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Nutritional Value of a Commercial Flathead Fish Species (*Platycephalus indicus*) from Karachi Waters, Pakistan

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Abstract:
Many fish species are commonly used as food by local communities but are not attracting researchers to investigate their nutritional benefits. From this point of view, this study aimed to investigate the nutritional value of a commercial fish species, *Platycephalus indicus*, which is sold at moderately low prices in Karachi, Pakistan. The investigation was carried out using standard AOAC official methods of analysis to determine the major constituents of food that reflect its nutritional value for humans. The results revealed high values of moisture (73.09 ± 1.38%), protein (23.19 ± 2.12%), and ash (4.25 ± 0.13%), but low values of fat in the muscle of this fish. The muscle was also mixed with skin and analyzed for the mentioned components; the results were not significantly different from that found in the muscle: 72.03± 1.62%, 22.39± 0.88%, and 4.21± 0.33% for moisture, protein, and ash, respectively. The fat content was the only constituent that showed a significant difference, with 1.44 ± 0.52% for muscle and 2.76 ± 0.90% for the muscle mixed with skin ($P<0.05$). The caloric value indicates the validity of this fish as a healthy food.

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Authors' Contribution
Ebtisam Shamsan conceived and designed the study. did literature review, write-up, and statistical analysis;
Shakil Ahmed; research administration; and resources,
Nasima Khatoon; methodology; and resources,
Salar Hafez; writing – review and editing. All the authors were involved in the laboratory experiments, and revised the paper.

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INTRODUCTION

Any constituents that nourish the body and enhance its growth may be called nutrients and can be classified into two categories macronutrients and micronutrients. Proteins, fats, and carbohydrates are macronutrients (Lilly *et al.*, 2017) forming the major energetic dietary elements. In contrast, micronutrients are represented by vitamins such as D3, B12, and A, and minerals (calcium, phosphorus, iodine, iron, zinc, and selenium) that are essential in minute quantities (Mohanty, 2015). Both nutrient categories are vital for human health (Khalili Tilami and Sampels, 2017; Chandravanshi *et al.,* 2019; Balami *et al.*, 2019) and can be gained from various food items.

Among the diets of humans, fish is considered a valuable food containing both macronutrients and micronutrients (Ahmed *et al.*, 2022), and one of the healthiest and cheapest natural sources of protein, essential amino acids, unsaturated fatty acids, minerals, and vitamins (Dutta *et al*., 2018; Shamsan and Al-Maqtari, 2018; Badoni *et al.*, 2021), so it can be referred to as 'rich food for poor people' (Balami *et al.*, 2019) which have an importance in hunger and malnutrition prevention. The nutrients provided by fish form better and healthier food than other animal food with low caloric value for humans (Sujatha *et al.*, 2013; Badoni *et al.*, 2021; Ullah *et al.*, 2022).

Determining the food's nutritional value is achieved by knowing the proximate composition (water, protein, fats, and ash) that forms the edible portion of the fish body (Anandan *et al.*, 2017). The biochemical content of fish varies among species (Ullah *et al.*, 2022), and from one individual to another depending on age, sex, spawning season, food availability, feeding intensity, environment (Shamsan and Ansari, 2010), and season (Ahmad *et al.*, 2021).

Protein and fats are the major constituents that determine the nutritional value of the fish (Badoni *et al.*, 2021), whereas carbohydrates (polysaccharides), nucleotides, and vitamins are available in minor quantities but, are decisive for the growth and development of the organisms and keeping the balance of other systems (Xalxo *et al.*, 2020).

The most crucial of these constituents for all living organisms is water, which acts as a medium for transporting many essential substances including nutrients, and metabolites inside the body fluids (Lorenzo *et al.*, 2019). It is also necessary for the normal working of most biological molecules.

Compared to other sources of animal protein, fish flesh is considered more digestible due to the low content of connective tissue and collagen fibers, as suggested by previous studies (Sujatha *et al.,* 2014; Akpambang, 2015; Suganthi *et al.,* 2015). As fish proteins contain enough amounts of necessary amino acids, they have a great biological significance (Salma and Nizar, 2015; Mohanty, 2015), encouraging the biological growth and development of the body (Sujatha *et al.*, 2014), and maintaining and repairing tissues in the body. In addition, fish protein plays a role in improving immunity, blood quality, defense against microbial infections, maintaining water balance, and production and balancing many regulatory factors (enzymes and hormones) in the human body (Maulu *et al.*, 2021; Abera and Adimas, 2024).

In fish, fats contain long-chain n-3 polyunsaturated fatty acids which have been considered important for human health and disease prevention (Zarate *et al*., 2017), moreover, fats represent a prime storage material (Ali *et al.*, 2019).

The minute quantity of minerals in the fish is important not only as a nutrient and their physiological impacts, but they have additional roles like enhancing food flavor, promoting or inhibiting enzyme-catalyzed and other biochemical activities, and altering food texture (Ersoy and Celik, 2010).

Therefore, knowledge about the proximate composition of any fish is a good indicator of fish quality (Ahmed *et al.*, 2022) and is also necessary for the medical field which is used in the prevention of several serious diseases such as reducing serum cholesterol (Stansby, 1985), cardiovascular disease (Van Dael, 2021; Bezbaruah and Deka, 2021), improvement of retina and brain development and reduce the risk of breast cancer (Simopoulos, 2002). However, the proximate composition of fish has a vital role in other fields as used for industrial and commercial purposes (Teame *et al.*, 2016; Shoba *et al.*, 2020).

Due to socioeconomic factors in Pakistan, large fish of low price are preferred over costly small-size fish (Qari *et al.*, 2017). The fish genus *Platycephalus* has a high commercial value and is well-known for its high-quality flesh (Puckridge *et al.*, 2013). Among the members of this genus, the species *Platycephalus indicus* is the most common and commercially important flathead fish found in Pakistan (Moazzam and Osmany, 2023), which is commonly known as bartail flathead and locally named Kukkar (FAO, 2015).

Although reports on the biochemical composition of different fish species from Pakistani waters have been given by several researchers (Munshi *et al.,* 2005; Nisa and Asadullah, 2008; 2011; Qari *et al.,* 2017; Ali *et al.,* 2019), there is not enough information about the proximate composition of *P. indicus* in Pakistan particularly from Karachi waters. This study aimed to fill the gaps in existing data on this fish species' proximate composition and nutritional value.

Considering the edible parts of the fish consumed by many populations are flesh and skin, the difference between the nutritional value of the flesh and flesh with skin separately will also be investigated in this study.

MATERIALS AND METHODS

Fish collection

Samples were purchased from the commercial market of Karachi and brought to the laboratory of IAC, International Centre for Chemical and Biological Sciences (ICCBS) in polythene bags filled with crushed ice. The fish specimens were washed with water and rubbed with tissue paper to remove the excess water. The size (cm) and weight (g) of each specimen were measured.

Fish Identification

Fish specimens were identified following FAO, species identification guide (FAO, 2015).

Flesh preparation

Fish specimens were dissected using a clean stainless-steel knife after taking their weights and morphometric measurements. Flesh samples were collected from different parts on both sides of the fish body. The collected flesh of each fish was mixed and cut into small pieces and minced when necessary. The samples were divided into two representative portions (sub-samples).

The first subsample set was a test portion of only muscle (M) while the second subsample set included muscle with skin (MS). Representative samples of both sets were weighed and dried for moisture content, fats, and ash analyses, while fresh portions were kept in a -20°C refrigerator for protein analysis.

Biochemical analysis

Biochemical components: moisture, protein, fats, and ash contents were analyzed, according to standard Association of Official Analytical Chemists (AOAC) methods. Since carbohydrate value is minute in fish, it will be ignored in this investigation.

Moisture content

Moisture content was estimated following the procedure in AOAC (2000), by taking a known weight of the sub-sample and drying it in a hot air oven at 100 - 105°C, cooling it in a desiccator, and reweighing. This process of heating, cooling, and reweighing is repeated until a constant weight is reached. The difference in weight was calculated and expressed as a percentage of moisture content using the following formula:

$$\text{Moisture \%} = \left(\frac{\text{Initial weight of sample} - \text{final weight of sample}}{\text{Initial weight of sample}}\right) \times 100$$

Protein content

Protein content was determined by estimating the nitrogen in the samples using the Kjeldahl method (DK Heating Digester, UDK 139 Semi-Automatic Distillation Unit of VELP SCIENTIFICA). Then the content of protein was calculated and expressed as %. The fresh subsamples were used.

Calculation of Nitrogen%:

$$\text{N2\%} = \frac{\text{V (mL of } H_2SO_4) \times \text{N (Conc. } H_2SO_4) \times 14.01 \times 100}{\text{Weight of sample (g)} \times 1000}$$

Calculation of Crude Protein:

$$\text{Crude Protein} = \text{N\%} \times 6.25 \text{ (conversion factor)}$$

Fats content

Fats were extracted with n-Hexane in a Soxhlet apparatus for about 10 hours (AOAC, 2005). The amount of fats in the flask was then calculated as follows:

$$\text{Fat content \%} = \left(\frac{\text{Weight of fat}}{\text{Weight of sample}}\right) \times 100$$

Ash content

Oven-dried samples were burned in a Muffle furnace at 550°C for 8-9 hours (AOAC, 2005). To calculate the ash content of the sample, the following formula was used:

$$\text{Ash content \%} = \left(\frac{\text{Weight of ash}}{\text{Weight of sample}}\right) \times 100$$

Caloric value

The caloric value was calculated by multiplying the concentration of various components with conversion factors 9.4, and 5.65, for fats, and protein, respectively, as in (Phillips, 1969), and expressed as calories per gram (KCal/ gm).

Statistical analysis

All the results are expressed as mean ± SD. Data obtained was analyzed using the two-tailed t-test to compare the results of the two subsamples (M and MS) with $P<0.05$ significance level. The statistical analysis was performed via the Statistical Program Graph pad prism 6.

RESULTS

As a part of proximate composition: moisture content, crude protein, crude fats, and ash contents of the two sets of sub-samples were analyzed, and their minimum, maximum, and mean values (%) ±SD are in Table (1).

Table 1. Biochemical composition and caloric values of the edible parts of *P. indicus*.

Contents	Muscle (M)			Muscle with Skin (MS)		
	Minimum	**Maximum**	**Mean±SD**	**Minimum**	**Maximum**	**Mean±SD**
Moisture %	71.30	75.50	73.09 ± 1.38	69.74	74.58	72.03 ± 1.62
Fats %	00.63	2.16	1.44 ± 0.52	1.04	4.11	2.76 ± 0.90
Protein %	20.31	25.65	23.19 ± 2.12	21.50	24.38	22.39 ± 0.88
Ash %	4.13	4.52	4.25 ± 0.13	3.64	4.79	4.21 ± 0.33
Kcal/100g	126.5	165.3	144.6 ± 15.0	134.9	168.79	152.5 ± 10.9

Results of the present study revealed that the highest component was moisture and the lowest was fats. Differences in the biochemical components between muscles (M) and muscles with skin (MS) are illustrated in Figure (1).
Moisture content ranged between 75.50 % and 71.30 % in the muscles subsample (M) with a mean value of 73.09± 1.38%, while the values were lesser in the muscles mixed with skin (MS) which varied from 74.58 % to 69.74 % with a mean value of 72.03± 1.62%.
The statistical analysis results showed no significant differences in moisture content between the two sub-samples (P = 0.1335).

The highest fat content percentage was 2.16% and 4.11, and the lowest was 0.63% and 1.04 % with mean values of 1.44± 0.52%, and 2.76± 0.90% for M and MS, respectively. The fat content of muscle mixed with skin MS showed a highly significant difference from that of the subsample M (P= 0.0008).

The quantity of protein ranged from 25.65 % to 20.31% in subsample M, and 24.38% to 21.50% in MS. The mean values were 23.19± 2.12% and 22.39± 0.88% in M and MS respectively. No significant difference was observed between M and MS (P= 0.2861).

Values of ash were at their maximum rate, showing 4.25± 0.13% mean value in M and 4.21± 0.33% in MS. The highest value was 4.52% in M and 4.79% in MS, whereas the lowest values were 4.13% and 3.64% in M and MS respectively. There was no significant difference between ash content in the subsample M and MS (P= 0.6852).

Caloric values of the energetic components (protein and fats) are shown in Table (1) which are calculated to be 144.6 Kcal/100g in M, and 152.5 Kcal/100g in MS.

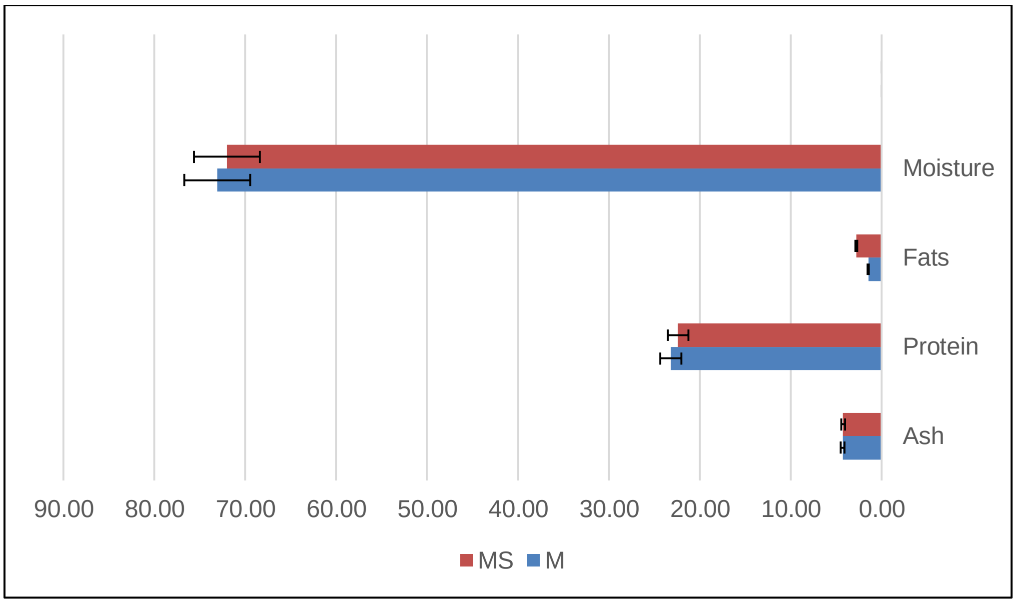

Fig. 1. Mean values of the biochemical components in muscles (M) and muscles with skin (MS) in *P. indicus.*

DISCUSSION

In the present study, the moisture content of *P. indicus* was in good amounts within the normal range. A smaller amount was recorded in the same species from Bangladesh (Bogard *et al.*, 2015). It was dissimilar from some other members of the same family (Platycephalidae) as Diana and Lubis (2018) reported lesser content in *Grammoplite scaber* (Baji baji) from Indonesia, and *Precophils brasiliensis* from Brazil (Rodrigues *et al.*, 2013).

Protein is the most important constituent of fish from a nutritional point of view. Chandravanshi et al. (2019) stated that protein in fish is usually between 16 and 21%, but values lower or higher occasionally found; up to 28% were recorded in some species, whereas Khalil et al. (2019) mentioned the range of about 18–20% proteins of the fish body weight.

In the current study, Protein content appears to be in the common range reported by other researchers. It showed higher values than the same species from Bangladesh which contains 18.8% of protein (Bogard *et al.*, 2015). Compared with members of the same family *P. indicus* from Pakistan contains higher amounts of protein than *P. brasiliensis* from Brazil

(Rodrigues *et al.*, 2013) and *G. scaber* from Indonesia (Diana and Lubis, 2018), in which protein was observed to be 19.7 and 15.45% respectively.

As mentioned by Rasul et al. (2021) and Ahmed et al. (2021), the fat content recorded by several authors ranged from 0.1 to 22%. Within this range, the fish fall under one of three categories: lain fish (<1%), moderate fish (1-8%), and fatty fish (>8%) as arranged by Srivastava (1999), therefore, *P. indicus* from Pakistani waters can be considered as a moderate fish with fat values tend to the minimum value of this category. The current findings of fat content were greater than the results of the same species from India reported by Sivakumar et al. (1994), from Bangladesh as reported by Bogard et al. (2015), and the species *P. brasiliensis* from Brazil (Rodrigues *et al.*, 2013). On the contrary, the fat content in the present study was lesser than that of *P. indicus* from Iran as reported by Aberoumand and Ziaei-Nejad (2015), and *G. scaber* from Indonesia (Diana and Lubis, 2018).

The species *P. indicus* from Pakistan contains high ash content. Ash content in the current investigation is compatible with what Diana and Lubis (2018) mentioned in *G. scaber*, but not harmonious with the findings of Aberoumand and Ziaei-Nejad (2015), Bogard et al. (2015) in the same species, and (Rodrigues *et al.*, 2013) in other species. Differences between the current results' findings and results reported by other authors can be attributed to differences in species and the properties of the surrounding environment.

In general, the values of the four main constituents that make the edible portion in the present study were in agreement with the ranges stated by Rasul et al. (2021) and Ahmad et al. (2021).

The two sub-samples muscles M and muscles mixed with skin MS investigated in the present study did not show any significant differences except for fat content which was higher in MS indicating that skin contributes a good quantity of fat. The low total caloric values seem to agree with the statement reported by Ali et al. (2019), which emphasizes the benefits of this fish as a healthy food.

CONCLUSION

From the results of the present study, it can be concluded that *P. indicus* from Pakistani waters is a non-fatty fish containing low to moderate amounts of fats, with high content of moisture, protein, and ash, with no significant differences between the sub-samples of muscles and sub-samples including muscles and skin together except for fat content in which muscles and skin seem to be richer in fats than separate muscle. Additionally, this fish has a low caloric value. This fish can be recommended for people looking for balanced, rich in protein, and non-fatty food, especially for athletes and those who suffer from cardiovascular disease. People who prefer to consume more fats should eat the flesh with their skin.

RECOMMENDATIONS

It is recommended to conduct more analysis on this species such as the analysis of minerals, vitamins, fatty acid profile, and other biological aspects.

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CONFLICT OF INTEREST

Authors hereby declare that they have no conflict of interest.

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