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Comparison of macro nutrients of preserved carp, treated under different cooking conditions

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Abstract :*Fish are rich sources of protein and are commonly consumed. This study is based on the comparison of contents of macro nutrients of carp, preserved with the combination of salt and turmeric and without preservative both up to 15 days. These preserved fishes were subjected to conventional cooking methods like open pan dry roasting, boiling, shallow frying and deep frying and macro nutrient contents were analysed after immediate (24hours) and long term (15 days) preservation. The nutrient contents of cooked fishes were significantly lower than those in the raw condition, changes occurring due to cooking. Loss of nutrients mainly occurred in boiling whereas it is better restored in deep frying method. The study significantly showed that the loss of nutrients occurred due to preservation but these losses can be reduced by using the combination of salt and turmeric. It was also found that among carp, restoration was greater for rohu.*

Keywords – **carp, macro nutrients, cooking methods, preservatives, deep fat frying**

Introduction

Fish is consumed mainly as a rich source of protein. But the nutrient contents change when it is preserved and cooked as shown in some studies previously carried out. In one study form Nigeria, three commonly available species of marine fish 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 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 [(3)]. 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)]. Another study was designed to observe the performance of turmeric and salt on *tengra* (Mystus vittatus) for several days, stored with preservatives of 2% of the sample weight, resulting in nutrient restoration.[(6)] The present study is significant due to the comparison of macro nutrient contents of carp after being preserved for several days and then subjected to cooking. Preservation can cause loss of nutrients; however, the amount of macro nutrients that can be restored using a combination of salt and turmeric for 15 days, is investigated in this study.

- This study aims to estimate the macro nutrient contents of preserved carp in both raw and cooked conditions after being preserved for 24 hours and 15 days with and without preservative.
- This study also aims at finding comparison of nutrient contents of preserved and cooked fish with and without preservative.
- To find out the deterioration level of preserved fishes in the perspective of the nutrient contents.
- To identify the best fish and the best cooking method in respect of nutrient restoration is the most important concern of this study.

Materials and Methods

1. Sample preparation and cooking

Rohu (*Labio rohita*) and *katla* (Katla katla) with a length of 25 – 30 cm and weight of 1 kg was obtained from the local fish market in Kolkata. It was 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 sample was filleted into three sections and each section was divided into five groups. In the first section one 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. The other two sections were allowed to preserve up to15 days. Among these two sections, one was preserved in the refrigerator at -20^{0}C without preservative and the other section was preserved with the combination of salt and turmeric. The amount of combination of salt and turmeric was used as 2% of the weight of the fish sample preserved in 1:1 ratio. The raw, fresh and preserved samples were then subjected to analysis post cooking on the 1st and 15thdays of preservation.

2. Proximate composition analysis

Proximate composition analyses for homogenized samples of fresh and preserved fish fillets, both raw and cooked, were done in triplicate for carbohydrate, protein and fat contents.

a. **Estimation of carbohydrate by Anthrone Method** [7]

100mg of the sample was taken into a boiling tube. Hydrolysis was done by keeping it in a boiling water bath 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. 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 was used for analysis, 4 ml anthrone was added to this solution after which it was heated for eight minutes in a boiling water bath and then cooled rapidly when a green to dark green colour appeared. The reading was then taken at 630 nm in a spectrophotometer (Perkin Elmer Lambda 25).

b. **Estimation of Protein by Lowry Method** [8]

200 mg of sample was taken and 20 ml of buffer, containing sodium dihydrogen phosphate and disodium hydrogen phosphate, was added and homogenized finely, kept overnight, after which 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 the 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 [9]

5gm of dried sample was placed inside the thimble of the apparatus. Then the extraction solvent petroleum ether of 60- 80 boiling range was placed in a distillation flask and placed on the heating mantel. The solvent was heated to reflux when 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 cooled and 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 returned to the distillation flask. This cycle may be allowed to repeat for 12 hours. After complete extraction of fat the solvent, poured into a weighed petridish, was evaporated and the final weight of the petridish containing fat was taken. From this the amount of the fat was calculated.

3.Statistical analysis

The effect of different cooking methods on macro-nutrient contents of fresh and preserved fishes was analyzed using Mean and Standard Deviations. One way ANOVA was done for comparing the nutrient contents in respect to cooking methods among preserved fishes with and without preservative. Differences were considered to be significant when F value was < 0.05. Data were analyzed by using SPSS package (Version 17).

Result

Table 1 - Carbohydrate content of fresh and preserved *rohu* with and without preservative

Duration	Raw	Boiling	Dry roasting	Shallow frying	Deep frying
Fresh	4.40± 0.10	2.80± 0.10	2.90± 0.10	3.20± 0.10	2.73± 0.15
24 hours	3.83± 0.15	2.50± 0.10	1.90± 0.10	3.16± 0.11	2.40±0. 10
15 days	5.08± 0.06	4.16± 0.06	3.66± 0.16	3.64± 0.33	3.94±0. 06
24hours(S +T)	4.78± 0.09	2.52± 0.07	1.68± 0.03	3.88± 0.03	4.50±0. 05
15 days(S+T)	4.52± 0.05	3.84± 0.08	2.82± 0.02	3.66± 0.07	4.07±0. 04

Table 2 - Protein content of fresh and preserved *rohu* with and without preservative

Duration	Raw	Boiling	Dry roasting	Shallow frying	Deep frying
fresh	17.5± 0.05	3.03±0 .23	5.7±0. 10	5.03±0 .15	7.3±0.15
24 hours	16.50 ± 0.50	4.40± 0.00	5.60± 0.20	4.46± 0.05	7.40± 0.17
15 days	6.26± 0.05	4.10±0 .10	5.26±0 .25	5.76±0 .05	7.53±0.0 5
24hours (S+T)	16.83 ±0.15	6.20± 0.20	13.10± 0.17	13.26± 0.25	15.86± 0.11
15 days(S+ T)	12.03 ±0.05	4.93±0 .11	6.10±0 .10	6.20±0 .17	8.66±0.0 5

Table 3 - Fat content of fresh and preserved rohu with and without preservative

Duration	Raw	Boiling	Dry roasting	Shallow frying	Deep frying
fresh	4.30 ±0.10	3.50± 0.10	1.89± 0.05	10.70± 0.10	5.65± 0.05
24 hours	1.30± 0.10	5.76± 0.15	6.10±0.10	9.7± 0.10	8.7± 0.10
15 days	2.38± 0.07	4.95±0.05	9.80±0.10	8.70±0.10	5.06±0.20
24hours (S+T)	5.66± 0.15	4.09±0.08	5.30±0.10	10.50±0.10	9.16±0.15
15 days(S+T)	8.16± 0.15	3.05±0.05	3.90±0.10	9.50±0.10	5.46±0.15

Table 4 – Carbohydrate content of fresh and preserved katla with and without preservative

Duration	Raw	Boiling	Dry roasting	Shallow frying	Deep frying
fresh	3.73± 0.15	2.70± 0.10	2.93± 0.11	3.33± 0.15	3.17± 0.15
24 hours	3.30± 0.10	2.10± 0.10	2.20± 0.10	3.10± 0.10	2.63± 0.15
15 days	3.80± 0.14	1.15±0.08	3.19±0.10	2.15±0.07	2.33±0.08
24hours (S+T)	8.45± 0.07	2.18±0.12	2.51±0.10	3.19±0.10	3.94±0.07
15 days(S+T)	3.33± 0.07	1.93±0.11	1.26±0.14	1.99±0.14	2.41±0.20

Table 5 - Protein content of fresh and preserved katla with and without preservative

Duration	Raw	Boiling	Dry roasting	Shallow frying	Deep frying
fresh	21.16 ±0.14	2.70± 0.10	6.33± 0.15	10.80± 0.10	4.00± 0.10
24 hours	16.40 ± 0.53	5.40± 0.10	7.10± 0.10	7.30± 0.10	5.05± 0.05
15 days	12.20 ±0.16	5.67±0.18	4.92±0.09	4.84±0.08	4.35±0.07
24hours(S+T)	17.30 ±0.36	6.20±0.10	5.90±0.10	8.10±0.10	10.77±0.15
15 days(S+T)	9.53± 0.15	3.50±0.20	6.70±0.10	7.13±0.15	7.97±0.15

Table 6 - Fat content of fresh and preserved katla with and without preservative

Duration	Raw	Boiling	Dry roasting	Shallow frying	Deep frying
fresh	9.10± 0.10	8.0± 0.10	3.20± 0.20	9.03± 0.05	8.70± 0.10
24 hours	7.43± 0.06	8.10± 0.10	9.0± 0.10	11.50± 0.10	7.63± 0.15
15 days	10.10 ±0.10	6.27±0.06	8.20±0.20	8.50±0.10	5.43±0.06
24hours (S+T)	9.26± 0.23	10.16± 0.05	6.50±0.10	9.16±0.15	6.10±0.10
15 days(S+T)	9.60± 0.10	5.36±0.05	9.36±0.15	11.10 ±0.10	10.80±0.10

Table 7- Comparison of carbohydrate content of preserved rohu and katla with and without preservative

Duration	Raw	Boiling	Dry roasting	Shallow frying	Deep frying
24 hours	0.007 (S)	0.008(S)	0.021(S)	0.492(NS)	0.091(NS)
15 days	0.000 (S)	0.000 (S)	0.014(S)	0.002(S)	0.000(S)
24hours(S+T)	0.000 (S)	0.014(S)	0.000(S)	0.000(S)	0.000(S)
15 days(S+T)	0.000 (S)	0.000(S)	0.000(S)	0.000(S)	0.000(S)

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

Table 8 - Comparison of protein content of preserved rohu and katla with and without preservative

Duration	Raw	Boiling	Dry roasting	Shallow frying	Deep frying
24 hours	0.686(NS)	0.000(S)	0.000 (S)	0.000 (S)	0.000 (S)
15 days	0.000(S)	0.000 (S)	0.086 (S)	0.000 (S)	0.000 (S)
24hours(S+T)	0.108(NS)	1.000(NS)	0.000 (S)	0.000 (S)	0.000 (S)
15 days(S+T)	0.000(S)	0.010(S)	0.002 (S)	0.000 (S)	0.002 (S)

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

Table 9 - Comparison of fat content of preserved rohu and katla with and without preservative

Duration	Raw	Boiling	Dry roasting	Shallow frying	Deep frying
24 hours	0.000 (S)	0.000 (S)	0.000 (S)	0.000(S)	0.001 (S)

15 days	0.000 (S)	0.000 (S)	0.000 (S)	0.070(NS)	0.042 (S)
24hours(S +T)	0.000 (S)	0.000 (S)	0.000 (S)	0.000(S)	0.000 (S)
15 days(S+T)	0.000 (S)	0.000 (S)	0.000 (S)	0.000(S)	0.000 (S)

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

Table 10 - Percentage of loss of carbohydrate in preserved rohu without preservative in comparison to fresh

Duration	Raw	Boiling	Dry Roasting	Shallow Frying	Deep Frying
24 hours	12.95	10.71	34.48	1.25	12.08
15 days	- 15.45	- 48.57	- 26.20	- 13.75	- 44.32
24hours(S+T)	- 8.63	10	42.06	- 21.25	- 64.83
15 days(S+T)	- 2.72	- 37.14	2.75	- 14.37	- 49.08

Table 11 - Percentage of loss of protein in preserved rohu with preservative in comparison to fresh

Duration	Raw	Boiling	Dry Roasting	Shallow Frying	Deep Frying
24 hours	5.71	-45.21	1.75	11.33	- 1.36
15 days	64.22	- 35.31	7.71	- 14.51	- 3.15
24hours(S +T)	3.82	- 104.62	- 129.82	- 163.61	-117.26
15 days(S+T)	31.25	- 62.70	- 7.01	- 24.45	- 18.63

Table 12 - Percentage of loss of fat in preserved rohu with preservative in comparison to fresh

Duration	Raw	Boiling	Dry Roasting	Shallow Frying	Deep Frying
24 hours	69.76	- 64.57	- 222.75	9.43	- 53.98
15 days	44.65	- 41.42	- 418.51	18.69	10.44
24 hours(S+ T)	- 31.62	- 16.85	- 180.42	1.86	- 62.12
15 days(S+T	- 89.7	12.85	- 106.34	11.21	3.36
)	6				

Table 13 - Percentage of loss of Carbohydrate in preserved katla with preservative in comparison to fresh

Duration	Raw	Boiling	Dry Roasting	Shallow Frying	Deep Frying
24 hours	11.52	22.22	24.91	6.90	17.03
15 days	-1.87	57.40	- 8.87	35.43	26.49
24 hours(S+ T)	- 127.34	19.25	14.33	4.20	- 24.29
15 days(S+T)	10.72	28.51	56.99	40.24	23.97

Table 14 - Percentage of loss of protein in preserved katla with preservative in comparison to fresh

Duration	Raw	Boiling	Dry Roasting	Shallow Frying	Deep Frying
24 hours	22.49	- 100.00	-12.16	32.40	- 26.25
15 days	42.34	- 110	22.27	55.18	- 8.75
24hours(S+ T)	18.24	- 129.62	6.79	25.0	- 169.25
15 days(S+T)	54.96	- 29.62	- 5.84	33.98	- 99.25

Table 15 - Percentage of loss of fat in preserved katla with preservative in comparison to fresh

Duration	Raw	Boiling	Dry Roasting	Shallow Frying	Deep Frying
24 hours	18.35	-1.25	-181.25	- 27.35	12.29
48 hours	- 10.98	21.62	- 156.25	5.86	37.58
14 days	- 1.78	- 27.0	- 103.12	- 1.43	29.88
15 days	5.49	33	- 192.50	- 22.92	- 24.13

Fig. a - Percentage of loss of carbohydrate in cooked rohu and katla preserved with and without preservative

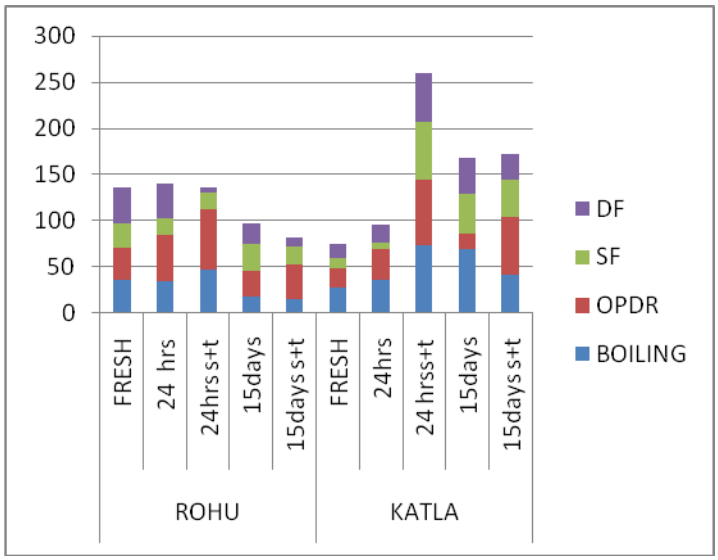


Fig. b - Percentage of loss of protein in cooked *rohu and katla* preserved with and without preservative

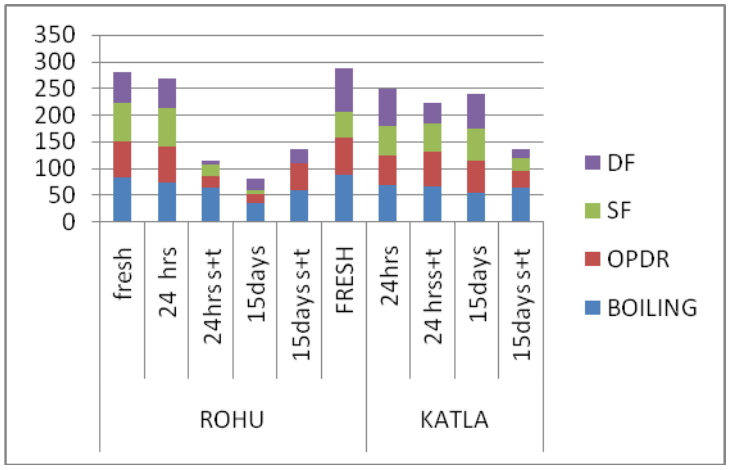
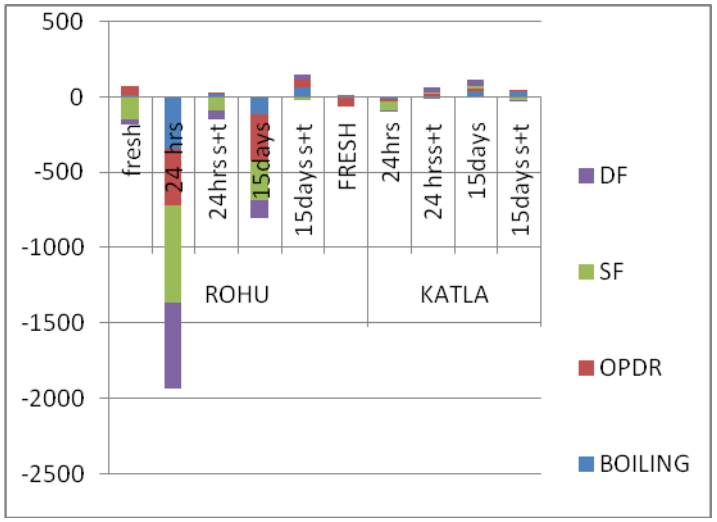


Fig. c - Percentage of loss of fat in cooked rohu and katla preserved with and without preservative



Discussion

Table 1, 2, 3 showed the carbohydrate, protein and fat contents of fresh and preserved *rohu* with and without preservative up to 15 days after subjecting it to different cooking methods. The raw and cooked values were displayed here. The nutrient contents were reduced due to application of different cooking methods. The highest loss occurred in boiling and it was found to be restored in deep frying method.

Table 4, 5, 6 exhibited the carbohydrate, protein and fat contents of the *katla* preserved with and without preservative for short and long time durations. Data showed that the significant difference was present in terms of raw and cooked values. Most of the loss occurred in boiling and the nutrient restoration occurred in deep frying.

Table 7, 8, 9 exhibited the comparison of carbohydrate, protein and fat contents of *rohu* and *katla*, preserved with and without preservative. Data indicated that there was a significant difference present between two fish in respect of different cooking methods and both short and long term preservation.

Table 10, 11, 12 showed the percentage of loss of carbohydrate, protein and fat contents post cooking of the preserved *rohu* with and without preservative in respect to the fresh values. Data indicated that deterioration occurred mainly in 24 hours of preservation but it can be restored with the combination of salt and turmeric up to 15th day of preservation.

Table 13, 14, 15 showed the deterioration value of carbohydrate, protein and fat contents post cooking of the preserved *katla* with and without preservative in respect to fresh values. Data indicated that losses occurred in both short and long term preservation but the use of preservative was not significantly effective for the restoration of nutrient contents of preserved *katla*.

Fig. a showed the loss percentage of carbohydrate contents of the cooked carp in respect of the raw values, preserved with and without preservative. It was found

that losses were more in boiling whereas less in deep frying. Loss was more in *katla* rather than *rohu*. In case of rohu loss was restored by the use of combination of salt and turmeric but this is not effective for *katla*.

Fig. b showed the loss percentage of protein contents following cooking of the carp preserved with and without preservative. Data indicated that losses occurred mostly in boiling. Here also comparison showed that losses were more in *katla* than in *rohu* but losses were restored by the use of combination of salt and turmeric for both the carps.

Fig. c exhibited the loss percentage of fat contents after cooking of the carp preserved with and without preservative. Result showed that loss of fat was very low, rather fat content increased due to addition of cooking oil and loss of water from the fish due to temperature of cooking. The fat gain mainly occurred in *rohu* fish rather than in *katla*.

Conclusion

All cooking methods can reduce the nutrient contents of the carp. The maximum restoration was found to be mostly in deep frying method while the loss occurred in boiling method. After preservation of the fishes up to 15th day, the deterioration of nutrient occurred in 15th day but this deterioration could be reduced to some extent with the use of natural preservative that is combination of salt and turmeric, which help to restore nutrient contents up to 15th day of preservation. Maximum restoration occurred in 24 hours of preservation after using preservative. After considering all advantages and disadvantages, it can be said that deep frying is the best method for protein restoration among the other cooking methods and use of salt and turmeric can delay this deterioration post cooking and among the two fish, *rohu* is better than *katla* in respect of nutrient restoration.

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