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# Comparative analysis of nutrient content between Prawn *(Fenneropenaeus indicus*) and Lobster *(Portunus sanguinolentus)*, preserved and cooked under different conditions

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**Abstract**
Crustaceans are rich sources of protein and have lower cholesterol content compared to other animal food and thus commonly consumed. The content of this study was the comparison of nutrients between prawn and lobster. The nutrient contents of prawn were higher than lobster in the raw condition. These species were both subjected to conventional cooking methods like open pan dry roasting, boiling, shallow frying and deep frying. They were also preserved up to 15 days. The nutrient contents had changed due to preservation and the application of cooking methods. Losses of nutrients had taken place in both species. Most of the nutrient retention occurred in prawn than in lobster after preservation and cooking. The study significantly revealed that cooked prawn was beneficial due to adequate protein, fat and mineral restoration and it could be preserved up to 15 days with minimal loss as compared to lobster. Most of the nutrient retention occurred in shallow frying method.

**Keywords:** macronutrients, mineral contents, prawn, lobster, cooking methods, preservation

## 1. Introduction
Fish and other aquatic species are rich sources of protein commonly consumed in many parts of the world. But the nutrient contents change when they are 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 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]. The present study is significant due to the comparison of macronutrient and micronutrient contents between prawn and lobster after being subjected to cooking and preservation up to 15 days. Cooking methods can cause loss of nutrients and the species that can restore more nutrients after preservation and cooking is investigated in this study.

- This study aims to compare the nutritive values of the two crustaceans under both raw and cooked conditions.
- It aims at finding the nutritive values restored after cooking and preservation.
- To find out the species that is beneficial in the perspective of nutrition is the most important concern of this study.

## 2. Materials and Methods
### 2.1 Sample preparation and cooking
Prawn *(Fenneropenaeus indicus*) and lobster *(Portunus sanguinolentus)* with a length of 10 cm, 15cm and weight of 50 gm, 90 gm respectively 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 dirt. Subsequently the samples were filleted and divided into two sections. The first section was sub-divided into five groups, one group was left uncooked while the other four were boiled, dry roasted in open pan, shallow fried and deep fried. Another section was preserved in the refrigerator at -20°C up to 15 days. 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 20 ml for deep frying. The fresh, preserved raw and cooked samples were then subjected to analysis.

### 2.2 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 [6] whereas the protein content was determined by the Lowry method [7]. Total lipid was extracted from the muscle tissues by soxhlet [8]. Mineral content was estimated by AOAC method [9] and energy content by energy conversion factor [10].

### 2.2.1 Estimation of carbohydrate by Anthrone Method [6]

100mg of the sample was taken into a boiling tube. Hydrolysis was carried out by keeping it in 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. Volume was made up to 100 ml and centrifuged at 3000 RPM for 15 minutes. The supernatant was collected and from it 1 ml was used for analysis. Then 4 ml Anthrone reagent was added to the solution. After that it was heated for eight minutes in a boiling water bath, cooled rapidly when green to dark green colour appeared. Then the reading was taken at 630 nm by spectrophotometer (Perkin Elmer Lambda 25).

### 2.2.2 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 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 by spectrophotometer (Perkin Elmer Lambda 25).

### 2.2.3 Estimation of fat by Soxhlet Extraction Method [8]

5gm of dried sample was placed inside the thimble of the apparatus, the extraction solvent petroleum ether of 60- 80$^0$C boiling range placed in a distillation flask and then on the heating mantel. The solvent was heated to reflux. The solvent vapour travelled up a distillation arm and flooded into the chamber housing the thimble. The condenser ensures 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 was allowed to repeat for 12hours. After complete extraction of fat, the solvent was poured into a weighed petri dish, evaporated and the final weight of the petri dish containing the fat was taken. From this, the amount of the fat was calculated.

### 2.2.4 Estimation of mineral by AOAC method after wet digestion [9]

Dried sample (500 mg) was taken in a 25 ml volumetric flask and 10 ml of concentrated nitric acid was added to it and kept overnight. After that the volumetric flask was placed on the hot plate and allowed to boil for 8 hours. Then 4 ml of perchloric acid was added and boiled until brown fumes from the digestion stopped. After that the volume was made up to the mark by double distilled water and this solution was used for the analysis of iron and calcium by atomic absorption spectrophotometer (Perkin Elmer).

### 2.2.5 Determination of energy content by energy conversion factor [10]

The energy content of the sample was determined by the summation of the amount of energy from carbohydrate, protein and fat. The carbohydrate and protein contents were multiplied by the conversion factor 4.1 and 4 respectively and the fat content was multiplied by 9.3 and the total calorie content was represented in Kcal per 100 gm of a sample.

### 2.3 Statistical analysis

The effects of preservation and different cooking methods on the nutrient content of crustaceans were analyzed using Mean and Standard Deviation. One way ANOVA was applied for comparing the nutritive values between the two species. Differences were considered to be significant when p value is $< 0.05$. Data were analyzed by using SPSS package (Version 17).

## 3. Results

### 3.1 Nutrient content

**Table 1:** Carbohydrate content of samples (gm/100gm)

| Sample | Duration | Raw | Boiling | Dry roasting | Shallow frying | Deep frying |
|---|---|---|---|---|---|---|
| **Prawn** | Fresh | 1.06±0.20 | 0.71±0.07 | 0.98±0.12 | 0.85±0.06 | 0.50±0.09 |
| | 24 hours | 0.88±0.10 | 0.41±0.09 | 0.55±0.13 | 0.88±0.10 | 0.51±0.17 |
| | 48 hours | 1.03±0.20 | 0.52±0.02 | 1.01±0.0 | 0.71±0.0 | 0.95±0.04 |
| | 14 days | 2.31±0.25 | 1.26±0.19 | 1.83±0.11 | 1.85±0.13 | 1.71±0.36 |
| | 15 day | 2.25±0.05 | 0.63±0.079 | 0.62±0.06 | 1.61±0.07 | 1.87±0.19 |
| **Lobster** | Fresh | 2.65±0.13 | 2.15±0.13 | 1.51±0.14 | 2.47±0.13 | 1.51±0.10 |
| | 24 hours | 1.65±0.13 | 1.51±0.09 | 1.11±0.10 | 1.63±0.11 | 1.29±0.06 |
| | 48 hours | 1.15±0.13 | 0.95±0.15 | 0.78±0.11 | 1.16±0.08 | 0.19±0.05 |
| | 14 days | 3.49±0.16 | 0.59±0.10 | 2.02±0.11 | 2.44±0.36 | 2.91±0.10 |
| | 15 days | 3.22±0.20 | 0.54±0.10 | 1.17±0.21 | 2.19±0.17 | 2.21±0.19 |

**Table 2:** Protein content of samples (gm/100gm)

| Sample | Duration | Raw | Boiling | Dry roasting | Shallow frying | Deep frying |
|---|---|---|---|---|---|---|
| **Prawn** | Fresh | 17.36±0.27 | 2.59±0.14 | 6.50±0.02 | 6.48±0.07 | 11.12±0.02 |
| | 24 hours | 14.20±0.28 | 4.60±0.02 | 6.99±0.09 | 6.51±0.08 | 7.17±0.15 |
| | 48 hours | 12.69±0.27 | 3.60±0.09 | 5.06±0.05 | 5.08±0.08 | 6.57±0.13 |
| | 14 days | 17.00±0.25 | 6.40±0.08 | 12.35±0.22 | 10.20±0.20 | 14.95±0.31 |
| | 15 day | 14.75±0.25 | 10.00±0.39 | 7.51±0.08 | 9.99±0.41 | 16.93±0.41 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Lobster** | Fresh | 19.20±0.20 | 8.69±0.11 | 7.96±0.04 | 9.53±0.04 | 13.60±0.11 |
| | 24 hours | 16.06±0.05 | 6.70±0.16 | 7.06±0.05 | 7.63±0.14 | 9.03±0.11 |
| | 48 hours | 11.72±0.56 | 5.63±0.17 | 5.85±0.05 | 5.90±0.05 | 6.25±0.04 |
| | 14 days | 15.36±0.31 | 6.11±0.51 | 10.27±0.61 | 8.33±0.59 | 10.00±0.48 |
| | 15 days | 15.25±0.25 | 12.89±0.51 | 8.40±0.40 | 7.43±0.59 | 12.37±0.48 |

**Table 3:** Fat content of samples (gm/100gm)

| Sample | Duration | Raw | Boiling | Dry roasting | Shallow frying | Deep frying |
|---|---|---|---|---|---|---|
| **Prawn** | Fresh | 2.46±0.04 | 3.02±0.04 | 3.04±0.05 | 6.46±0.04 | 4.35±0.07 |
| | 24 hours | 1.85±0.03 | 1.59±0.03 | 1.94±0.05 | 9.78±0.03 | 9.29±0.01 |
| | 48 hours | 0.86±0.04 | 0.76±0.04 | 1.56±0.06 | 2.57±0.04 | 3.62±0.03 |
| | 14 days | 0.90±0.05 | 0.80±0.02 | 1.04±0.04 | 4.42±0.03 | 2.04±0.04 |
| | 15 day | 0.78±0.06 | 0.63±0.02 | 0.97±0.06 | 6.40±0.02 | 2.04±0.04 |
| **Lobster** | Fresh | 2.09±0.07 | 2.58±0.05 | 2.02±0.02 | 6.75±0.06 | 6.14±0.06 |
| | 24 hours | 0.88±0.02 | 0.58±0.03 | 0.63±0.01 | 4.20±0.05 | 4.07±0.04 |
| | 48 hours | 1.09±0.07 | 1.339±0.04 | 0.56±0.04 | 5.78±0.05 | 7.76±0.03 |
| | 14 days | 1.20±0.05 | 1.59±0.04 | 0.59±0.01 | 4.90±0.03 | 4.69±0.07 |
| | 15 days | 1.01±0.04 | 1.14±0.04 | 0.98±0.09 | 7.72±0.07 | 4.68±0.03 |

**Table 4:** Iron content of samples (mg/100gm)

| Sample | Duration | Raw | Boiling | Dry roasting | Shallow frying | Deep frying |
|---|---|---|---|---|---|---|
| **Prawn** | Fresh | 1.40±0.01 | 1.45±0.02 | 1.51±0.01 | 0.93±0.01 | 0.67±0.05 |
| | 24 hours | 2.52±0.02 | 1.80±0.08 | 1.74±0.05 | 3.45±0.03 | 2.50±0.02 |
| | 48 hours | 1.58±0.05 | 1.32±0.02 | 2.03±0.04 | 2.32±0.02 | 2.23±0.04 |
| | 14 days | 4.03±0.04 | 3.44±0.06 | 4.52±0.02 | 1.53±0.04 | 1.52±0.02 |
| | 15 day | 3.12±0.02 | 2.16±0.05 | 1.41±0.01 | 2.65±0.03 | 2.84±0.04 |
| **Lobster** | Fresh | 2.55±0.01 | 1.65±0.03 | 4.60±0.02 | 1.72±0.04 | 0.89±0.05 |
| | 24 hours | 0.56±0.02 | 1.45±0.03 | 0.94 ±0.04 | 1.17±0.02 | 1.40±0.05 |
| | 48 hours | 0.90±0.02 | 0.55±0.02 | 1.52±0.02 | 1.05±0.04 | 1.46±0.04 |
| | 14 days | 0.61±0.06 | 1.63±0.05 | 0.56±0.04 | 0.70±0.05 | 1.07±0.02 |
| | 15 days | 1.17±0.02 | 1.77±0.02 | 3.97±0.02 | 1.51±0.01 | 1.66±0.01 |

**Table 5:** Calcium content of samples (mg/100gm)

| Sample | Duration | Raw | Boiling | Dry roasting | Shallow frying | Deep frying |
|---|---|---|---|---|---|---|
| **Prawn** | Fresh | 177.23±2.08 | 302.10±2.00 | 251.12±2.00 | 50.04±1.00 | 40.18±1.52 |
| | 24 hours | 216.13±1.52 | 248.22±2.64 | 131.10±1.00 | 201.14±208 | 126.27±1.52 |
| | 48 hours | 176.04±1.52 | 106.28±1.52 | 336.08±1.00 | 501.10±2.08 | 201.11±1.52 |
| | 14 days | 136.10±1.52 | 136.34±1.52 | 227.33±2.51 | 202.65±2.64 | 162.39±2.00 |
| | 15 day | 185.10±3.00 | 180.45±2.00 | 152.37±2.51 | 142.44±2.51 | 201.60±2.08 |
| **Lobster** | Fresh | 241.34±1.52 | 271.35±1.52 | 241.44±1.00 | 201.37±1.52 | 151.44±1.52 |
| | 24 hours | 201.25±1.52 | 260.24±2.00 | 161.33±1.52 | 123.33±2.52 | 151.36±1.52 |
| | 48 hours | 167.37±3.78 | 212.94±2.64 | 166.23±2.52 | 125.27±2.08 | 125.06±2.08 |
| | 14 days | 351.95±1.00 | 501.65±1.00 | 281.88±1.00 | 265.32±2.08 | 151.36±1.52 |
| | 15 days | 133.47±1.52 | 153.37±1.52 | 152.25±2.08 | 141.10±1.52 | 136.56±2.08 |

**Table 6:** Energy content of samples (kcal/100gm)

| Sample | Duration | Raw | Boiling | Dry roasting | Shallow frying | Deep frying |
|---|---|---|---|---|---|---|
| **Prawn** | Fresh | 96.61±1.74 | 41.26±0.61 | 58.36±0.29 | 89.55±0.24 | 87.01±0.72 |
| | 24 hours | 77.54±1.30 | 34.86±0.56 | 48.22±1.24 | 124.48±0.25 | 171.13±0.85 |
| | 48 hours | 62.88±0.11 | 23.53±0.61 | 38.70±0.58 | 47.04±0.33 | 63.79±0.56 |
| | 14 days | 86.02±1.92 | 39.65±1.79 | 66.46±0.28 | 89.42±1.14 | 85.04±1.19 |
| | 15 day | 75.25±0.50 | 48.41±1.80 | 41.59±3.07 | 105.95±2.00 | 93.19±0.74 |
| **Lobster** | Fresh | 106.87±0.53 | 67.37±0.35 | 56.71±0.94 | 110.87±0.91 | 117.54±1.28 |
| | 24 hours | 78.82±0.31 | 38.25±0.49 | 38.60±0.40 | 76.16±0.41 | 79.04±0.34 |
| | 48 hours | 61.91±2.19 | 39.35±0.62 | 30.66±2.13 | 82.03±0.27 | 97.90±0.54 |
| | 14 days | 87.22±0.47 | 41.59±2.18 | 54.76±2.65 | 85.06±2.98 | 97.70±1.78 |
| | 15 days | 83.30±1.98 | 64.31±2.61 | 47.24±2.36 | 110.28±2.21 | 101.96±2.44 |

### 3.2 Comparison between Prawn and Lobster

**Table 7:** One way anova for comparison of crustaceans

| Nutrient | Duration | Raw | Boiling | Dry roasting | Shallow frying | Deep frying |
|---|---|---|---|---|---|---|
| Carbohydrate | Fresh | 0.000(S) | 0.000(S) | 0.008(S) | 0.000(S) | 0.000(S) |
| | 24 hours | 0.002(S) | 0.000(S) | 0.004(S) | 0.001(S) | 0.002(S) |
| | 48 hours | 0.459(NS) | 0.008(S) | 0.045(S) | 0.004(S) | 0.000(S) |
| | 14 days | 0.003(S) | 0.006(S) | 0.111(NS) | 0.058(NS) | 0.005(S) |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 15 day | 0.001(S) | 0.272(NS) | 0.015(S) | 0.006(S) | 0.104(NS) |
| Protein | Fresh | 0.001(S) | 0.000(S) | 0.000(S) | 0.000(S) | 0.000(S) |
| | 24 hours | 0.000(S) | 0.000(S) | 0.331(NS) | 0.000(S) | 0.000(S) |
| | 48 hours | 0.055(NS) | 0.000(S) | 0.000(S) | 0.000(S) | 0.017(S) |
| | 14 days | 0.002(S) | 0.617(NS) | 0.005(S) | 0.006(S) | 0.000(S) |
| | 15 days | 0.070(NS) | 0.001(S) | 0.120(NS) | 0.000(S) | 0.003(S) |
| Fat | Fresh | 0.001(S) | 0.000(S) | 0.000(S) | 0.002(S) | 0.000(S) |
| | 24 hours | 0.010(S) | 0.000(S) | 0.000(S) | 0.000(S) | 0.000(S) |
| | 48 hours | 0.000(S) | 0.000(S) | 0.000(S) | 0.000(S) | 0.000(S) |
| | 14 days | 0.002(S) | 0.000(S) | 0.000(S) | 0.000(S) | 0.000(S) |
| | 15 day | 0.005(S) | 0.000(S) | 0.879(NS) | 0.000(S) | 0.000(S) |
| Iron | Fresh | 0.000(S) | 0.001(S) | 0.000(S) | 0.000(S) | 0.008(S) |
| | 24 hours | 0.000(S) | 0.002(S) | 0.000(S) | 0.000(S) | 0.000(S) |
| | 48 hours | 0.000(S) | 0.000(S) | 0.000(S) | 0.000(S) | 0.000(S) |
| | 14 days | 0.000(S) | 0.000(S) | 0.000(S) | 0.000(S) | 0.000(S) |
| | 15 days | 0.000(S) | 0.000(S) | 0.000(S) | 0.000(S) | 0.000(S) |
| Calcium | Fresh | 0.000(S) | 0.000(S) | 0.000(S) | 0.000(S) | 0.000(S) |
| | 24 hours | 0.000(S) | 0.002(S) | 0.000(S) | 0.000(S) | 0.000(S) |
| | 48 hours | 0.017(S) | 0.033(S) | 0.000(S) | 0.000(S) | 0.000(S) |
| | 14 days | 0.000(S) | 0.000(S) | 0.000(S) | 0.000(S) | 0.561(NS) |
| | 15 day | 0.000(S) | 0.000(S) | 0.000(S) | 0.000(S) | 0.000(S) |
| Energy | Fresh | 0.001(S) | 0.000(S) | 0.044(S) | 0.000(S) | 0.000(S) |
| | 24 hours | 0.173(S) | 0.001(S) | 0.000(S) | 0.000(S) | 0.000(S) |
| | 48 hours | 0.489(NS) | 0.000(S) | 0.003(S) | 0.000(S) | 0.000(S) |
| | 14 days | 0.354(NS) | 0.300(NS) | 0.002(S) | 0.077(NS) | 0.001(S) |
| | 15 days | 0.002(S) | 0.001(S) | 0.065(NS) | 0.066(NS) | 0.004(S) |

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

**Table 8:** Percentage of loss of preserved Prawn & Lobster up to 24 hours

| Nutrients Loss (%) | Raw | | Boiling | | Open pan Dry roasting | | Shallow fry | | Deep fry | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Prawn | Lobster | Prawn | Lobster | Prawn | Lobster | Prawn | Lobster | Prawn | Lobster |
| Carbohydrate | 16.98 | 37.73 | 42.25 | 29.76 | 43.87 | 26.49 | -3.53 | 34.00 | -2.00 | 14.56 |
| protein | 18.20 | 16.35 | 77.60 | 22.89 | -7.53 | 11.30 | -0.46 | 19.93 | 35.52 | 33.60 |
| Fat | 24.79 | 57.89 | 24.79 | 77.51 | 47.35 | 68.81 | -51.39 | 37.77 | -113.56 | 33.71 |
| Iron | -80.00 | 78.03 | -24.13 | 12.12 | -15.23 | 79.56 | -270.96 | 31.97 | -273.13 | -57.30 |
| Calcium | -22.03 | 16.59 | 17.88 | 4.05 | 47.80 | 33.19 | -302.00 | 38.80 | -215.00 | 0.00 |
| Energy | 19.73 | 26.24 | 15.51 | 43.22 | 17.37 | 31.93 | -34.53 | 31.30 | -96.67 | 32.78 |

**Table 9:** Percentage of loss of preserved Prawn & Lobster up to 48 hours

| Nutrients Loss (%) | Raw | | Boiling | | Open pan Dry roasting | | Shallow fry | | Deep fry | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Prawn | Lobster | Prawn | Lobster | Prawn | Lobster | Prawn | Lobster | Prawn | Lobster |
| Carbohydrate | 2.83 | 56.60 | 26.76 | 55.81 | -3.06 | 48.34 | 16.47 | 53.03 | -90.00 | 87.41 |
| protein | 26.90 | 38.95 | -38.99 | 35.21 | 22.15 | 26.50 | 21.60 | 38.09 | 40.91 | 54.04 |
| Fat | 65.04 | 47.84 | 74.83 | 46.12 | 48.68 | 72.27 | 60.21 | 14.37 | 16.78 | -26.38 |
| Iron | -12.85 | 64.70 | 8.96 | 66.66 | -34.43 | 66.95 | -149.46 | 38.95 | -232.83 | -64.04 |
| Calcium | 0.56 | 30.70 | 64.90 | 21.77 | -33.86 | 31.12 | -902.00 | 37.81 | -402.50 | 17.21 |
| Energy | 34.91 | 42.06 | 42.97 | 41.59 | 33.56 | 45.93 | 47.47 | 26.01 | 26.74 | 16.74 |

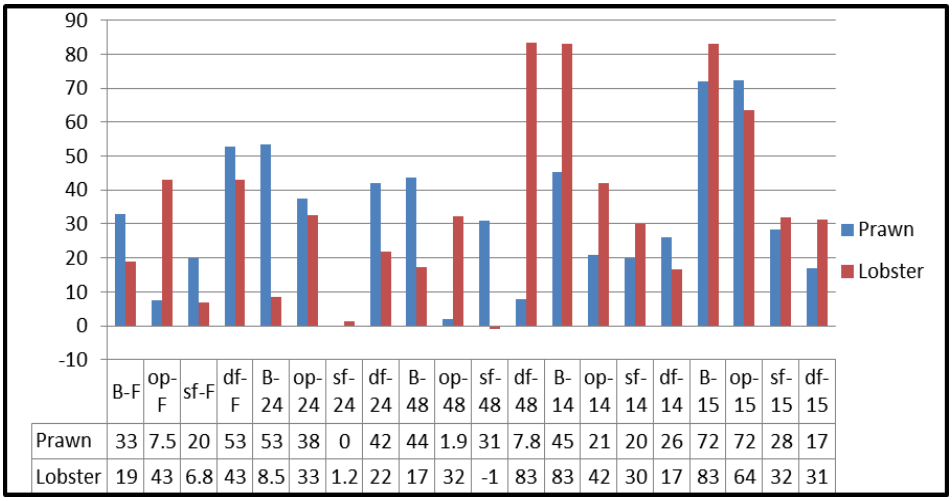
**Table 10:** Percentage of loss of preserved Prawn & Lobster up to 14days

| Nutrients Loss (%) | Raw | | Boiling | | Open pan Dry roasting | | Shallow fry | | Deep fry | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Prawn | Lobster | Prawn | Lobster | Prawn | Lobster | Prawn | Lobster | Prawn | Lobster |
| **Carbohydrate** | -117.92 | -31.69 | -77.46 | 72.55 | -86.73 | -33.77 | -11.76 | 1.21 | -242 | -92.71 |
| **Protein** | 2.07 | 20 | -147.10 | 29.68 | -90 | -29.02 | -57.40 | 12.59 | -34.44 | 26.47 |
| **Fat** | 63.41 | 42.58 | 73.50 | 38.37 | 65.78 | 70.79 | 31.57 | 27.40 | 53.10 | 23.61 |
| **Iron** | -187.85 | 76.07 | -37.24 | -7.27 | -99.33 | 87.82 | -64.51 | 59.30 | -128.35 | -20.22 |
| **Calcium** | -11.29 | -45.64 | 46.35 | -84.87 | 0.00 | -16.59 | -402 | -31.84 | -277.50 | 0.00 |
| **Energy** | 10.96 | 18.38 | 3.90 | 38.26 | -13.87 | 3.43 | 0.14 | 23.27 | 2.26 | 16.91 |

**Table 11:** Percentage of loss of preserved Prawn & Lobster up to 15days

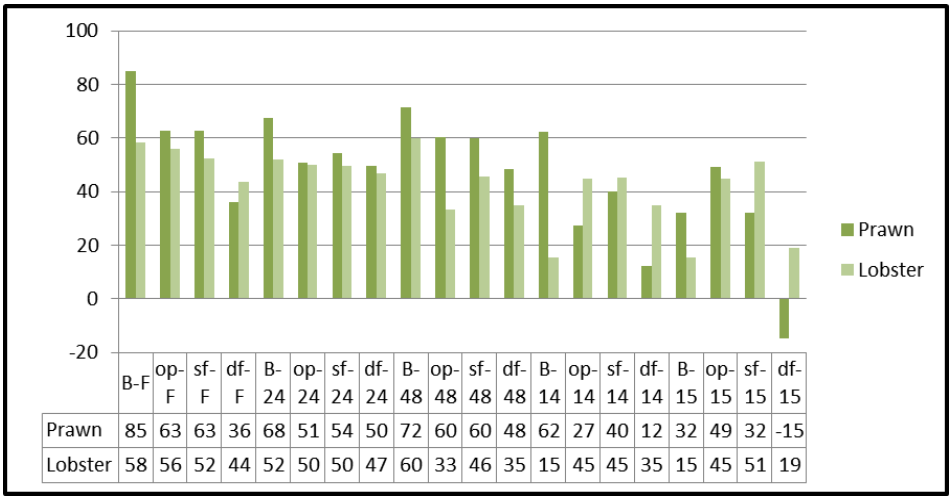
| Nutrients Loss (%) | Raw | | Boiling | | Open pan Dry roasting | | Shallow fry | | Deep fry | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Prawn | Lobster | Prawn | Lobster | Prawn | Lobster | Prawn | Lobster | Prawn | Lobster |
| Carbohydrate | -112.26 | -21.50 | 11.26 | 74.88 | 36.73 | 22.51 | -89.41 | 11.33 | 2.74 | -46.35 |
| Protein | 15.03 | 20.57 | -286.10 | -48.33 | -15.53 | -5.52 | -54.16 | 22.03 | -52.24 | 9.64 |
| Fat | 68.29 | 51.67 | 79.13 | 55.81 | 68.09 | 51.48 | 0.92 | -14.37 | 53.10 | 23.77 |
| Iron | -122.85 | 54.11 | -48.96 | -7.27 | 6.62 | 13.69 | -184.94 | 12.20 | -184.94 | -86.51 |
| Calcium | 14.68 | 44.81 | -66.22 | 43.54 | 39.44 | 36.92 | -482 | 29.85 | -365 | 9.93 |
| Energy | 22.10 | 22.05 | -17.32 | 4.54 | 28.73 | 16.69 | -18.31 | 0.53 | -7.10 | 13.29 |

### 3.3 Comparison of percentage of nutrient loss due to cooking



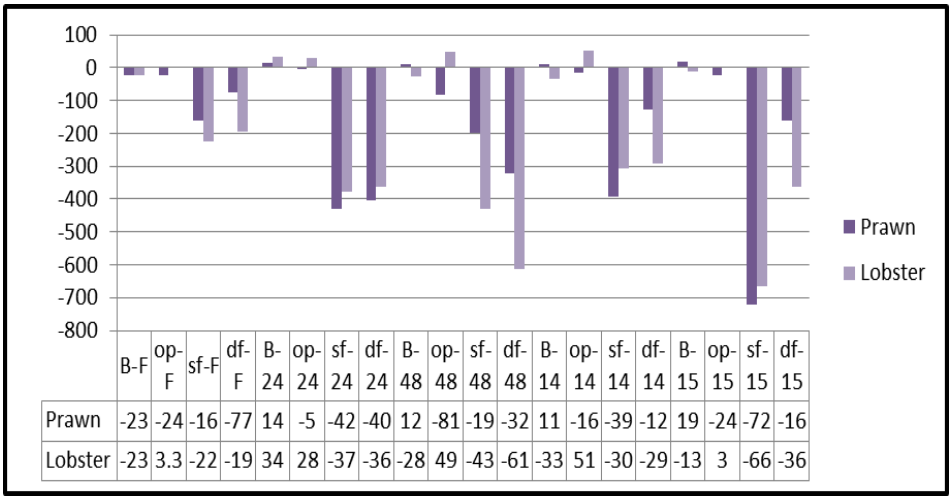

| | B-F | op-F | sf-F | df-F | B-24 | op-24 | sf-24 | df-24 | B-48 | op-48 | sf-48 | df-48 | B-14 | op-14 | sf-14 | df-14 | B-15 | op-15 | sf-15 | df-15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Prawn | 33 | 7.5 | 20 | 53 | 53 | 38 | 0 | 42 | 44 | 1.9 | 31 | 7.8 | 45 | 21 | 20 | 26 | 72 | 72 | 28 | 17 |
| Lobster | 19 | 43 | 6.8 | 43 | 8.5 | 33 | 1.2 | 22 | 17 | 32 | -1 | 83 | 83 | 42 | 30 | 17 | 83 | 64 | 32 | 31 |

**Fig 1:** Carbohydrate content



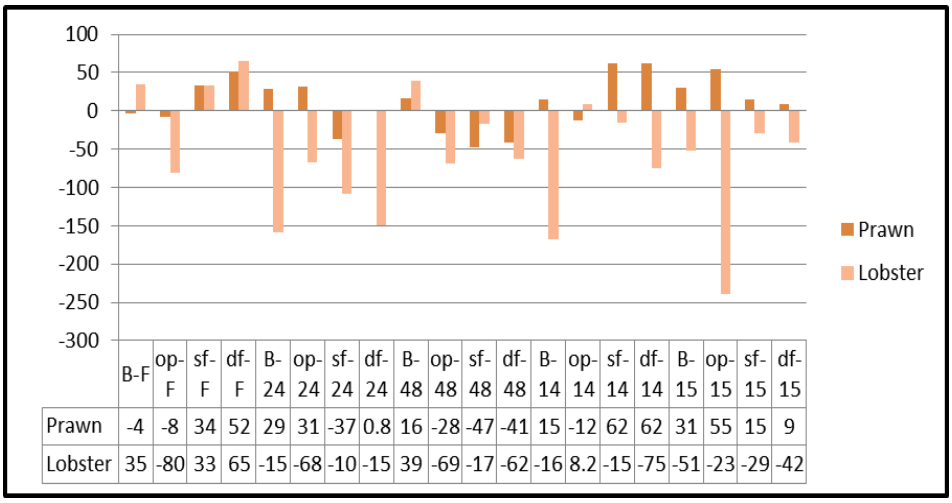

| | B-F | op-F | sf-F | df-F | B-24 | op-24 | sf-24 | df-24 | B-48 | op-48 | sf-48 | df-48 | B-14 | op-14 | sf-14 | df-14 | B-15 | op-15 | sf-15 | df-15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Prawn | 85 | 63 | 63 | 36 | 68 | 51 | 54 | 50 | 72 | 60 | 60 | 48 | 62 | 27 | 40 | 12 | 32 | 49 | 32 | -15 |
| Lobster | 58 | 56 | 52 | 44 | 52 | 50 | 50 | 47 | 60 | 33 | 46 | 35 | 15 | 45 | 45 | 35 | 15 | 45 | 51 | 19 |

**Fig 2:** Protein content



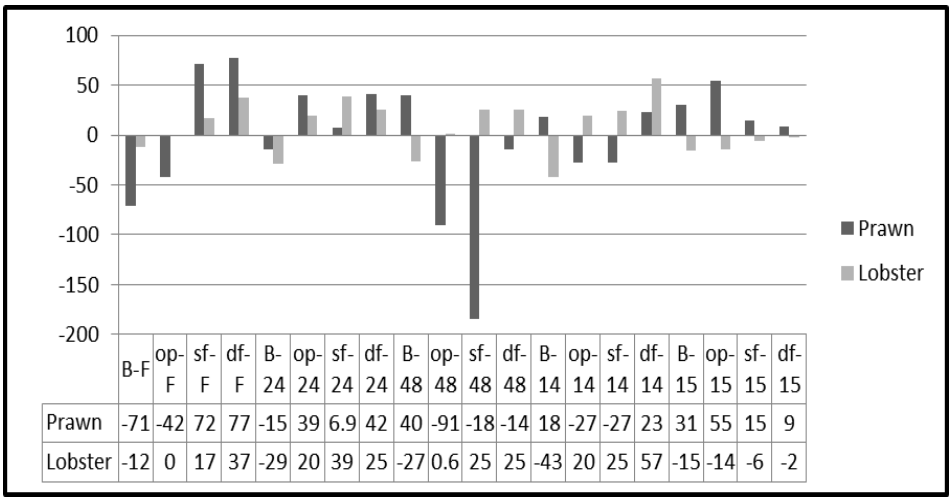

| | B-F | op-F | sf-F | df-F | B-24 | op-24 | sf-24 | df-24 | B-48 | op-48 | sf-48 | df-48 | B-14 | op-14 | sf-14 | df-14 | B-15 | op-15 | sf-15 | df-15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Prawn | -23 | -24 | -16 | -77 | 14 | -5 | -42 | -40 | 12 | -81 | -19 | -32 | 11 | -16 | -39 | -12 | 19 | -24 | -72 | -16 |
| Lobster | -23 | 3.3 | -22 | -19 | 34 | 28 | -37 | -36 | -28 | 49 | -43 | -61 | -33 | 51 | -30 | -29 | -13 | 3 | -66 | -36 |

**Fig 3:** Fat content



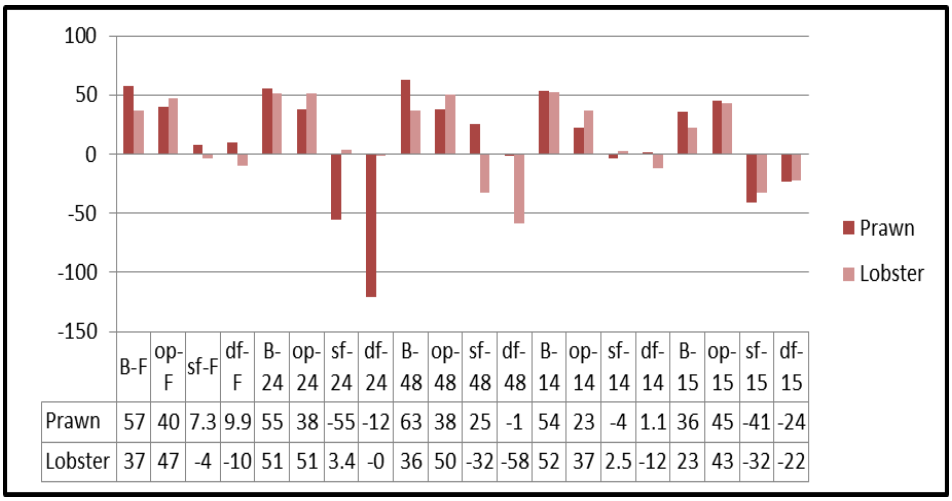

| | B-F | op-F | sf-F | df-F | B-24 | op-24 | sf-24 | df-24 | B-48 | op-48 | sf-48 | df-48 | B-14 | op-14 | sf-14 | df-14 | B-15 | op-15 | sf-15 | df-15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Prawn | -4 | -8 | 34 | 52 | 29 | 31 | -37 | 0.8 | 16 | -28 | -47 | -41 | 15 | -12 | 62 | 62 | 31 | 55 | 15 | 9 |
| Lobster | 35 | -80 | 33 | 65 | -15 | -68 | -10 | -15 | 39 | -69 | -17 | -62 | -16 | 8.2 | -15 | -75 | -51 | -23 | -29 | -42 |

**Fig 4:** Iron content




| | B-F | op-F | sf-F | df-F | B-24 | op-24 | sf-24 | df-24 | B-48 | op-48 | sf-48 | df-48 | B-14 | op-14 | sf-14 | df-14 | B-15 | op-15 | sf-15 | df-15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Prawn | -71 | -42 | 72 | 77 | -15 | 39 | 6.9 | 42 | 40 | -91 | -18 | -14 | 18 | -27 | -27 | 23 | 31 | 55 | 15 | 9 |
| Lobster | -12 | 0 | 17 | 37 | -29 | 20 | 39 | 25 | -27 | 0.6 | 25 | 25 | -43 | 20 | 25 | 57 | -15 | -14 | -6 | -2 |

**Fig 5:** Calcium content




| | B-F | op-F | sf-F | df-F | B-24 | op-24 | sf-24 | df-24 | B-48 | op-48 | sf-48 | df-48 | B-14 | op-14 | sf-14 | df-14 | B-15 | op-15 | sf-15 | df-15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Prawn | 57 | 40 | 7.3 | 9.9 | 55 | 38 | -55 | -12 | 63 | 38 | 25 | -1 | 54 | 23 | -4 | 1.1 | 36 | 45 | -41 | -24 |
| Lobster | 37 | 47 | -4 | -10 | 51 | 51 | 3.4 | -0 | 36 | 50 | -32 | -58 | 52 | 37 | 2.5 | -12 | 23 | 43 | -32 | -22 |

**Fig 6:** Energy content

## 4. Discussion

Table I, II, III, IV, V, VI showed the nutrient contents like carbohydrate, protein, fat, iron, calcium and energy contents of prawn and lobster. The raw and cooked values were displayed here along with the preservation days up to 15$^{th}$. The proximate compositions and the mineral contents were reduced due to application of different cooking methods and preservation up to 15days.The table showed the changes between the raw values and the cooked values. Most of the nutrient content was highest in lobster rather than in prawn in fresh raw condition but due to cooking and preservation nutrient restoration occurred mainly in prawn.

Table VII showed the comparison between the two crustaceans. Most of the values are significant ($P<0.05$) which means there is significant difference present between the fresh and preserved raw and cooked samples.

Table VIII, IX, X, XI showed the percentage of loss due to preservation of prawn and lobster for 24 hours, 48hours, 14days and 15 days preservation. The values show that nutrient loss occurred in both 24 and 48 hours but most of the nutrient restoration occurred in $14^{th}$ and $15^{th}$ days of preservation. Due to prolonged preservation moisture loss occurred from the crustaceans so the nutrients become more concentrated and when these are subjected to cooking further some moisture loss occurred which could increase the amount of nutrients than in fresh condition. Prawn can restore most of the nutrients than lobster during preservation.

Fig. 1, 2, 3, 4, 5, 6 showed the percentage of loss of nutrients due to cooking of both fresh and preserved crustaceans. The carbohydrate and protein content reduced due to cooking. The percentage of loss was more for lobster than for prawn. Fat content is increased for both of the crustaceans due to moisture loss as a result of application of heat. Iron content also increased for both of them due to use of iron pan for cooking. Iron content mostly increased in lobster than in prawn whereas calcium content reduced mostly in lobster rather than in prawn. Energy content is increased in shallow frying and deep frying method mainly for oil absorption of the crustaceans.

## 5. Conclusion

The maximum losses occur in lobster after preservation and cooking rather than in prawn. Losses occur in both the crustaceans but loss percentage due to cooking and preservation for carbohydrate, protein, calcium and energy are higher in prawn rather than in lobster, both due to cooking and preservation, whereas fat and iron content are better restored in lobster. Boiling and open pan dry roasting can mostly reduce the nutrient content whereas shallow frying retains more nutrients. They can be preserved almost up to 2 weeks. After considering all pros and cons, it can be concluded that prawn is better than lobster in terms of nutrient restoration after cooking and preservation.

## 6. Acknowledgement

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