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RESEARCH ARTICLE

COMPARATIVE ANALYSIS OF MACRONUTRIENTS BETWEEN RIVER FISH *ROHU (LABIO ROHITA)* AND SEA FISH *POMFRET (PAMPUS ARGENTEUS)*, TREATED UNDER DIFFERENT COOKING CONDITIONS

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ABSTRACT

Fish can be of two types according to habitat, i.e. river and sea fish. The content of this study was the comparison of macronutrients between *rohu* and *pomfret*. The carbohydrate and protein contents of *rohu* were higher than *pomfret* but the fat content was more in *pomfret* as compared to *rohu* in the raw condition. These fish were both subjected to conventional cooking methods like open pan dry roasting, boiling, shallow frying and deep frying. The nutrient contents had changed due to the application of cooking methods. Losses of nutrients had taken place in both fish. The carbohydrate and protein contents became higher in *pomfret* than in *rohu* after cooking whereas the fat content was higher in cooked *rohu* rather than in cooked *pomfret*. The study significantly showed that cooked *pomfret* was beneficial due to adequate protein and carbohydrate restoration whereas *rohu* was useful for fat restoration.

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INTRODUCTION

Fish is a rich source of protein commonly consumed as an alternative source due to higher cost of other animal proteins. But the nutrient contents change when fish is cooked as shown in some studies previously carried out. In one study, three commonly available species of marine fish in Nigeria were subjected to boiling, frying and roasting and the effects of these cooking methods on the fish were observed. The results showed reduced protein content for all the fish types (Goldman *et al*., 1997). In yet another research, amino acid and proximate compositions were determined in six commonly consumed raw and cooked marine fish in Turkey. The changes in amino acid and proximate contents were found to be significant for all cooking methods in all fish species (Erkan *et al*., 2010). Another research showed that cooking methods were also applied for vegetable samples which could also be a reference for this present study. Three cooking methods, namely boiling, steaming and stir-frying were used to evaluate the effect on nutrient components of bamboo shoots, resulting in decreased contents of protein, soluble sugar and ash. Results indicated an appreciable loss in the total free amino acids in boiling method. All procedures were carried out for 10 minutes (Mkandawire *et al*., 2014). The effects of five domestic cooking methods, including steaming, microwaving, boiling, stir-frying and stir-frying followed by boiling on the nutrients and health-promoting compounds of broccoli were investigated. The results showed that all cooking treatments, except steaming, caused significant losses of total soluble proteins and soluble sugars (Yuan *et al*., 2009). The effects of different cooking methods (boiling, baking, frying and grilling) on proximate and mineral composition of snakehead fish were investigated. The changes in the amount of protein and fat were found to be significantly higher in frying and grilling fish (Marimuthu *et al*., 2012). The present study is significant due to the comparison of macronutrient contents between river fish and sea fish after being subjected to cooking. Cooking methods can cause loss of nutrients and the fish that can restore more nutrients after cooking is investigated in this study.

- This study aims to compare the nutritive values of river fish and sea fish in both raw and cooked conditions.
- This study aims at finding the nutritive values restored after cooking.

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- To find the fish that is beneficial in the perspective of nutrition is the most important concern of this study.

MATERIALS AND METHODS

1.Sample preparation and cooking

Rohu (*Labio rohita*) with a length of 25 – 30 cm and weight of 1 kg and *pomfret* (*Pampus argenteus*) with a length of 12cm and weight of 250–300 g were obtained from the local fish market in Kolkata. They were kept in a plastic container, transported to the laboratory and washed with tap water several times to remove adhering blood and excessive mucous. Subsequently the fish samples were filleted and divided into five groups. The first group was left uncooked while the other four were boiled, dry roasted in open pan, shallow fried and deep fried. Boiling was performed at 99–101 °C (water temperature) for 10 minutes. Open pan dry roasting of fillets was performed in a pan at 180 °C for 10 minutes. The frying of fillets was performed in a domestic frying pan of 2 L capacity at a temperature of approximately 180 °C for 10 minutes. Mustard oil was used as the medium for frying. For shallow frying and deep frying 10 ml and 20 ml oil were used respectively. The fresh raw and cooked samples were then subjected to analysis.

2. Proximate composition analysis

Proximate composition analyses for homogenized samples of cooked and raw fish fillets were done in triplicate for carbohydrate, protein and lipid contents. The carbohydrate content was determined by Anthrone method (Clegg *et al*., 1956) whereas the crude protein content was determined by the Lowry method (Lowry *et al*., 1951). Total lipid was extracted from the muscle tissues by soxhlet (De Castro *et al*., 1998).

a.Estimation of carbohydrate by Anthrone Method (Thomas *et al*., 1956)

100mg of the sample was taken in a boiling tube and hydrolysed by immersing in boiling water for three hours with 5mL of 2.5 N HCl and cooled to room temperature. Then it was neutralized with solid sodium carbonate until the effervescence ceased. On dilution to 100 ml, the solution was centrifuged at 3000 RPM for 15 minutes. The supernatant was collected and 1 ml of it was used for analysis. 4 ml of Anthrone reagent was added to the solution after which it was heated for eight minutes in a boiling water bath and cooled rapidly. A green to dark green colour was appeared. Then the reading was taken at 630 nm by spectrophotometer (Perkin Elmer Lambda 25).

b.Estimation of protein by Lowry Method (Lowry *et al.* 1951)

200 mg of sample was taken and 20 ml of buffer containing sodium dihydrogen phosphate and disodium hydrogen phosphate was added and homogenized finely. Then it was kept overnight. After that it was cold centrifuged at 5000 RPM for 20 minutes. The supernatant was collected and 1 ml of it was used for analysis. Then 5 ml of Lowry reagent was added to the supernatant and allowed to incubate for 10 minutes. After that 0.5 ml of Folinciocaltue reagent was added and incubated for 30 minutes until a dark blue colour appeared. The reading was taken at 660 nm in a spectrophotometer (Perkin Elmer Lambda 25).

c.Estimation of fat by Soxhlet extraction method (de Castro *et al.* 1998)

The dried sample (5gms) was placed inside the thimble of the apparatus which was extracted with petroleum ether of 60 ^{0}c-80 ^{0}c boiling range which was placed in a distillation flask. On refluxing, the solvent vapour travelled up a distillation arm and flooded into the chamber housing the thimble of solid. The condenser ensured that any solvent vapour that cooled, dripped back down into the chamber housing the solid material. The chamber containing the solid material slowly filled with warm solvent. The fat present in the sample was dissolved in the solvent which was returned to the distillation flask. This cycle may be allowed to repeat for 12 hours. After complete extraction of fat, the solution, poured into a weighed petri dish was evaporated and the final weight of the petri dish containing the fat was taken. From this the amount of the fat was calculated.

3.Statistical analysis

The effect of different cooking methods on the proximate compositions of river fish and sea fish were analyzed using Mean and Standard Deviation. Paired sample t - test was done for comparing the nutritive values between the two fish. Differences were considered to be significant when p value is < 0.05. Data were analyzed by using SPSS package (Version 17).

RESULTS AND DISCUSSION

Table 1 showed the proximate compositions like carbohydrate, protein and fat contents of *rohu.* The raw and cooked values were displayed here. The proximate compositions were reduced due to application of different cooking methods. While the carbohydrate content was highest in shallow frying, the protein content was found to be highest in deep frying, whereas the fat content was restored best in shallow frying. The data showed that carbohydrate loss took place mainly in deep frying method. Protein loss occurred in boiling, whereas fat content was reduced in open pan dry roasting.

Table 2 showed the proximate compositions of *pomfret*. Here also the changes occur between the raw values and the cooked values. Deep frying could restore both carbohydrate and protein whereas shallow frying had increased the amount of fat content in the fish. Boiling could reduce both carbohydrate and protein contents whereas open pan dry roasting helped to reduce fat content of the fish.

Table 3 showed the difference of the proximate nutrient contents between *rohu* and *pomfret* in terms of raw and cooked value. Data showed that there was no significant difference present for carbohydrate content in raw, boiling and open pan

A.Nutrient content of Rohu

Nutrients	Raw	Boiling	Open Pan Dry roasting	Shallow fry	Deep fry
carbohydrate	4.40±0.10	2.83± 0.06	2.87± 0.06	3.17± 0.15	2.73± 0.15
protein	17.50± 0.50	3.03± 0.23	5.70± 0.10	5.03± 0.15	7.33± 0.15
fat	4.33± 0.12	3.47± 0.06	1.83± 0.06	10.77± 0.06	5.60±0.00

B.Nutrient content of Pomfret

Nutrients	Raw	Boiling	Open Pan Dry roasting	Shallow fry	Deep fry
carbohydrate	2.13 ±0.15	1.40± 0.10	1.70± 0.10	1.90± 0.10	2.07± 0.12
protein	16.33± 0.29	4.20± 0.20	6.20± 0.00	6.80± 0.00	7.90± 0.10
fat	5.07± 0.06	3.00± 0.00	2.33± 0.06	8.40± 0.00	5.10± 0.10

C.Comparison of Rohu and Pomfret

Nutrients	Raw	Boiling	Open Pan Dry roasting	Shallow fry	Deep fry
Carbohydrate	2.7661 (NS)	2.7679 (NS)	6.2604 (NS)	0.0002 (S)	0.0038 (S)
protein	0.0248 (S)	0.0027(S)	0.0009 (S)	3.6649 (NS)	0.0057 (S)
Fat	0.0005 (S)	0.0001 (S)	0.0004 (S)	2.3580 (S)	0.00094.4 (S)

(P value = <0.05 = significantly different) (S= significant, NS= Non significant)

D.Percentage of loss between Rohu & Pomfret

Nutrients Loss (%)	Boiling		Open pan Dry roasting		Shallow fry		Deep fry	
	Rohu	Pomfret	Rohu	Pomfret	Rohu	Pomfret	Rohu	Pomfret
Carbohydrate	35.68	34.27	34.77	20.18	27.95	10.79	37.95	2.81
protein	82.68	74.28	67.42	62.03	71.25	58.35	58.11	51.62
Fat	19.86	40.82	57.73	54.04	-59.79	-39.64	-22.67	-0.58

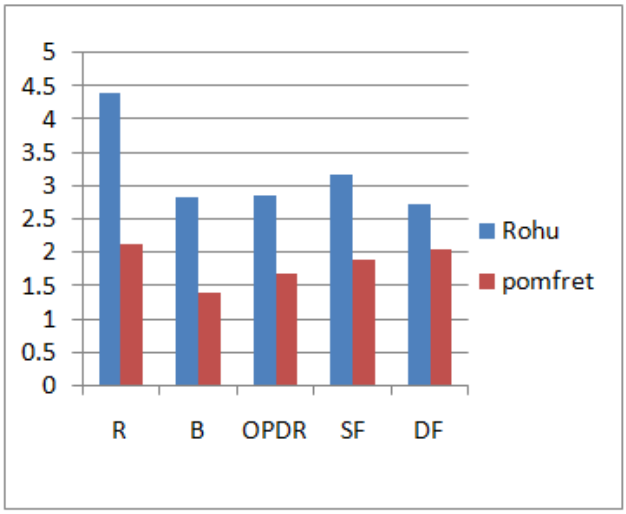

Fig. a. Comparison of carbohydrate content

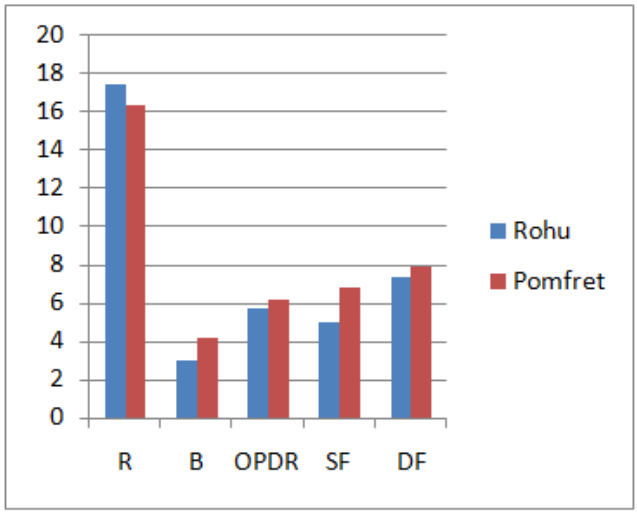

Fig. b. Comparison of protein content

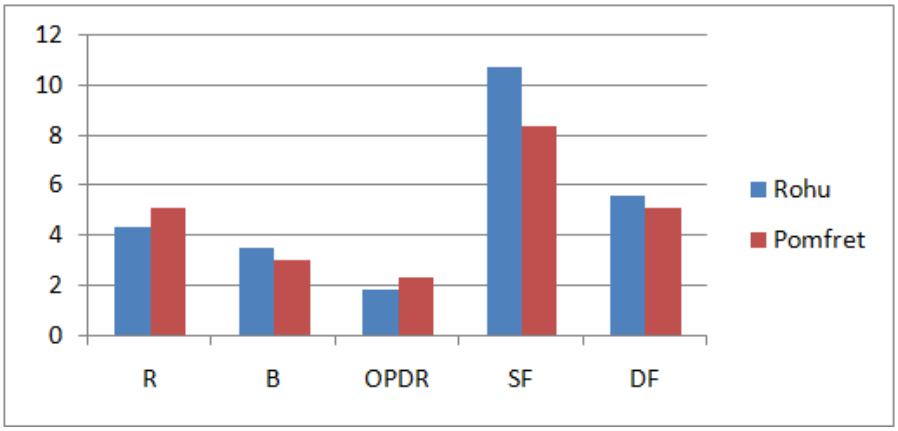

Fig. c. Comparison of fat content

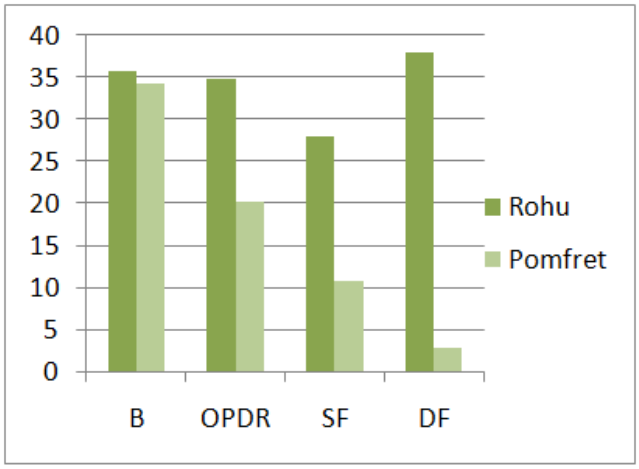

Fig. d. Percentage loss of carbohydrate

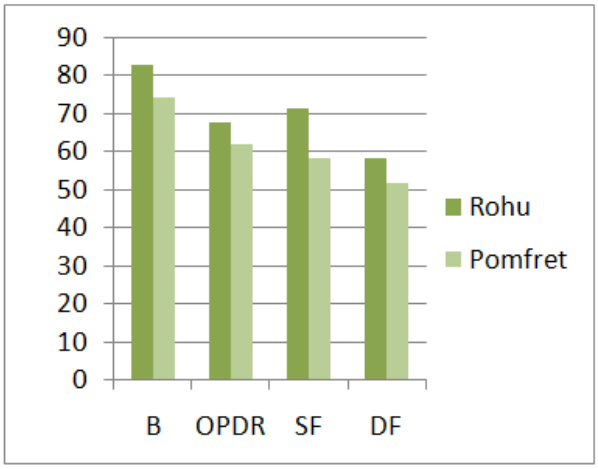

Fig. e. Percentage loss of protein

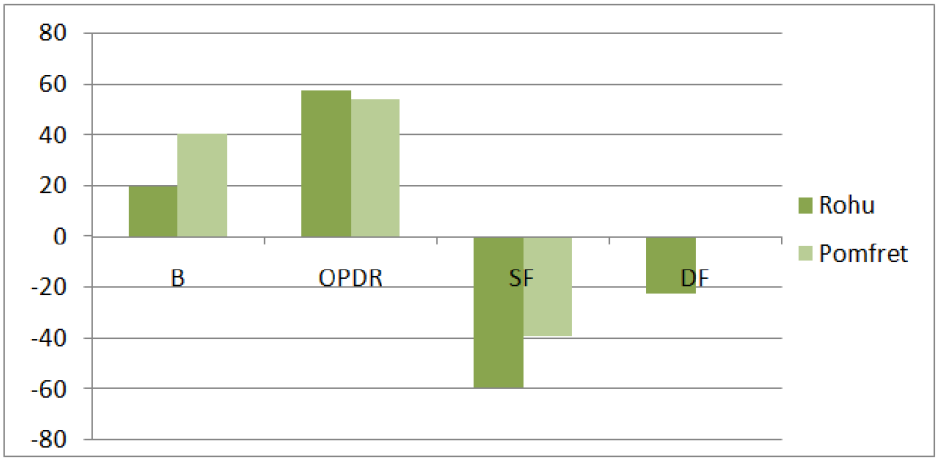

Fig. f. Percentage loss of fat

dry roasting but shallow and deep frying significantly differ in both the fish. Protein contents significantly differ in raw, boiling, open pan dry roasting and deep frying. Shallow frying had the non-significant difference. Fat content significantly differed in raw condition and also for all the four cooking methods. Protein and fat contents significantly differed in raw condition so that it was obvious that significant differences were also present for the cooked values.

Table 4 exhibited the percentage of losses due to cooking. Most of the carbohydrate and protein loss occurred in *rohu* rather than in *pomfret* after cooking. On the other hand, the loss of fat was higher in *pomfret* post cooking. But open pan dry roasting reduced the fat content of *rohu* more than that of *pomfret.* The fat contents increased for both the fish in shallow frying and deep frying methods in comparison to raw conditions due to the addition of mustard oil for frying.

Fig. a, b, c showed the difference among the carbohydrate, protein and fat contents of *rohu* and *pomfret*. These figures had suggested that in raw condition both carbohydrate and protein contents were higher in *rohu* and fat content was higher in *pomfret*. But after the application of cooking methods, carbohydrate contents were higher in *rohu* and protein contents were higher in *pomfret*.

The fat content was higher in *pomfret* in raw condition whereas it was found to be higher in *rohu* after cooking.

Fig c, d, e showed that the loss percentage of carbohydrate and protein contents was more in *rohu* after cooking, but fat loss was more in *pomfret*.

Conclusion

The maximum losses occurred in river fish after cooking rather than in sea fish. Losses occurred in both the fish but loss percentage for both carbohydrate and protein were higher in *rohu* rather than in *pomfret*. The loss of fat was more in *pomfret*. This might be due to the presence of extra fatty tissue in the sea fish which could give protection when it was subjected to cooking.

The fat loss was more for *pomfret* due to application of heat like open pan dry roasting which could eliminate oil from the fatty tissues. *Rohu* did not contain excessive fat so the loss also occurred in smaller amounts. In case of shallow and deep frying, oil was used, which increased the amount of fat contents. After considering all advantages and disadvantages, it can be said that sea fish is better than river fish in terms of nutrient restoration after cooking.

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