International Journal of Environment and Climate Change

Volume 13, Issue 4, Page 156-168, 2023; Article no.IJECC.97400
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Evaluation of Muscle Proximate Composition and Nutritional Value of Six Freshwater Fish Species

Basawarajeshwari Indur [a], D. Vishwajit [a], V. Prashant [b*] and V. Ambrish [b]

[a] Department of PG Studies and Research in Zoology, Sharnbasva University, Kalaburagi-585103, India.
[b] Department of PG Studies and Research in Zoology, Gulbarga University, Kalaburagi-585106, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i41722

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/97400

Original Research Article

Received: 08/01/2023
Accepted: 10/03/2023
Published: 13/03/2023

ABSTRACT

Fish is an economically viable source of animal protein that is widely available even in rural areas, making it an easily accessible source of protein. The aim of the present study was to determine the proximate composition and nutritional value of 6 different freshwater species of fishes: *Orechromis nitoticus, Labeo rohita, Ompok bimaculatus, Notopterus chitala, Channa striata,* and *Catla catla*. The study was conducted from March to September 2022. Nutritional and economic factors were taken into account in the selection of the fish types. According to our findings, dry fish has high-protein content and low-fat which can contribute greatly to children's as well as adult's recommended protein intake. Fish nutritional value varies significantly depending on the species, size, and age of the fish, but understanding the proximate composition of the fish can provide us with a general idea of its nutritional profile. The data that has been summarized could prove to be

**Corresponding author: E-mail: pvc.132@gmail.com;*

beneficial for further studies to determine how dry fish can be utilized effectively to combat malnutrition issues in India and also shares an insight into nutritional values of different fresh water fishes available in the Kalaburagi region.

Keywords: Freshwater fish; Kalaburagi; nutritional value; proximate composition.

1. INTRODUCTION

Fish is a key source of animal protein and an essential part of a balanced diet. It has been widely accepted as a nutritious source of protein and vitamins, that can help promote a healthy body and well-being (Maula, 2021). Despite large differences in nutrient content among freshwater fish species, different species share a consistent set of nutritional characteristics and are considered essential sources of several important nutrients in the human diet. The four major biological constituents of muscle tissue (fillet) are water, protein, lipid, and ash, also called the approximate composition of fish. Fish is a particularly important part of the traditional cuisine, and its consumption has been proven to have many health benefits. Dried fish products are an effective way to extend fish shelf life after they have been caught [1]. Through the process of dehydration, moisture is removed from the fish and this helps to preserve it for longer. This type of preservation is especially useful if the fish is to be transported over a long distance or stored in areas with a warm climate. Sun-drying is an essential and inexpensive method of preserving fish, and the products offer nutritious food to people worldwide. The demand for dried and dehydrated fish, specifically for international markets, has been growing exponentially in recent years. Utilizing fish has numerous medical advantages. Solid evidence underlines how the utilization of fish can be advantageous. According to the report of Global Hunger Index 2018, India [2], the second largest producer of fishes, was placed 103rd out of 119 countries, with hunger levels in the nation classified as a pressing and serious issue, threatening the health and wellbeing of many in the population. Fish flesh is comprised of a large percentage of water (ranging from 70 to 80%), a moderate amount of protein (20 to 30%) and a small quantity of lipid (2 to 12%) [3]. Dry fish is frequently utilized for more than just human consumption, it is also a key ingredient in poultry feed formulations. Fish-based products are packed with vital nutrients that provide an essential source of energy for the body [4]. Nowadays people are more worried about the nutritional issues. According to numerous studies, people with higher incomes are more concerned with eating nutritious foods. Evaluation of proximate composition gives a thorough nutritional profile of the chosen fish species. In aspects of the researcher's, this study will be the first to record the nutritional status and proximate composition of certain freshwater fish in Kalaburagi, Karnataka, India.

2. MATERIALS AND METHODS

2.1 Study Area

Kalaburagi city is one of the 30 districts of Karnataka. Kalaburagi is a city of heap of stones hence the name so, Kal-means stone in Kannada. It lies between 76°50′ 03.46″ East longitude and 17°19′47.03″ North latitude, located in the northern part of the state. Covering an area of 10,951 km² situated in Deccan Plateau. The 300 to 750 meters above mean sea level is the range of elevation observed at Kalaburagi region [5].

Table 1. Scientific name and common name of the fish species

Sl. No	Common name	Scientific Name
1.	Tilapi	*Oreochromis nitoticus*
2.	Rohu	*Labeo rohita*
3.	Pabda	*Ompok bimaculatus*
4.	Chambhari	*Notopterus chitala*
5.	Murrel	*Channa striata*
6.	Catla	*Catla catla*

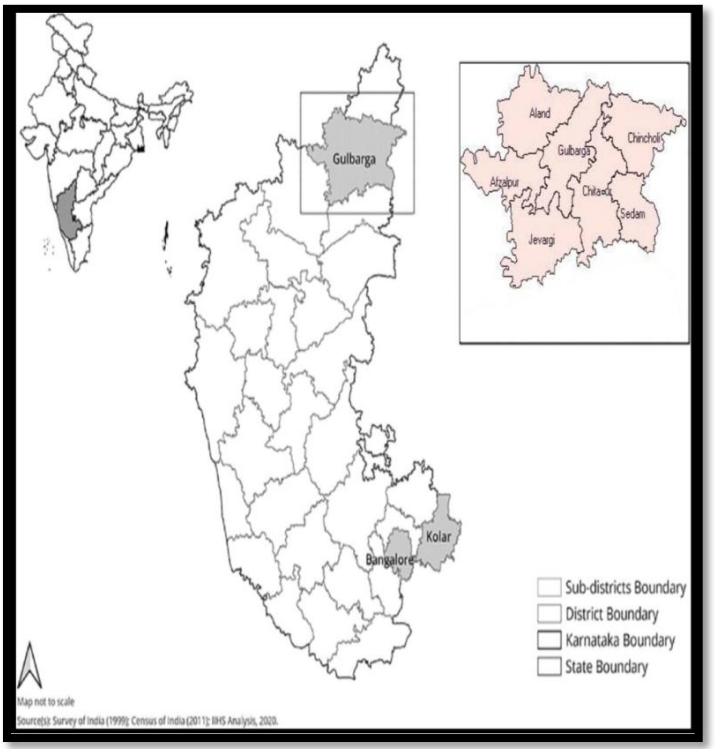

Fig. 1. India Map showing Karnataka and Kalaburagi Map

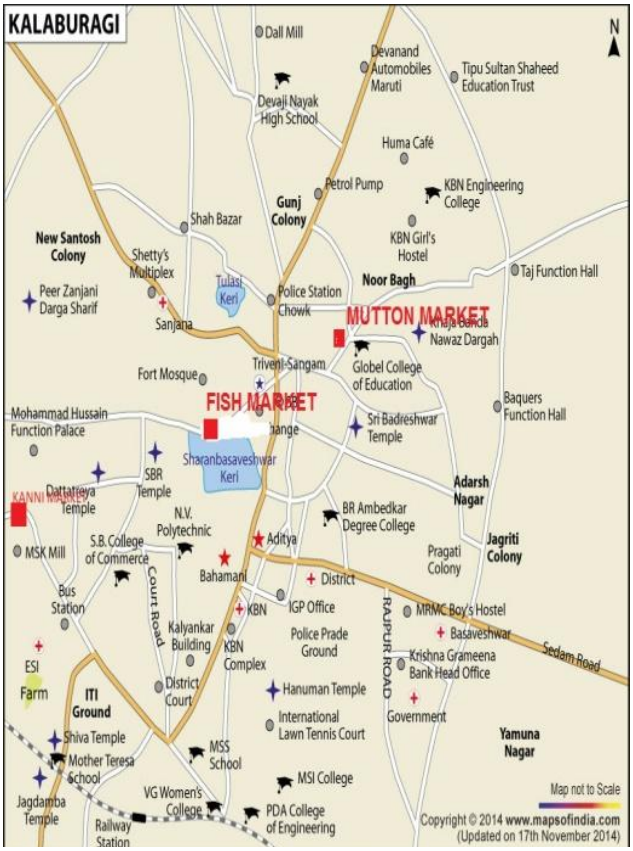

Fig. 2. Map showing location of study area

2.2 Sampling

On 6 species of fish, the study was conducted from March 2022 to June 2022 on group of 6 species of fish. Which are widely sought after and easily accessible in Kalaburagi. Tilapia (*Oreochromis nitoticus*), Rohu (*Labeo rohita*), Pabda (*Ompok bimaculatus*), Chambhari (*Notopterus Chitala*), Snakehead Murrel (*Channa striata*), and Catla (*Catla catla*) are the fish that have been chosen. These samples were collected from different fish markets in Kalaburagi, such as the Mutton market, Kanni market, and Fish market, where vendors obtained their catch from the Khaja Kotnoor, Bhosga Lake, Saradagi dam, and Bheema river.

Plate 1. *Oreochromis nitoticus*

Plate 2. *Labeo rohita*

Plate 3. *Ompok bimaculatus*

Plate 4. *Notopterus chitala*

Plate 5. *Channa striata*

Plate 6. *Catla catla*

2.3 Processing of Collected Fish Samples

The fish was washed with tap water to remove dirt, the fish was then gutted and viscera were removed, rinsed over with tap water to clear away blood and mucus and other unwanted substances. The cleaned fish was exposed to sunlight for 4-5 days until completely dry [6]. After drying in the sun, it was pulverized with an electric mixer and stored in an airtight plastic bag to prevent moisture absorption. Samples were then stored in a clean, cool and dry area to measure moisture, pH, protein, lipids, and carbohydrates using different methods.

Plate 7. Eviscerated sample

2.4 Sample Preparation

For the analysis the sample was taken accurately and each sample was crushed by using electric blender. The samples were analyzed for protein, carbohydrates, lipid, pH and moisture in each sample.

Plate 8. Dried and Crushed *Orechromis nitoticus* Sample

Plate 9. Dried and Crushed *Labeo rohita* Sample

Plate 10. Dried and Crushed *Ompok bimaculatus* Sample

Plate 11. Dried and Crushed *Notopterus chitala* Sample

Plate 12. Dried and Crushed *Channa striata* Sample

Plate 13. Dried and Crushed *Catla catla* Sample

2.5 Estimation of Protein

Protein content was determined using the Lowry method [7]. 1 ml of 1N NaOH was added to 50 mg of the sample and protein derivation was performed in a water bath for 30 minutes. It was then cooled to room temperature and neutralized with 1N HCl. The sample was then centrifuged at 2000 rpm for 10 minutes, a portion of the sample (1 ml) was further diluted using distilled water (1/9 v/v) and 1 ml he placed in 6 different test tubes. 0.1 ml and 0.2 ml of sample extract were taken in to two different tubes and the volume of all tubes was adjusted to 1 ml. 5 ml of alkaline copper solution was added to each tube, mixed well, and left for 10 minutes. Then 0.5 ml of FCR reagent was added and incubated at room temperature in the dark for 30 minutes to develop a blue color. Absorbance was read at 660 nm. A standard chart was generated and the amount of protein present in the samples was calculated from the graph.

2.6 Estimation of Lipids

Lipid content was estimated by the Soxhlet method [8]. First, we weighed an empty tumbler. We then weighed them together with the samples. The difference between these two weights is the weight of the sample. The sample was then placed in a pre-set Soxhlet extractor. After confirming that the extraction was complete, the petroleum ether was evaporated and the residue was dried at 105° C. to constant weight. The following calculation was used to determine the lipid content of dried fish samples.

$$\text{Lipid } (\%) = \frac{\text{Weight of the extracted lipid content}}{\text{Weight of the sample}} \text{X}100$$

2.7 Estimation of Carbohydrate

The carbohydrate percentage is calculated by simply subtracting the total percentage of protein, water, along with ash from 100. The following formula was used to determine the number of carbohydrates

$$Carbohydrate\ (\%) = 100 - \%\ of\ (Protein + Moisture + Ash)$$

2.8 Estimation of Moisture

Moisture was determined by drying the sample at +105ºC in an oven. By subtraction, the moisture was calculated. For determining moisture [9], Aluminium dishwas cleaned, dried and then the constant weight of the dish was taken. Sample was placed in the dish and weight was achieved. The following equation was used to determine the moisture content of the dry fish sample:

$$\text{Moisture } (\%) = \frac{\text{Weight of the sample} - \text{Weight of the dried sample}}{\text{Weight of the sample}} \text{X}100$$

2.9 Estimation of Ash Content

Ash content was measured by muffing samples at 6000-7000°C to dry the ash content. It was obtained by subtracting the ash content. First, a clean porcelain crucible was heated to 6000°C in a muffle furnace and the crucible was maintained

until the weight remained constant. The sample containing the crucible was then weighed until a stable weight was attained.

$$\text{Ash}(\%) = \frac{\text{Weight of ash}}{\text{Weight of the sample}} \text{X}100$$

2.10 Data Analysis

In this study, the Statistical Package for Social Sciences (SPSS 23.0 version) was used to determine mean percentages, standard deviations, and correlation matrices.

3. RESULTS AND DISCUSSION

Proximate composition: The proximate composition of six freshwater fishes (*Orechromis nitoticus, Labeo rohita, Ompok bimaculatus, Notopterus chitala, Channa striata, and Catla catla)* was done in the research laboratory to investigate the mean percentages of protein, lipid, carbohydrate, moisture, pH and ash content. The mean concentrations of protein, lipid, carbohydrate, moisture, pH and ash content of Tilapia (*Orechromis nitoticus*), Rohu (*Labeo rohita*), Indian Catfish (*Ompok bimaculatus*), Knifefish (*Notopterus chitala*), Snakehead Murrel *(Channa striata),* Catla *(Catlt catla)* were 17.593, 5.618, 1.938, 16.141, 6.02 and 1.22 % respectively (Table 2).

3.1 Protein

In the present study, protein levels in the analyzed samples (Orechromis nitoticus, Labeo rohita, Ompok bimaculatus, Notopterus chitala, Channa striata, and Catla catla) varied between 14.92 and 19.8%, with Catla having the higher protein levels. Showed (19.8%). analyzed. The lower protein analyzed was Ompok bimaculatus (14.98%) as shown in Fig. 3. However, the results of this study show that the average protein content of freshly harvested dried fish is very close to previous studies [10].

Table 2. Proximate composition of six different freshwater dry fish (Mean±SD)

Dry Fish Species	Protein	Lipid	Carbohydrate	Moisture	pH	Ash
Orechromis nitoticus	16.52±0.24	5.07±0.05	3.12±0.02	19.23±0.14	6.55±0.02	1.01±0.29
Labeo rohita	19.65±0.27	9.75±3.06	1.77±0.19	14.07±0.01	5.6±0.24	1.05±0.08
Ompok bimaculatus	14.63±0.33	3.88±0.09	2.33±0.10	16.32±0.18	5.68±0.19	1.18±0.14
Notopterus chitala	17.24±0.17	1.48±0.18	1.03±0.04	12.32±.027	6.01±0.01	1.05±0.08
Channa striata	17.14±0.17	1.47±1.40	1.66±1.41	10.23±10.45	5.49±0.25	1.34±1.21
Catla catla	19.74±0.21	10.45±0.20	1.30±0.14	23.64±1.85	5.67±0.22	1.18±0.12

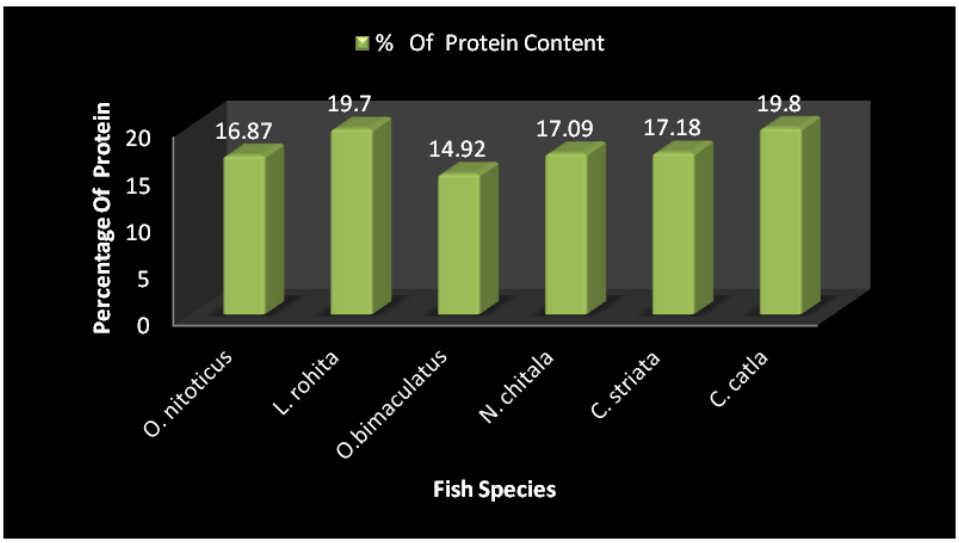

Fig. 3. Percentage of Protein Content in Six Freshwater Fish Species

3.2 Lipid

Lipid Content varied from 1% to 10.90%. The highest lipid Content was found in *Labeo rohita* (10.89%) and the lowest in *Channa striata* (1.47%). Almost similar to [11] Detailed percentages of lipid content (%) of other dried species of fish are shown in Fig. 4.

3.3 Estimation of Carbohydrates

Carbohydrate content varied from 1% to 3.5%. The study also indicated that the fish samples are good sources of carbohydrates. The highest Carbohydrate Content was found in Oreochromis nitoticus (3.50%) and the lowest in *Notopterus chitala* (1.05%). The detailed carbohydrate content (%) of other dried species of fish is shown in Fig. 5.

3.4 Estimation of Moisture

Normally the Sun-dried fish contain an average of 10% to 20% of moisture. The highest moisture content was found in *Catla catla* (23.62%) and the lowest moisture content was found in *Channa striata* (10.53%). Low moisture content is very important. Because the low moisture content increases the Protein content in the fish species by coagulating. The detailed moisture content of other dried species of fish is shown in Fig. 6.

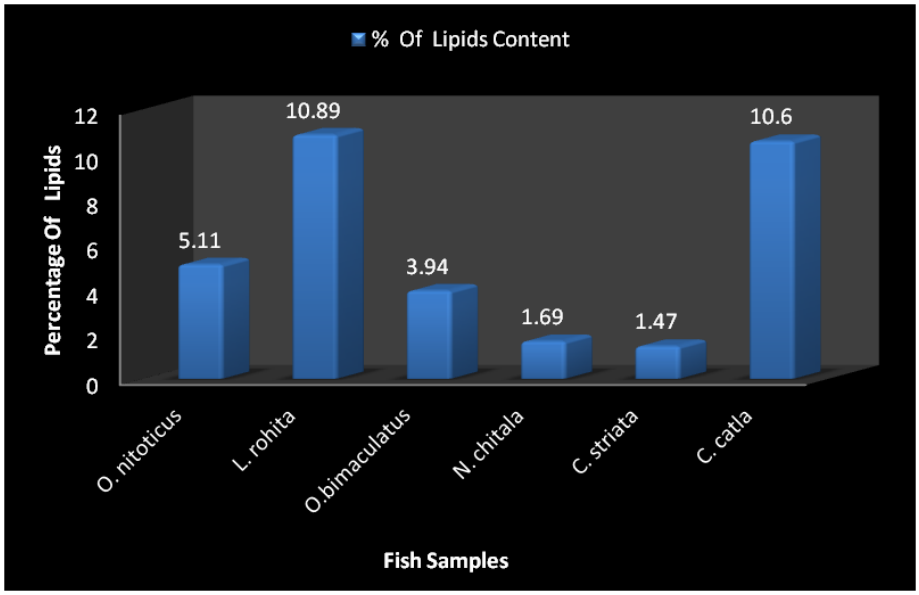

Fig. 4. Percentage of Lipid Content in Six Freshwater Fish Species

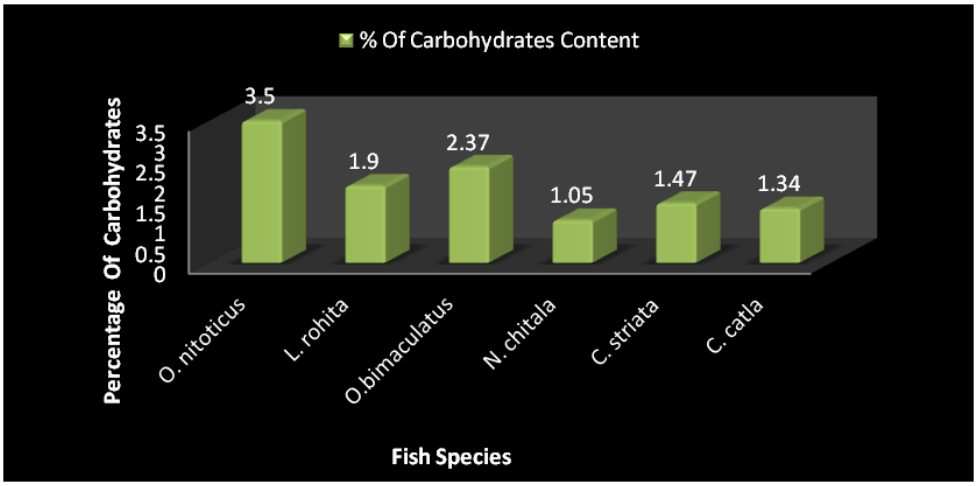

Fig. 5. Percentage of Carbohydrates Content in Six Freshwater Fish Species

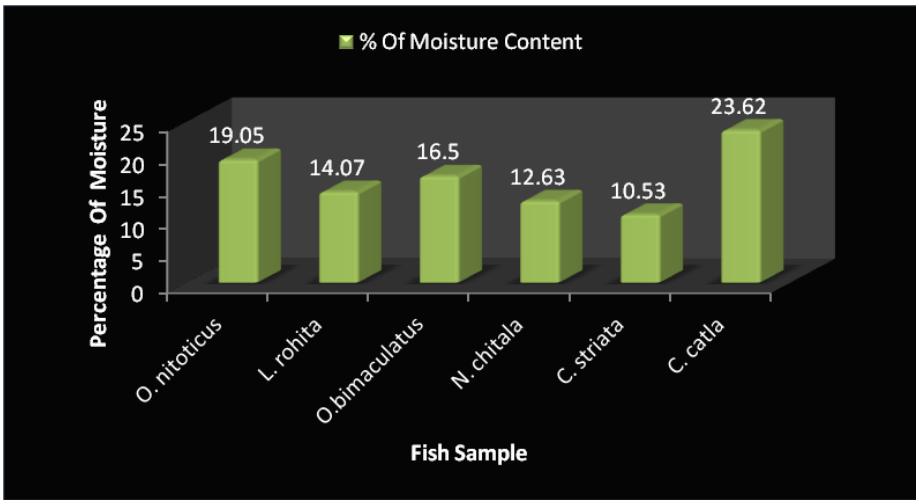

Fig. 6. Percentage of Moisture Content in Six Freshwater Fish Species

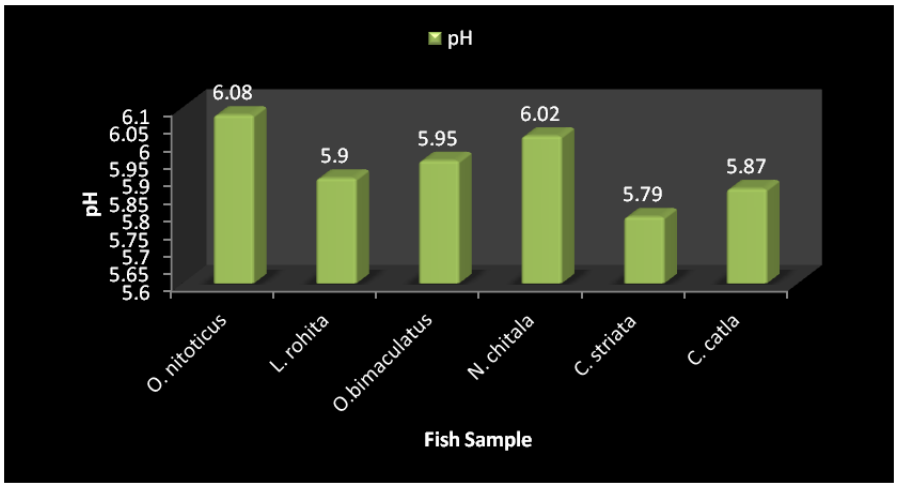

Fig. 7. Percentage of Moisture Content in Six Freshwater Fish Species

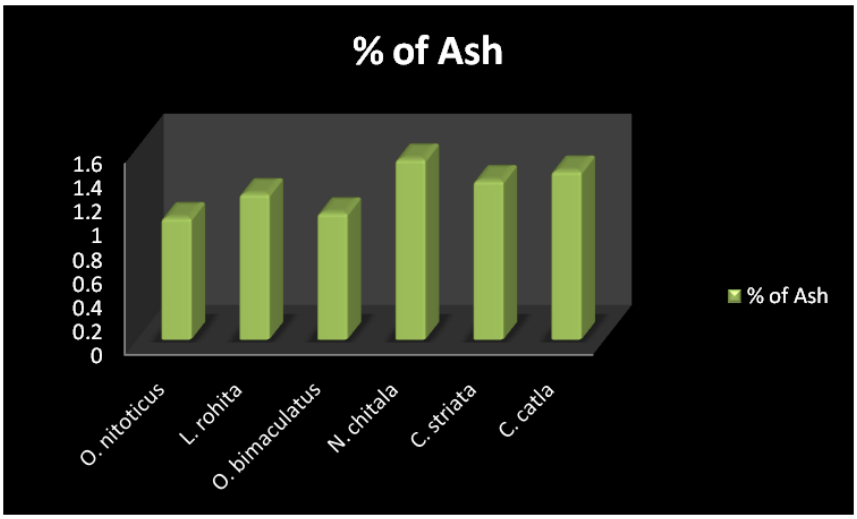

Fig. 8. Percentage of Ash Content in Six Freshwater Fish Species

3.5 Estimation of pH

The pH of the dried fish sample ranges from 5.79 to 6.21. The highest pH was found in *Orechromis nitoticus* (6.59) and the lowest pH was found in *Channa striata* (5.79). The detailed pH range of the six dried species of fishes (Fig. 7).

3.6 Estimation of Ash

The residue without water and volatile constituents are containing carbon dioxide, oxides of nitrogen and water as known ash. In the present study, ash level is analyzed in dried fish samples varied from 1.0 to 1.5 % (Fig. 8) greater, as compared to [12].

Fish are widely recognized as one of the most crucial sources of animal protein and other elements needed to maintain a healthy body also plays an important role in the country's diet, income, employment and foreign exchange earnings [13]. Seafood is the main source of animal protein and provides high-quality protein with high biological value, especially essential amino acids. The results of the current study, therefore, play an important role in identifying good sources of water, protein, lipids, and carbohydrates in the diet. Sun-drying is the easiest and cheapest way to preserve fish is one of the natural ways. It is an important food source for many developed and developing countries and is a better source of nutrition compared to fresh fish. Fish play an important role in remodeling food security and nutritional status. Also, the quality and safety of dried fish products are strongly demanded by the health-conscious public, and in order to realize this scientific and enhanced drying process, it should be practiced nationwide.

Mainly the results showed that the nutritional value of dried fish was rich in proteins, lipids, and carbohydrates [14]. Moisture and protein content is high in *Catla catla* compared to the other six species of fish. The lipid content of *Labeo rohita* is high compared to the other six fish species [15,16]. The carbohydrate content of *Orechromis nitoticus* is high compared to the other six fish species. Overall, among all nutritional values, protein content is high compared to carbohydrate and lipid content in all species. Further research can be done by studying different methods of drying fish. Sun drying, oven drying, freeze drying.

4. CONCLUSION

Present study reveals that the freshwater dry fishes have a very good nutritional value. Higher amount of protein content of dry fishes make it highly nutritious. The protein and lipid concentrations of the selected dry fishes were much higher than the fresh fish. The results explore that the protein and lipid content is comparatively lower with increasing of moisture content. Therefore, this study recommends the necessary steps should be taken for moisture control of dry fish products by air tight packing to protect from nutritional deterioration.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Mahmud A, Abraha B, Samuel M, et al. Fish preservation: a multi-dimensional approach. MOJ Food Process Technology. 2018;6(3);303-310.
2. Klaus von Grebmer, Jill Bernstein, Fraser Patterson, Andrea Sonntag, Lisa Maria Klaus, Jan Fahlbusch, Olive Towey, Connell Foley, Seth Gitter, Kierstin Ekstrom, and Heidi Fritschel: Global Hunger Index Forced Migration And Hunger. Global Hunger Index. 2018;1-62.
3. Ali M, Iqbal F, Salam A, Iram S, Athar M. (Comparative study of body composition of different fish species from brackish water pond. International Journal of Environmental Science & Technology. 2005;2:229-232.
4. Koffi-Nevry R, Ouina TST, Koussemon M, Brou K. Chemical composition and lactic microflora of Adjuevan, a traditional Ivorian fermented fish condiment. Pakistan Journal of Nutrition. 2011;10(4):332-337.
5. Prashant V, Vijayakumar K, Sanket M. Evaluation of Persistent Organochlorine pollutants in mother's milk from Kalaburagi district, Karnataka, India. International Journal of Ecology and Environmental Sciences. 2023;49:321-324.
6. George Ninan. Fish Processing and Value Addition – A Global Scenario In: Bindu J, Sreejith S, Sarika K. Protocols for the production of high value secondary products from industrial fish and shellfish processing, Central Institute of Fisheries Technology, Cochin, India. 2018;1-17.

7. Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. Protein measurement with the Folin-Phenol reagent. Journal of Biological Chemistry. 1951;193:265-275.
8. McNichol J, MacDougall K, Melanson J, McGinn P. Suitability of Soxhlet extraction to quantify microalgal fatty acids as determined by comparison with in situ Transesterification. Lipids. 2012;(47):195–207.
9. Uzma, Shabir, Raiees Raja, Imtiaz, Ahmad, Khan. Estimation of proximate composition (moisture and ash content) of some economically important fishes of the valley. International Journal of Advance Research in Science and Engineering. 2018;7(4):2046-2053.
10. Eswaran, Sundarabalan, Palanisamy, Muniyandi, Muniasamy. (Comparative Analysis of Nutritional value of Catla Catla And Labeo Rohita from different lakes of Coimbatore, Tamil Nadu, India. International Journal of Creative Research Thoughts. 2021;9(9):a674-680.
11. Prabhakara Rao PG, Jyothirmayi T, Karuna MS, Prasad RB. Studies on lipid profiles and fatty acid composition of roe from rohu (*Labeo rohita*) and murrel (*Channa striatus*). Journal of Oleo Science. 2010;59(10):515-519.
12. Hussain B, Mahboob S, Hassan M, Liaqat F, Sultana T, Tariq H. Comparitive analysis of proximate composition of head from wild and farmed. 2011;21 (2):207-210. Sharma P, Kumar V, Sinha AK, Ranjan J, Kithsiri H, Venkateshwarlu G. Comparative fatty acid profiles of wild and farmed tropical freshwater fish rohu (*Labeo rohita*). Fish Physiology and Biochemistry. 2010;36 (3):411-417.
13. Somen, Sahu. Bostanul, Arefin. Soumyadip, Purkait and Saymantaka, Sahu. International Journal of Current Microbiology and Applied Sciences. 2018;7(10):3480-3487.
14. Asbjorn Jonsson, Gudrun, Anna Finnbogadottir, Guojon, porkelsson, Hannes. Magnusson, Olafur, Reykdal. Sigurjon, Arason. Dried fish as health food. Biotechnology. 2007;1(3):1-22.
15. Prakash S, Verma AK. Effect of arsenic on lipid metabolism of a fresh water cat fish, *Mystus vittatus*. Liver. 2019; 10(20):30.
16. Chebli Y, El Otmani S, Elame F, Moula N, Chentouf M, Hornick JL, Cabaraux JF. Silvopastoral system in Morocco: Focus on their importance, strategic functions, and recent changes in the Mediterranean side. Sustainability. 2021;13(19):10744.

© 2023 Indur et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/97400