Comparison of restoration of carbohydrate and protein contents among different fish and other edible aquatic species, treated under different cooking conditions

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Abstract- Fish are rich sources of protein commonly consumed as an alternative source of protein due to higher cost of other animal proteins. This study was based on the comparison of carbohydrate and protein contents among different fish and other edible aquatic species namely *rohu*, *katla*, prawn, lobster, *pomfret* and *hilsa* after being subjected to conventional cooking methods. The carbohydrate and protein contents of cooked fish are significantly lower than those in the raw condition. These fish were subjected to conventional cooking methods like open pan dry roasting, boiling, shallow frying and deep frying, which altered their nutrient contents. Loss of nutrients mainly occurs in boiling, whereas it is better restored in deep fat frying method. The study significantly showed that cooked lobster was beneficial due to adequate protein and carbohydrate restoration compared to all other fish and edible aquatic species.

Keywords – carbohydrate, cooking methods, edible aquatics species, protein, sea fish, sweet water fish

Introduction

Fish is consumed mainly as a rich source of protein. But the nutrient contents change when it 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 [(1)]. 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 [(2)]. Another research showed that cooking methods were also applied for vegetable samples which could 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 [(3)]. Elsewhere, 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 [(4)]. 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 [(5)]. The present study is significant due to the comparison of carbohydrate and protein contents among river fish, sea fish and other edible aquatic species (crustaceans) after being subjected to cooking. Cooking methods can cause loss of nutrients and the fish that can restore more nutrients after cooking are investigated in this study.

This study aims to

- Estimate the nutritive values of different fish and other edible aquatic species in both raw and cooked conditions
- Find the nutritive values restored after cooking
- Find the fish that is beneficial in the perspective of nutrition

Materials and Methods

1. Sample preparation and cooking

Rohu (*Labio rohita*), *katla* (*Catla catla*), *hilsa* (*Hilsa ilisa*) with a length of 25 – 30 cm and weight of 1 kg, *pomfret* (*Pampus argenteus*) with a length of 12cm and weight of 250–300 g and prawn and lobster with a length of 10 cm and 15cm, and weight of 50 gm and 90 gm respectively were obtained from the local fish market in Kolkata. They were kept in a plastic containers, 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. In case of shallow frying 10 ml oil was used and for deep frying 20 ml oil. 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 and protein contents. The carbohydrate content was determined by Anthrone method [6] whereas the crude protein content was determined by the Lowry method [7].

a. Estimation of carbohydrate by Anthrone Method [6]

100mg of the sample was taken in a boiling tube. Hydrolysis was carried out by keeping it in a boiling water bath for three hours with 5mL of 2.5 N HCl followed by cooling to room temperature and neutralizing with solid sodium carbonate until the effervescence ceased. The volume was made up to 100 ml and centrifugation was done at 3000 RPM for 15 minutes. The supernatant was collected and 1 ml of it was used for analysis. Then 4 ml Anthrone was added to the solution. After that it was heated for eight minutes in a boiling water bath and was cooled rapidly. Green to dark green colour appeared. Then the reading was taken at 630 nm by a spectrophotometer (Perkin Elmer Lambda 25).

b. Estimation of Protein by Lowry Method [7]

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 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 with a spectrophotometer (Perkin Elmer Lambda 25).

3. Statistical analysis

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

Result

Table – 1

a. Nutrient contents of *rohu*

Nutrients	Raw	Boiling	Dry roasting	Shallow frying	Deep frying
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

b. Nutrient contents of *katla*

Nutrients	Raw	Boiling	Dry roasting	Shallow frying	Deep frying
carbohydrate	3.73± 0.15	2.70 ±0.10	2.93± 0.12	3.33± 0.15	3.17± 0.15
protein	21.17± 0.29	2.70± 0.00	6.20±0.00	10.90±0.00	5.00± 0.00

c. Nutrient contents of *pomfret*

Nutrients	Raw	Boiling	Dry roasting	Shallow frying	Deep frying
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

d. Nutrient contents of *hilsa*

Nutrients	Raw	Boiling	Dry roasting	Shallow frying	Deep frying
carbohydrate	3.57± 0.12	2.37± 0.15	1.67± 0.12	2.13± 0.12	3.17± 0.06
protein	24.07± 0.12	6.53± 0.23	9.60± 0.17	10.70± 0.17	11.87 ± 0.12

e. Nutrient contents of prawn

Nutrients	Raw	Boiling	Dry roasting	Shallow frying	Deep frying
carbohydrate	1.03± 0.21	0.67± 0.12	0.97± 0.15	0.83± 0.06	0.50± 0.10
protein	17.33±0.29	2.57± 0.12	6.47± 0.06	6.47± 0.06	11.10± 0.00

f. Nutrient contents of lobster

Nutrients	Raw	Boiling	Dry roasting	Shallow frying	Deep frying

carbohydrate	2.63± 0.12	2.13± 0.12	1.47± 0.12	2.43± 0.15	1.50± 0.10
protein	19.20 ±0.20	8.67± 0.15	7.93± 0.06	9.50±0.00	13.57±0 .12

Table – 2 : Comparison of carbohydrate contents of raw and cooked fish

Nutrients	Boiling	Dry roasting	Shallow frying	Deep frying
Rohu	1.94382(NS)	2.11732(NS)	0.000305(S)	9.34927(NS)
Katla	0.000607 (S)	0.001935(S)	0.032678(S)	0.01047(S)
Pomfret	0.006074 (S)	0.000245(S)	0.144704(NS)	0.000211(S)
Hilsa	0.006074 (S)	0.000245(S)	0.144704(S)	0.000211(S)
Prawn	0.055929 (S)	0.677869(NS)	0.184074(NS)	0.01613(S)
Lobster	0.006074 (S)	0.000245(S)	0.144704(NS)	0.000211(S)

(P value = <0.05 = significantly different)

(S= significant, NS= Non significant)

Table -3: Comparison of protein contents of raw and cooked fish and other edible aquatic species

Nutrients	Boiling	Dry roasting	Shallow frying	Deep frying
Rohu	1.39(S)	2.31(S)	2.05(S)	4.63(NS)
Katla	3.98(S)	9.22(NS)	4.16(S)	6.77(NS)
Pomfret	4.67(NS)	4.38(NS)	5.59(NS)	1.14(S)
Hilsa	3.13(S)	2.86(S)	3.92(S)	2.14(S)
Prawn	1.31(S)	3.59(S)	3.59(S)	3.05(S)
Lobster	2.17(S)	7.76(NS)	1.2(S)	1.88(S)

(P value is calculated by using the standard t-Table at the level of 5%.)

(S= significant, NS= Non significant)

Table - 4

Percentage of losses of carbohydrate among different fish and other edible aquatic species

Name of fish	Boiling	Dry Roasting	Shallow Frying	Deep Frying
Rohu	35.68	34.77	27.95	37.95
katla	27.6	21.4	10.7	15.0
Pomfret	34.27	20.18	10.79	2.81
Hilsa	33.61	53.22	40.3	11.2
Prawn	34.9	5.82	19.4	51.4
Lobster	19.0	44.10	7.60	42.9

Table - 5

Percentage of losses of protein among different fish and other edible aquatic species

Name of fish	Boiling	Dry Roasting	Shallow Frying	Deep Frying
Rohu	82.68	67.42	71.25	58.11
Katla	87.24	70.7	48.5	76.3
Pomfret	74.28	62.03	58.35	51.62
Hilsa	72.8	60.11	55.5	50.6
Prawn	85.17	62.6	62.6	35.94
Lobster	54.84	58.6	50.5	29.3

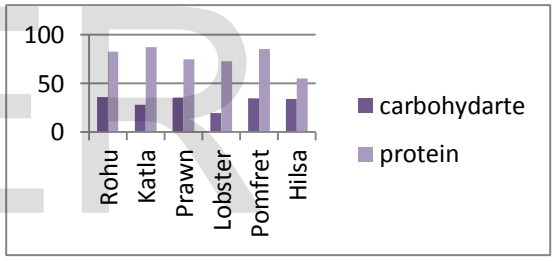

Fig a. Percentage loss in boiling

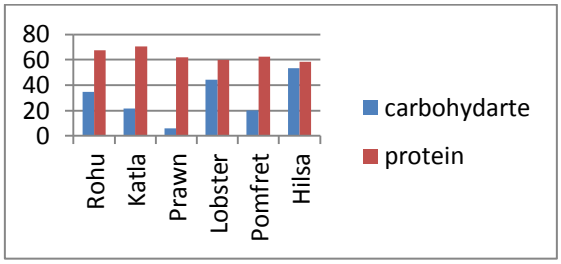

Fig b. Percentage loss in open pan dry roasting

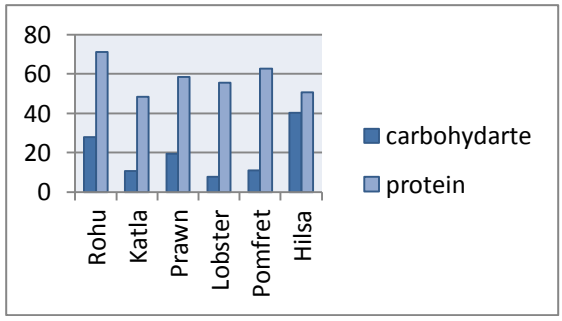

Fig c. Percentage loss in shallow frying

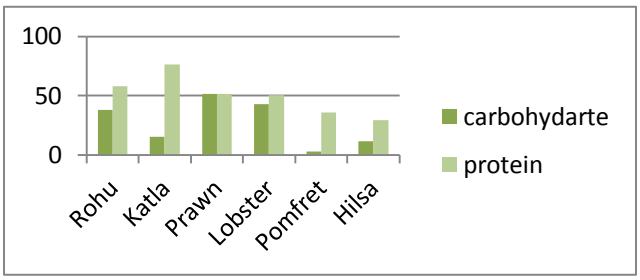

Fig d. Percentage loss in deep frying

Discussion

Table 1-a, b, c, d, e and f showed the proximate compositions like carbohydrate and protein contents of *rohu, katla, pomfret, hilsa,* prawn and lobster. 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 for *rohu, katla,* prawn and lobster, the protein content was found to be highest in deep frying for all the fish. For the sea fish *pomfret* and *hilsa* the carbohydrate contents were better restored in deep frying. The data showed that carbohydrate and protein losses took place mainly in boiling method for *rohu, katla* and prawn whereas dry roasting was responsible for carbohydrate loss for *pomfret, hilsa* and lobster. Protein loss occurred in boiling for the sea fish.

Table 2 showed the comparison of carbohydrate contents of different fish. Here also the changes occurred between the raw and the cooked values. Boiling, open pan dry roasting and deep frying methods significantly differed from the raw values of *katla, pomfret, hilsa* and lobster whereas shallow frying significantly differed from the raw content of *rohu*. Boiling and deep frying could differ from the raw value of prawn.

Table 3 showed the difference of the protein contents of the fish in terms of raw and cooked value. Data showed that there was a significant difference present for protein content in raw, boiling and open pan dry roasting and shallow frying but deep frying method was non- significant for *rohu*, whereas in *katla*, boiling and shallow frying were significant, but open pan dry roasting and deep frying were non-significant. All the cooking methods significantly differ from the raw protein contents of prawn, lobster and *hilsa*. In case of *pomfret,* protein content significantly differs in deep frying whereas boiling, open pan dry roasting and shallow frying had the non-significant difference.

Table 4 exhibited the percentage of carbohydrate losses due to cooking. Most of the carbohydrate loss occurred in *rohu* after boiling. On the other hand, the loss was higher in *hilsa* post open pan dry roasting and shallow frying. But deep frying reduced the carbohydrate content in prawn the most. Losses mainly occurred in boiling while the nutrient restoration in deep frying.

Table 5 exhibited the percentage of protein losses post cooking. Most of the loss occurred in *katla* after boiling, open pan dry roasting and deep frying whereas shallow frying reduced the protein content the most in *rohu*. Protein losses mainly occurred in boiling and the nutrient restoration occurred in deep frying.

Fig. a. showed that the loss percentage of carbohydrate and protein contents of aquatic species occurred post boiling. It was found that losses were more in *rohu* and *katla* whereas it was low in lobster.

Fig. b. showed that the loss percentage of nutrient contents was more in *hilsa* and *katla* respectively whereas it was lower in prawn and lobster after open pan dry roasting.

Fig. c. showed that the losses were more in *hilsa* and *rohu* but less in lobster and *katla* after shallow frying.

Fig. d. showed that the loss percentage of carbohydrate and protein contents was more in prawn and *katla* but less in *pomfret* and lobster for deep frying method.

Conclusion

The maximum carbohydrate and protein contents were found to be highest in rohu and hilsa respectively in raw condition but prone to loss after cooking, although losses occurred after cooking for all the fish. The carbohydrate content was mostly restored in shallow frying for *rohu, katla* and lobster whereas deep frying helped to restore more in case of *pomfret* and *hilsa* but open pan dry roasting could reserve carbohydrate in prawn. Protein contents were retained mainly in deep frying for all the fish except *katla* whose protein restoration occurred in shallow frying. Most of the carbohydrate restoration occurred in prawn, lobster and *pomfret* post cooking whereas protein reservation occurred mostly in lobster. After considering all advantages and disadvantages, it can be said that boiling could reduce both carbohydrate and protein contents and deep frying can restore nutrients among the other cooking methods and lobster is the best among the other fish, regarding the restoration of nutrients post cooking.

Acknowledgement

The University Grants Commission (UGC) is thanked for awarding a Junior Research Fellowship to Uttiya Jana.

Billiography

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