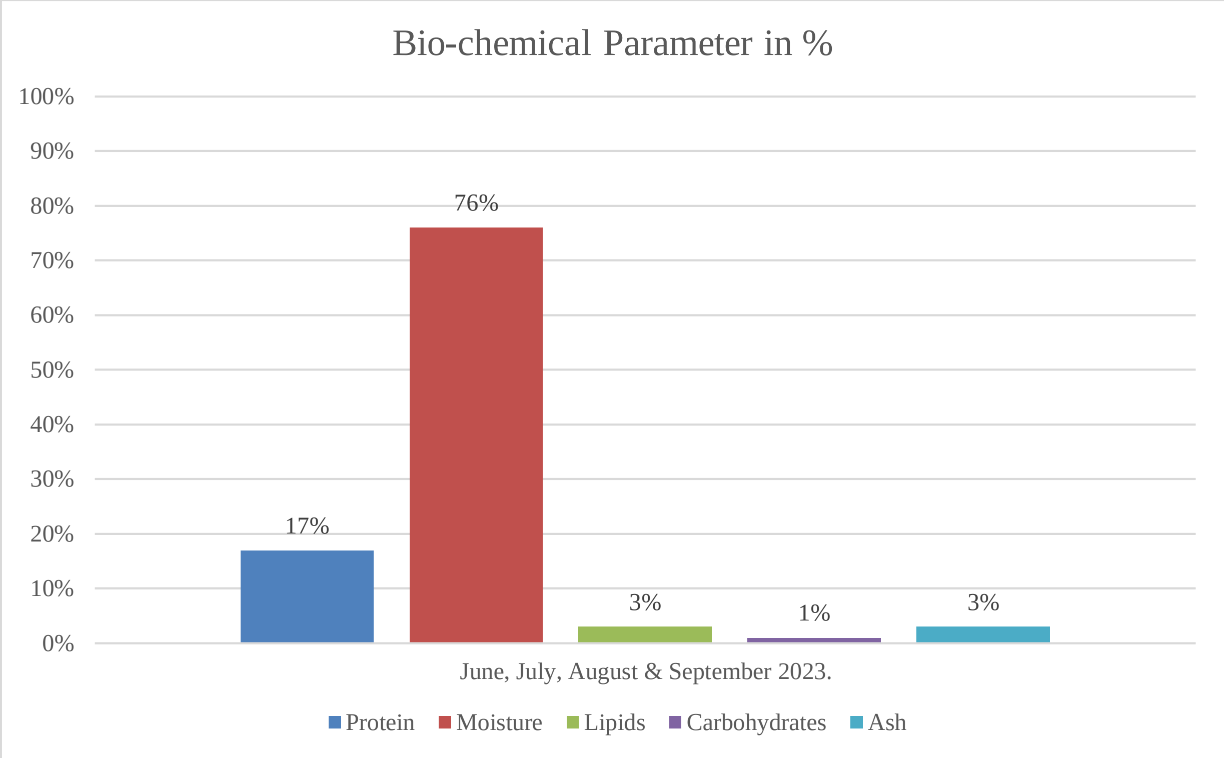

Figure.1: From June to September 2023, the biochemical composition of the sample reveals a high moisture level at 76%, which dominates the overall makeup. This finding indicates that the sample is largely water-based during this period, likely due to environmental conditions such as rainfall or storage in humid settings. The high moisture content can affect the concentration of other nutrients by diluting them. Protein content is recorded at 17%, showing a moderate presence of this essential nutrient. While slightly lower than in some other months, this protein level still represents a significant portion of the non-water components and contributes to the nutritional value of the sample. We measure both lipids and ash at 3%, suggesting that the sample contains a balanced amount of fats and minerals. These values suggest stability in the fat and mineral content, even with fluctuating moisture levels. Carbohydrates are at their lowest level, measuring only 1%, which indicates a minimal presence of sugars or starches during this period. In simple terms, during June through September 2023, the sample is very moist and has a fair amount of protein, stable fats and minerals, and very low carbohydrate content. This composition suggests a softer, water-rich sample with moderate nutritional density.

Figure.2: Seasonal Changes in Biochemical Composition of *Channa striata* (Bloch 1793) October, November, December 2023 & January 2024.

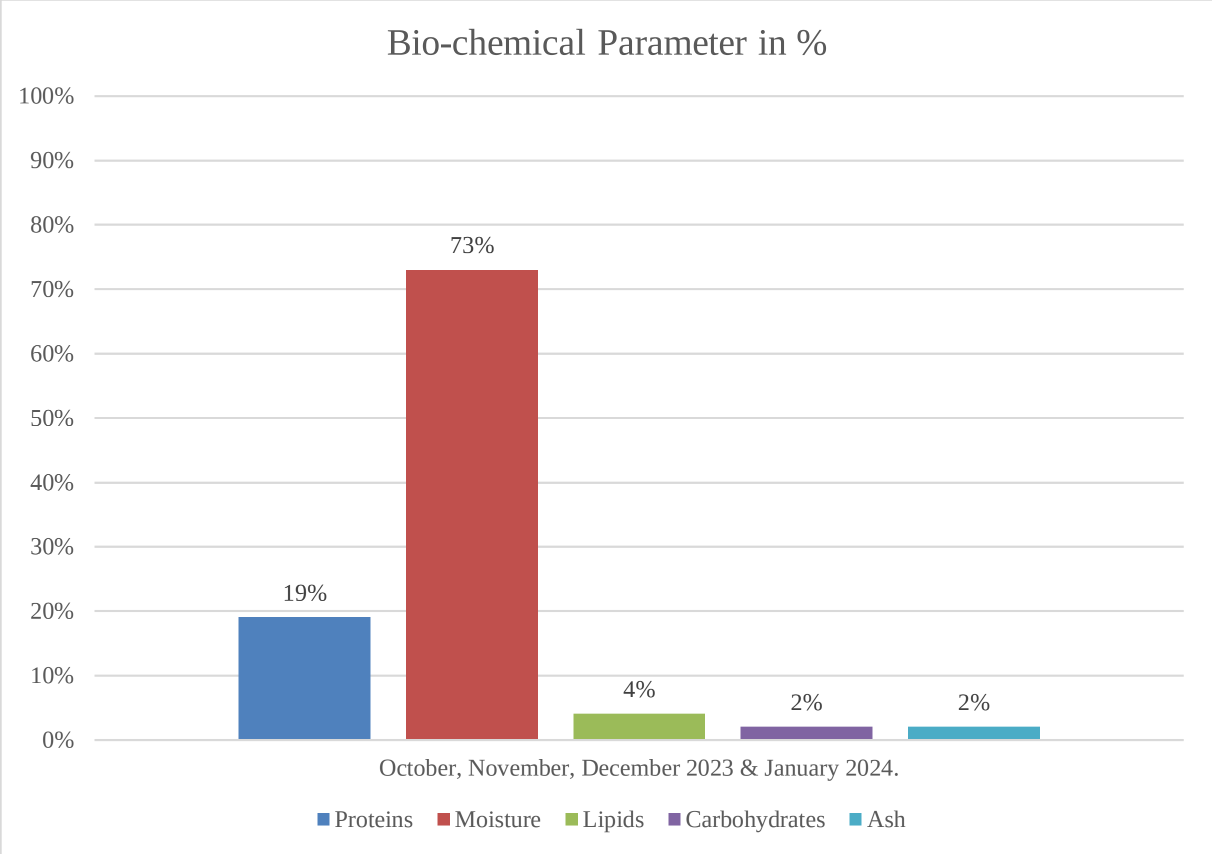

Figure.2: Between October 2023 and January 2024, the biochemical composition of the sample has shown gradual but notable changes. The most prominent component throughout the period remains moisture, although it has slightly decreased—from 76% in earlier months (such as October or November) to 73% by January 2024. This small reduction in water content could suggest natural drying, environmental effects, or a change in sample handling over time. At the same time, there has been a steady increase in the protein content. Initially measured at 17%, proteins have risen to 19%, indicating a strengthening of the sample's nutritional or structural properties. This increase might reflect a higher concentration of solid matter as moisture decreases. Lipids, or fats, have also seen a mild rise, going from 3% to 4%. Although still a small portion, this suggests a slightly richer fat composition in the later months. Carbohydrates, while originally very minimal at 1%, have doubled to 2%—still low overall, but the increase shows that there is a trend toward greater energy-yielding components in the sample. Meanwhile, ash content, which represents the mineral or inorganic portion of the sample, has gone down slightly—from 3% to 2%. This small decrease could be due to changes in mineral retention or composition as other nutrients become more prominent. In summary, over these four months, the sample appears to be gradually losing water and concentrating in nutrients like protein, fats, and carbohydrates, while minerals are slightly declining. These shifts may be due to natural processes, seasonal variation, or treatment conditions affecting the sample.

Figure.3: Seasonal Changes in Biochemical Composition of *Channa striata* (Bloch 1793) February, March and April, May 2024.

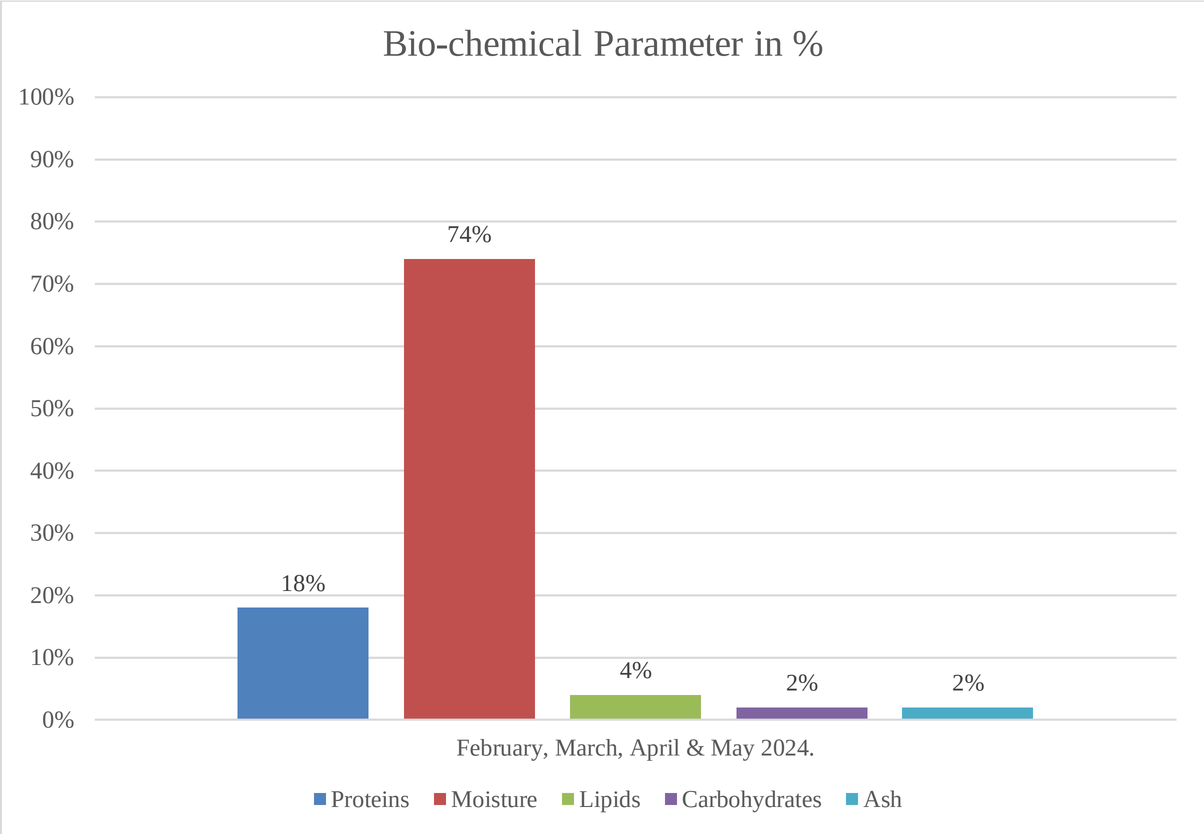

Figure.3: From February to May 2024, the biochemical composition of the sample continues to show gradual changes, though the overall structure remains consistent with earlier trends. Moisture still dominates the composition, holding steady at 74%, which is slightly higher than in January (73%) but lower than in October (76%). This indicates that the water content has stabilized following a minor decline earlier in the season, which may suggest that the sample has reached a natural equilibrium in moisture retention. Proteins are present at 18%, which is just slightly lower than the 19% observed in January. This small fluctuation is within normal variation and shows that the sample still retains a solid protein content, maintaining its nutritional value. The lipid level remains unchanged at 4%, suggesting the fat content has been consistent across recent months. Carbohydrates and ash both measure at 2%, the same as in January. The steady presence of carbohydrates indicates no significant increase in sugar or starch levels, and the ash content being stable shows that mineral composition has remained constant as well. Overall, from February through May 2024, the biochemical profile appears stable, with only minor shifts. The sample has maintained a high moisture level, consistent protein and fat values, and unchanged levels of carbohydrates and minerals. This consistency might reflect a controlled environment, stabilized storage conditions, or a matured stage in the sample's life cycle where drastic changes are no longer occurring.

Figure.4: Seasonal Changes in Biochemical Composition of *Channa striata* (Bloch 1793) June, July and August, September 2024.

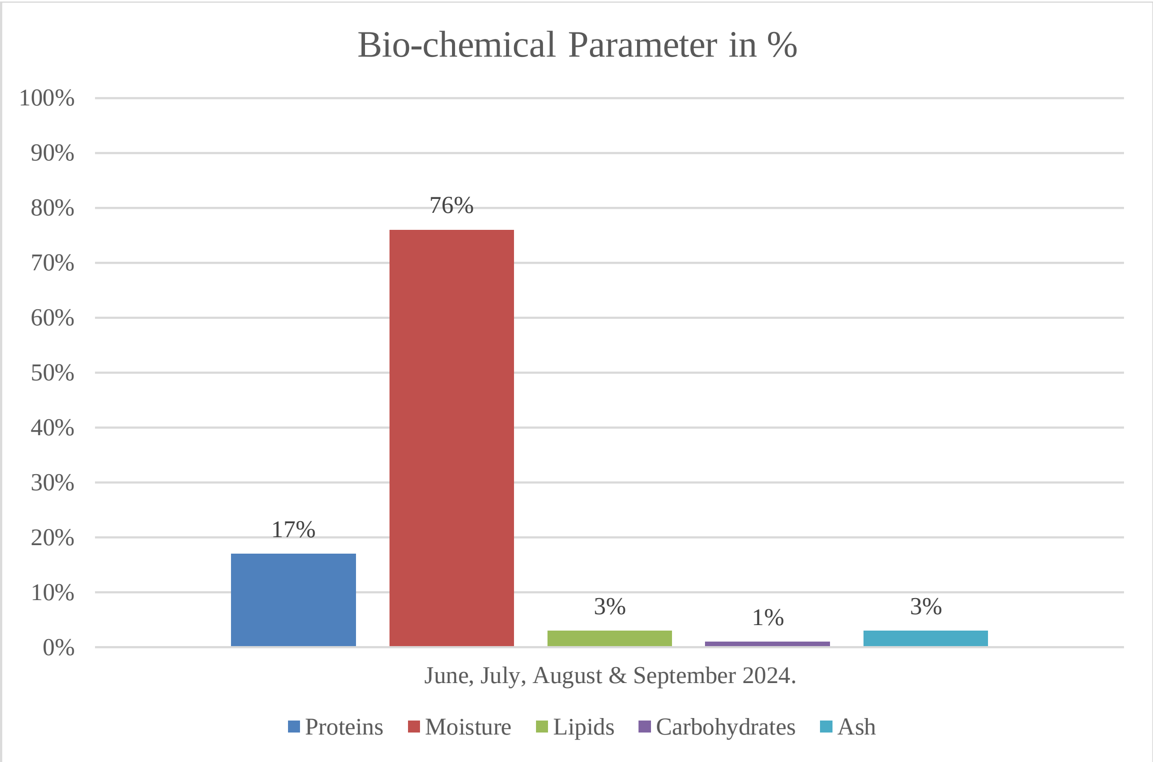

Figure.4: From June to September 2024, the biochemical composition of the sample shows a return to the earlier pattern observed in late 2023. Moisture content has increased to 76%, which is the highest level recorded during the year. The increase suggests the sample has absorbed more water or retained moisture more effectively during the mid-year months, possibly due to environmental factors like humidity or storage conditions during the rainy season or warmer climate. Protein content has slightly decreased to 17% from the previous months' 18–19%, indicating a mild dilution effect likely caused by the higher moisture level. Despite this small drop, proteins still represent a significant portion of the solid components, maintaining the nutritional quality of the sample. Lipids are present at 3%, showing a slight decrease from the earlier 4% observed from February through May. This suggests that there may be a modest reduction in fat concentration, likely due to the higher moisture content diluting the overall proportions. Carbohydrates are at 1%, dropping from 2% in previous months. The present value marks the lowest carbohydrate level in recent records, suggesting that the sample may now have fewer sugar- or starch-based components. Ash content, representing the mineral fraction, remains stable at 3%, consistent with levels seen in earlier charts. In simple terms, the months of June through September 2024 reflect a shift toward higher water content and slightly reduced levels of proteins, fats, and carbohydrates. The composition suggests the sample may have taken on more moisture during this period, leading to a softer or diluted profile while still maintaining a steady level of minerals.

Figure.5: Seasonal Changes in Biochemical Composition of *Channa striata* (Bloch 1793) October, November, December 2024 & January 2025.

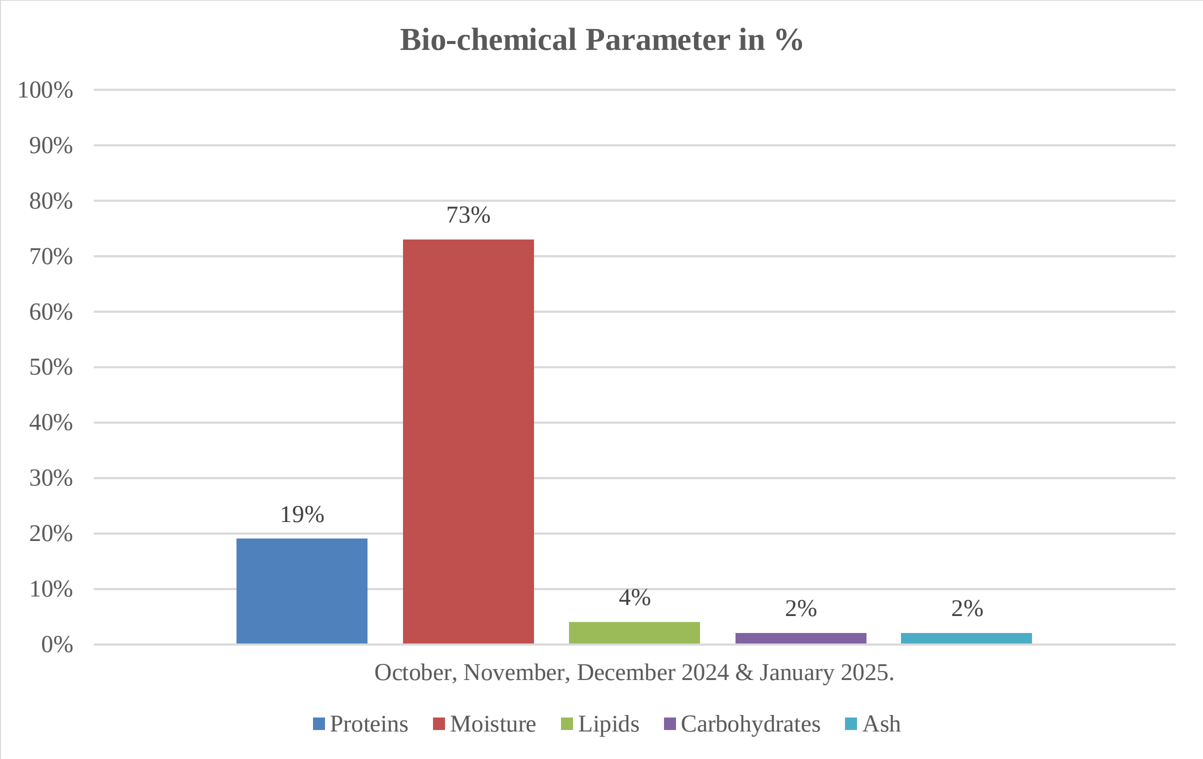

Figure.5*:* From October 2024 to January 2025, the biochemical composition of the sample reflects a shift toward a more concentrated nutrient profile, with a slight decrease in moisture and a rise in key nutritional components. Moisture content, while still dominant, has reduced slightly to 73%, which is lower than the 76% observed during mid-2024. The decrease suggests that the sample has lost some water, possibly due to seasonal drying or controlled storage conditions. In contrast, the protein level has increased to 19%, reaching one of the highest levels recorded over the past year. This rise indicates a richer protein concentration, which may be a result of the moisture loss concentrating the remaining components. The increase in protein enhances the nutritional value of the sample, making it potentially more beneficial for dietary or biological purposes. Lipids have remained steady at 4%, showing that the fat content has not changed significantly during these months. The recorded levels of carbohydrates and ash, both at 2%, are slightly higher than those during the wetter months earlier in the year. This data suggests a modest rise in energy-providing carbohydrates and mineral content, likely due to the same concentration effect as moisture decreases. Overall, the period from October 2024 to January 2025 shows a sample that is slightly drier but nutritionally denser, with higher protein and stable levels of fats, minerals, and carbohydrates. These changes may reflect environmental influences or maturing conditions that enhance the sample's quality and value.

Figure.6: Seasonal Changes in Biochemical Composition of *Channa striata* (Bloch 1793) February, March and April, May 2025.

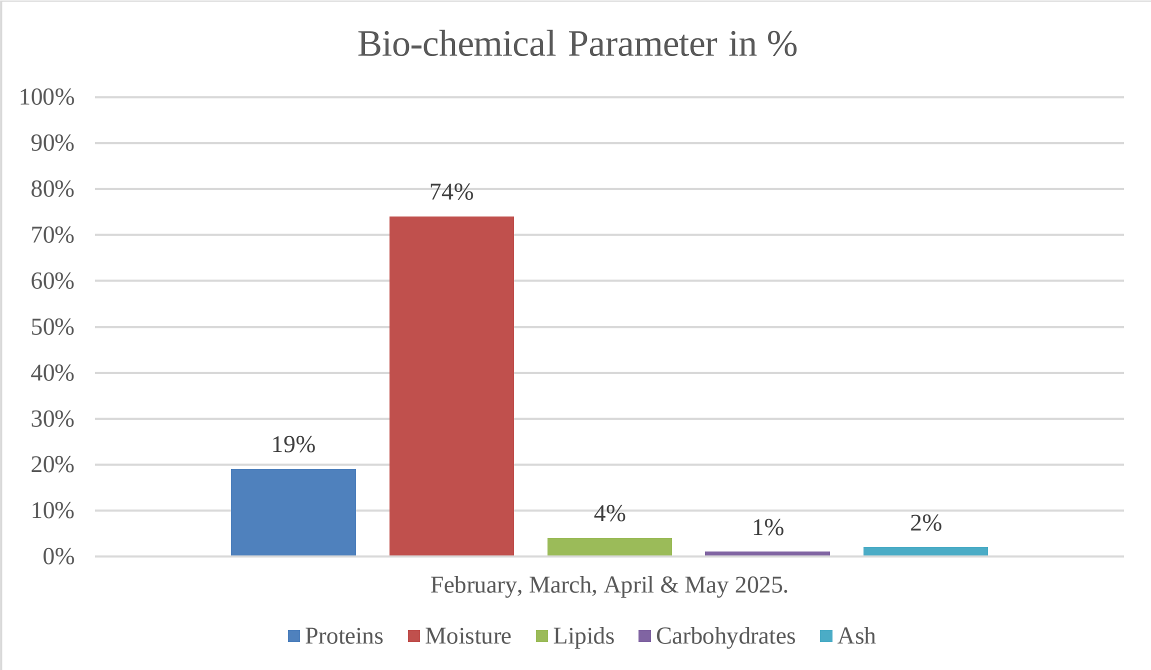

Figure.6: From February to May 2025, the biochemical composition of the sample shows a largely stable profile with slight adjustments in some parameters. Moisture remains the most dominant component at 74%, which is a minor increase from the 73% recorded in the previous months. This slight rise suggests that the sample may have absorbed a bit more water, possibly due to environmental humidity or storage conditions during this time. Protein content holds steady at 19%, reflecting a continued strong presence of this essential nutrient. This consistency indicates that the sample maintains its high nutritional quality, with proteins remaining a key component of its makeup. Lipids remain unchanged at 4%, showing that the fat content is stable and unaffected by seasonal or handling variations. Carbohydrates have slightly decreased to 1%, down from the 2% seen earlier, suggesting a small reduction in sugar or starch-based elements, which may be due to natural breakdown or metabolic activity. Ash content is constant at 2%, indicating no significant change in the mineral composition of the sample. Overall, the February to May 2025 period reflects a sample with a high moisture level, stable protein and fat content, and minor fluctuations in carbohydrates. These results suggest the sample is chemically steady and maintains its core nutritional characteristics with only subtle shifts influenced by external conditions.

Conclusion: From June 2023 to May 2025, the biochemical analysis of the samples indicates that moisture consistently constitutes the largest portion, ranging from 73% to 76%, which means that the samples remain highly water-based throughout the year. The nutritional quality of the samples varies slightly but remains strong, mostly between 17% and 19%. Lipid levels stay consistent at 3% to 4%, and ash content remains stable between 2% and 3%, showing reliable fat and mineral composition. Carbohydrates are consistently the least present component, usually at 1% to 2%. Overall, the results suggest that despite minor seasonal shifts, the sample maintains a stable biochemical profile with high moisture, moderate protein, and low carbohydrate content, making it nutritionally consistent and water-rich across all months.

This present investigation focuses on the Bio-Chemical Composition of *Channa striata* in the Nagapur Dam, Parli Vaijnath, Beed district, Maharashtra, India.

I. ACKNOWLEDGMENT

We sincerely acknowledge the support of the PG Department and Zoology Research Centre, Mrs. K.S.K. College, Beed, for providing necessary facilities and guidance. Special thanks to the corresponding authors, Dr. Anil Shelke for his valuable supervision, and to Mr. Jagdish V. Jagatkar and Mr. Meghraj S. More for their collaborative support. We are also grateful to the local fishing community of the Wan River Basin for their cooperation during sample collection.

REFERENCES

1) Aliyu-Paiko, M., Hashim, R., & Amuzat, A. O. (2012). Comparison of the whole-body composition of fatty acids and amino acids between reared and wild snakehead fish Channa striata (Bloch 1793) juveniles. Asian Fisheries Science, 25(4). https://doi.org/10.33997/j.afs.2012.25.4.005
2) AOAC. (2005). Official Methods of Analysis (18th ed.). Association of Official Analytical Chemists.
3) A.O.A.C. (1950). Official method of the association of agriculture chemists (7th ed.).
4) Ayoola, A. A. (2010). Replacement of fish meal with alternative protein source in aquaculture diets (Master's thesis, North Carolina State University).
5) Azam, K., Ali, M. Y., Asaduzzaman, M., & Basak, B. (2004). Biochemical assessment of selected fresh fish. Journal of Biological Sciences, 4(1), 9–10. https://doi.org/10.3923/jbs.2004.9.10
6) Ayyappan, S., & Diwan, A. D. (2007). In Indian fisheries: A progressive outlook, National Fisheries Development Board and Fisheries Policy. In K. K. Vijayan, P. Jayashankar, & P. Vijaygopal (Eds.), CMFRI, Cochin, India, 1–11.
7) Baehaki, A., Widiastuti, I., Nainggolan, C., & Gofar, N. (2020). Antioxidant activities of snakehead (Channa striata) fish skin: Peptides hydrolysis using protease TP2 isolate from swamp plant silage. Potravinarstvo Slovak Journal of Food Sciences, 14(1), 99.
8) Bene, C., Macfadyen, G., & Allison, E. H. (2007). Increasing the contribution of small-scale fisheries to poverty alleviation and food security (FAO Fisheries Technical Paper No. 481, 125 pp.).
9) Bligh, E. G., & Dyer, W. J. (1959). A rapid method of total lipid extraction and purification. Canadian Journal of Biochemistry and Physiology, 37(8), 911–917.
10) Bruce, J. R. (1924). Changes in the chemical composition of the tissues of the herring in relation to age and maturity. Biochemical Journal, 18, 469–485. https://doi.org/10.1042/bj0180469
11) Dubois, M., Gilles, K. A., Hamilton, J. K., Rebers, P. A., & Smith, F. (1956). Colorimetric method for determination of sugars and related substances. Analytical Chemistry, 28(3), 350–356.
12) Dutta, M., & Dutta, P. (2020). Fatty acid profile and monthly variation of total fatty acid and lipid obtained from the oil of striped snakehead Channa striata. International Journal of Applied Pharmaceutics, 12(6), 56–59. https://doi.org/10.22159/ijap.2020v12i6.39305
13) Dewita, D., Sidauruk, S. W., & Desmelati, D. (2022). Amino acid and mineral profiles of fresh snakehead (Channa striata) meat to potential as an immune system. IOP Conference Series: Earth and Environmental Science, 1118(1), 012034. https://doi.org/10.1088/1755-1315/1118/1/012034

14) Dwivedi, A. C. (2009). Ecological assessment of fishes and population dynamics of Labeo rohita (Hamilton), Tor tor (Hamilton) and Labeo calbasu (Hamilton) in the Paisuni River. Aquaculture, 10(2), 249–259.

15) Ghafouri, Z., Keivany, Y., & Soofiani, N. M. (2019). Reproductive biology of Aphanius isfahanensis in the Zayandehrud River, central Iran. Environmental Biology of Fishes, 102, 19–25.

16) Jabde, P. V. (1985). Biology of Chanda ranga (Hamilton Buchanan) (Doctoral dissertation, Marathwada University, Aurangabad). Under the guidance of Dr. P. G. Jadhav.

17) Kode, S. (2023). Studies on some aspects of the biology and biochemical observations of Channa striata from river Krishna, Andhra Pradesh (PhD thesis, Acharya Nagarjuna University).

18) Krishna, P. V., Anil Kumar, K., Panchakshari, V., & Prabhavathi, K. (2017). Assessment of fluctuations of the physico-chemical parameters of water from Krishna estuarine region, East Coast of India. International Journal of Fisheries and Aquatic Studies, 5(1), 247–252.

19) Krishna, P. V., & Sreeramulu, K. (1999). Biochemical studies on Diplostomum (Trematoda) infested Labeo rohita. Indian Journal of Comparative Animal Physiology, 17(1), 8–11.

20) Mathana, P., Raj, S. T., Nair, C. R. K., et al. (2012). Seasonal changes in the biochemical composition of four different tissues of red spotted emperor Lethrinus lentjan (Family: Lethrinidae). Annals of Biological Research, 3(11), 5078–5082.

21) Mustafa, A., Sujuti, H., Permatasari, N., & Widodo, M. A. (2013). Determination of nutrient contents and amino acid composition of Pasuruan Channa striata extract. IEESE International Journal of Science and Technology (IJSTE), 2(4), 1–11.

22) Nargis, A. (2006). Seasonal variation in the chemical composition of body flesh of Koi fish Anabas testudineus (Bloch) (Anabantidae: Perciformes). Bangladesh Journal of Scientific and Industrial Research, 41(3–4), 219–226. https://doi.org/10.3329/bjsir.v4113.292

23) Panchakshari, V., Krishna, P. V., Prabhavathi, K., & Bhanu Prakash, K. (2016). Effect of feed and fertilizers on the growth and body composition of air-breathing fishes Channa striata and Pangasius hypophthalmus fry. International Journal of Advanced Research, 4(7), 1732–1739.

24) Rao, R. J. (2001). Biological resources of the Ganga River, India. Hydrobiologia.

25) Rosmawati, Effendi, A., Tawali, S., & M. I. (2018). Chemical composition, amino acid and collagen content of snakehead (Channa striata) fish skin and bone. Scientific Research Journal (SCIRJ), VI(1).

26) Setiawan, H., Intanon, M., Chummitri, P., Sringarm, K., & Sathanawongs, A. (2024). Snakehead fish, Channa striata (Bloch, 1973), protein concentrate: Excellent recovery of fish-based albumin source and its possible application for sperm capacitation. Asian Fisheries Science, 37(2). https://doi.org/10.33997/j.afs.2024.37.2.005

27) Shamsan, E. F., & Ansari, Z. A. (2010). Biochemical composition and caloric content in sand whiting Sillago sihama (Forsskal), from Zuari Estuary, Goa. Indian Journal of Fisheries, 57(1), 61–64. http://drs.nio.org/drs/handle/2264/3614

28) Sonavane, A. E., Koli, J. M., Patanga, S. B., et al. (2017). Proximate composition and fatty acid profile of Indian mackerel (Rastrelliger kanagurta) off Ratnagiri, West Coast of India. International Journal of Pure and Applied Bioscience, 5(4), 920–924. http://dx.doi.org/10.18782/2320-7051.5438

29) Suhendi, A., Pawarti, H., Rohman, A., & Wahyono, D. (2020). Snakehead fish extract (Channa striata): A review of pharmacological activity. EurAsian Journal of Biosciences, 14, 4527–4533.

30) Tiralongo, F., Messina, G., Lombardo, B. M., Longhitano, L., Li Volti, G., & Tibullo, D. (2020). Skin mucus of marine fish as a source for the development of antimicrobial agents. Frontiers in Marine Science, 7, 760.

31) Ullah, M. R., Roy, N., Chakma, S., & Rahman, M. A. (2022). Biochemical composition of some catfishes from a coastal river of Bangladesh in relation to a biometric indicator. Archives of Agriculture and Environmental Science, 7(2), 185–191.