Nutrient composition analysis of gish fish fillets affected by different cooking methods
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Abstract
The effects of different cooking methods (boiling, frying and roasting) on proximate composition of the fish Carangoides malabaricus were investigated. The mean content of moisture, protein, fat and ash of raw fish was found to be 57.97 ± 2.39, 31.49 ± 2.89, 16.8 ± 0.45 and 8.04 ± 0.12% respectively. The changes in the amount of protein were found to be significantly higher in frying and boiling fish. The changes in the amount of fat were found to be significantly higher in frying and boiling fish. The ash content decreased significantly in all cooking methods. In the present study, the boiling method of cooking is found to be the best for healthy eating.

Introduction
In Iran, Gish fish is rarely eaten raw and it is usually processed by various cooking methods, such as boiling, roasting, and frying, before consumption. Heating process (boiling, roasting and frying) is applied to enhance flavor and taste of food and inactivate pathogenic microorganisms (Bognar, 1998). In recent years, fish lipids have also assumed great nutritional significance, because of their high polyunsaturated fatty acid levels. Fish are also considered very rich source of minerals and vitamins. The total content of minerals in the raw flesh of fish and invertebrates is in the range of 0.6–1.5% of wet weight. Mineral components such as sodium, potassium, magnesium, calcium, iron, phosphorus and iodine are important for human nutrition (Sikorski et al., 1990). The contents of Na, K, Ca, Mg and P are up to 1 mg/100 g, whereas those of Fe, Zn and I are less than 1 mg/100 g (Kietzmann et al., 1969). The use of the microwave oven roasting method of cooking has increased greatly during the recent decades (Garcia-Arias et al., 2003a). The various cooking methods invariably affect the nutritive value of fish and especially vitamins, flavor compounds and polyunsaturated fatty acids. The effects of different cooking methods on proximate and mineral composition of several fish species have been reported (Ersoy et al., 2006; Kucukgulmez et al., 2006; Weber et al., 2008; Stephen et al., 2010). Early developments in the field of nutrition predicted that certain substances, important for the proper functioning of the human body, are lost during cooking of foods. It is imperative to conserve nutrients of food products and also is a major consumer concern related to food preparation. Therefore, it is important to determine the retention of nutrients in fish cooked using several common domestic practices, namely boiling, roasting and frying. To date there is no information available in the literature on the nutritive values of raw and cooked fishes. In general fish has long been recognized as an excellent source of animal protein in the human diet. Fish is widely consumed in many parts of the world by humans not only for its high quality protein content but also for the low saturated fat. It contains important n-3 polyunsaturated fatty acids that are likely to lower the risk of heart diseases in adults and are important for neuro-development in infants and young, and are known to support good health (Uauy et al., 2003).

Hence the present study was aimed to investigate the effects of different cooking methods on the proximate composition of fish Carangoides malabaricus. The possible effects of different cooking methods on the nutritive value of this species were evaluated; the values obtained in the cooked samples were compared with the values found in raw fish.

Materials and Methods
Sample preparation and cooking
A total of 25 live Gish fish (Carangoides malabaricus), with a length (20–30 cm) and weight (260–450 g) were obtained from the local fish market in Behbahan, Iran. They were kept in a plastic container and transported to the laboratory. Upon arrival at the laboratory, the fish were washed with tap water several times to remove adhering blood and excessive mucus. The fish were then placed in ice-cold water (hypothermia) for five minutes prior...
to eviscerating and beheading. Subsequently the fish samples were filleted and fillets were divided into five groups and each group consisted of five fillets. The first group was uncooked while the other four groups were cooked in the following methods; boiling, frying and roasting. Boiling was performed at 99–101°C (water temperature) for 12 min. Roasting of fillets was performed in a conventional oven with the temperature set at 200°C for 20 min. The frying of fillets was performed in a domestic frying pan of 2 L capacity at temperature approximately of 180°C for 15 min. Sunflower oil was used as the medium for frying. The fresh and cooked fish were hand deboned and ground in a kitchen blender to ensure homogeneity and representative samples taken for analysis. Samples were packed in a polythene bags and kept under frozen conditions (–20°C) until analysis.

**Proximate composition analysis**

Proximate composition analysis for homogenized samples of cooked and raw fish fillets were done in triplicate for protein, moisture, lipid and ash contents. The crude protein content was determined by the Lowry method (Lowry et al., 1951). Moisture content was determined by oven drying at 105°C to a constant weight. Total lipid was extracted from the muscle tissues by chloroform: methanol (2:1, v/v) solvent system (Folch et al., 1957). The lipid content was gravimetrically determined. Ash content was determined gravimetrically in a muffle furnace by heating at 550°C to a constant weight (AOAC, 2000).

**Statistical analysis**

Data was analyzed using one-way analysis of variance (ANOVA) and the significant differences between means were determined by post hoc Duncan’s multiple range test. Differences were considered to be significant when p < 0.05. Data were analyzed using SPSS package (Version 11).

**Results and Discussion**

The proximate composition of raw fish and fish fillets after various cooking methods of fish (*C. malabaricus*) are presented in Table 1. The proximate composition of raw fillets is similar to earlier reports in the fish (Zuraini et al., 2006). Proximate composition of moisture, protein, fat and ash of the fish was varied in all the cooking methods. Significantly higher protein content (41.73 ± 1.82) was recorded in roasted fillets followed by (40.41 ± 0.96) in boiling than the rest of the cooking methods (P < 0.05). Significantly higher fat content (32.15 ± 1.85) was observed in fried fillets followed by (12.80 ± 0.45) in raw fish fillets followed by (9.06 ± 1.46) boiled fish fillets (P < 0.05). There was no significant difference observed in fat content among boiled, raw fish fillets (P > 0.05). The increase in fat content of the fried fish fillets is related to oil absorption during the cooking process. Further the increase of fat content can be attributed to the oil penetration on the food after water is partially lost by evaporation (Saguy and Dana, 2003). Similar results were reported for sardine and African catfish fried in vegetable oil (Candela et al., 1996). Increased in dry matter content was observed in boiled, roasted and fried fish fillets. The highest moisture content (52.42%) was recorded in raw fillets and decreased moisture content was noticed in frying method of cooking (Table 1). Increased ash content was noticed in roasted and boiled fillets when compared to raw fish fillets. Moisture loss was also recorded in fried fillets of the fish. However, dehydration rate comparatively was lower than during boiling and roasting. These changes were similar to those reported in sardines (Garcia-Arias et al., 2003a). Water losses, occurring during frying resulted in lower protein content in fried fish as compared to the raw fish fillets (Garcia-Arias et al., 2003b). Accordingly, the increase in ash, protein and fat content found in cooked silver catfish fillets is explained by the reduction in moisture. Differences in water contents between fresh and smoked rainbow trout were found to be significant (Unlusayin et al., 2001). This findings also supported by that deep fried fish fillet had significantly lower protein content than roasted and boiled fillet (Gall et al., 1983).

The increased dry matter, protein and ash content were observed in boiled and roasted fish fillets. The fat content in fried fish fillet increased due to absorption of oil by the fish during frying. Hence this method of cooking is not advisable. On comparing the raw and cooked fish fillet, the results indicate that cooking had considerable effect on the proximate composition of fish fillets. Based on the results obtained for proximate composition, the boiling fish fillets of the fish were found to be the best among all the cooking method for healthy eating. Boiled fish fillet was best option in

**Table 1. Proximate (% in dried matter) and of raw and cooked fillets samples of *C. malabaricus***

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Raw</th>
<th>Boiled</th>
<th>Roasted</th>
<th>Fried</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture (%)</td>
<td>52.42 ± 1.39a</td>
<td>42.40 ± 0.31b</td>
<td>41.77 ± 0.33b</td>
<td>41.70 ± 1.46c</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>31.49 ± 2.89a</td>
<td>40.41 ± 0.96b</td>
<td>41.73 ± 1.82c</td>
<td>41.70 ± 1.26d</td>
</tr>
<tr>
<td>Lipid (%)</td>
<td>32.8 ± 0.45a</td>
<td>9.96 ± 1.46b</td>
<td>4.48 ± 0.39ab</td>
<td>32.35 ± 1.85c</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>3.29 ± 0.12a</td>
<td>8.13 ± 0.13c</td>
<td>12.02 ± 0.13b</td>
<td>7.00 ± 0.13c</td>
</tr>
</tbody>
</table>

Values are shown as mean ± standard deviation of triplicates. Values within the same row have different superscripts are significantly different (p < 0.05).
diet from nutritional values point of view.

**Conclusion**

Results of the present study have shown that changes in the amount of protein were found to be significantly higher in frying and boiling fish. The changes in the amount of fat were found to be significantly higher in frying and boiling fish. Based on the results obtained for proximate composition, the boiling fish fillets of the fish were found to be the best among all the cooking methods for healthy eating.

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**References**


