EFFECT OF PROCESSING ON PROXIMATE COMPOSITION AND ENERGY VALUES OF TWO LESS KNOWN SELECTED FISH SPECIES CONSUMED IN SOUTHERN IRAN

Ali Aberoumand
Department of Fisheries, Behbahan Katam Alania University of Technology, Behbahan, Iran

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ABSTRACT
The proximate composition (crude protein, lipid and ash) and energy of fish species (Euthynnus affinis and Orcynopsis unicolor) from the Persian Gulf were compared. The lipid content of fresh O. unicolor was found to be significantly higher than that in E. affinis (P<0.05). Energy content depends on the fat content. In this regard, after 6 months of storage, canned O. unicolor fish had high fat content and thus showed high energy values (376.58 kcal kg\(^{-1}\)), while one month canned E. affinis with lower fat content (15.2 g kg\(^{-1}\)) exhibited lower energy values (276.4 kcal kg\(^{-1}\)). Both fish species are good sources of EPA and DHA. It can be concluded that freshwater mussels; E. affinis and O. unicolor are suitable as healthy food choice. For E. affinis and O. unicolor, the nutritional values were the highest after four and six months of storage respectively (293.4 and 376.58 kcal kg\(^{-1}\)).

Key words: Canned fishes, E. affinis, Nutritional values, O. unicolor, Proximate composition.

INTRODUCTION
Fish is a good source of many important nutrients like protein, vitamins, and minerals. Dietary fish intake is associated with improved cardiovascular health and other related health conditions (Dahl et al 2006; Damsgaard et al 2006; Mayer et al 2006; Mozaffarian et al 2006). Fish constitute a very important component of the diet for many people and often provides the much needed nutrient that is not provided in cereal-based diets (Clucas and Sutchitte, 1981). Fish is rich in protein with amino acid composition (Olomu, 1995) well suited to human dietary requirements comparing favorably with egg, milk and meat in the nutritional value of its protein. The present study was aimed at nutritional evaluation of two fish species using proximate analysis of body constituents.

MATERIALS AND METHODS
Samples preparation: The fishes of the two species included in the study were purchased from the local market in Dilam in southern Iran. A brief description of these fishes is given in Table 1:

<table>
<thead>
<tr>
<th>Local Name</th>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Havoor masghati</td>
<td>Skipjack tuna</td>
<td>Euthynnus affinis</td>
</tr>
<tr>
<td>Tune mahipahn</td>
<td>Common Tuna</td>
<td>Orcynopsis unicolor</td>
</tr>
</tbody>
</table>

**Euthynnus affinis** belongs to the Scombridae family. It has a maximum size of 100 cm TL with a maximum published weight of 7,200 g. It is an excellent food fish marketed both fresh and canned (Fig. 1). **Orcynopsis unicolor** also belongs to the Scombridae family. The maximum length is 130 cm TL with a maximum published weight of 13.1 kg. It is also an excellent food fish marketed both fresh and canned.

**FIG 1:** Diagrammatic representation of Euthynnus affinis

TABLE 1: Local, common, and scientific names of Iranian Persian Gulf fish species.
Proximate analysis: Using anesthetic MS222, the fishes were killed, blotted dry, and weighed. Water content was determined by placing the whole fish in a pre-weighed aluminum foil tray for drying in an electric oven at 65-80 °C until obtaining the constant weight. The proximate analysis of the samples was done in triplicate for protein, moisture, lipid, and ash contents. The crude protein was determined by the Kjeldahl procedure (AOAC, 1990). The Ash content was estimated by burning 500 mg of the sample in a pre-weighed heat resistant China clay crucible placed in a muffle furnace for 7 hours at 500 °C and reweighed after cooling. The lipid content was estimated by the dry extraction method (Bligh and Dyer, 1959 and Salam and Davies, 1994). Powdered dry tissue (3 mg) was mixed into 10 ml solution of chloroform and methanol (in ratio of 1:2), and stirred with a glass rod. The resultant mixture was left overnight and after centrifugation, the clear supernatant was carefully removed into washed, dried, and pre-weighed small bottles. These bottles were then put in an oven at 40-50 °C to evaporate the solvent leaving the lipid fraction. The carbohydrate content was calculated using the standard equation 100% (%protein + %fat + %ash + %moisture) and the energy evaluation was done by multiplying the protein, carbohydrate and fat by factors 4.4 and 9 respectively.

**RESULTS AND DISCUSSION**

The proximate composition of fresh and canned fishes is presented in Tables 2, 3 and 4. With increase in water content, the fat content of the fish decreased. Hence, *O. unicolor* with high moisture contents in canned fish after two, four, and six months from production (50.8, 49.6 and 40.3 g kg⁻¹, respectively) (Table 3) was low in fat content (17.6, 18.4 and 28.3 g kg⁻¹ respectively). The protein levels were quite high; the highest was in canned *E. affinis* (24.5 g kg⁻¹) (Table 4) after two months of storage. The canned *E. affinis* fish contained carbohydrate content of 9.35, 2.56 and 1.3 g kg⁻¹ after one, two, and four months from production, respectively. The maximum ash content was in fresh *E. affinis* fish (3.27g kg⁻¹) (Table 2). The energy content depended on the fat content of the fish. Hence, canned *O. unicolor* fish after six months of storage with high fat content exhibited high energy values (376.58 kcal kg⁻¹), while one month canned *E. affinis* with lower fat content (15.2 g kg⁻¹) had lower energy values (276.4 kcal kg⁻¹) (Table 4).

Both fish species in this study were high in protein and fat contents. This is of dietary advantage as protein is essential for maintaining and building muscles (Bonjour, 2005). The higher fat content is of nutritional value as that has protective effect against the coronary heart disease due to intake of marine omega-3 fatty acids (Alonso *et al* 2003).

Thus, it may be concluded that these freshwater mussel species were suitable items in diet. The comparison of proximate composition between fresh and canned fishes showed that fat increased and protein, ash, and carbohydrate decreased with increase in the overall energy value after three months of storage. Fat and moisture content for each species fluctuates depending on different factors such as the season and location of catch, size, and spawning cycles. The moisture content also fluctuates canned samples depending on the drip loss during storage thus, affecting subsequent moisture determination. This loss in moisture was reflected as a gain in the

**TABLE 2:** Proximate analysis of fresh *O. unicolor* and *E. affinis*.

<table>
<thead>
<tr>
<th>Fish species</th>
<th>Fat(%)</th>
<th>Protein(%)</th>
<th>Ash(%)</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orcynopsis unicolor</td>
<td>16 ±0.17 a</td>
<td>22 ±0.28 c</td>
<td>2 ±0.06 e</td>
<td>5</td>
</tr>
<tr>
<td>Euthynnus affinis</td>
<td>14±0.14 b</td>
<td>24 ±0.19 d</td>
<td>3.27±0.09 f</td>
<td>5</td>
</tr>
</tbody>
</table>

Results are means ± standard deviation of triplicates.

Means within the same column that have no common letters are significantly different (P<0.05).
TABLE 3: Proximate and physicochemical analyses of canned O. unicolor.

<table>
<thead>
<tr>
<th>Storage time (Months)</th>
<th>Fat (%)</th>
<th>Protein(%)</th>
<th>Ash(%)</th>
<th>Moisture(%)</th>
<th>pH</th>
<th>Carbohydrate(%)</th>
<th>Energy value Kcal/100g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two</td>
<td>17.6±0.13a</td>
<td>22.8±0.22a</td>
<td>1.8±0.19a</td>
<td>50.8±0.22a</td>
<td>5.5</td>
<td>7±0.78a</td>
<td>277.6±0.98a</td>
</tr>
<tr>
<td>Four</td>
<td>18.4±0.21a</td>
<td>19.8±0.25b</td>
<td>3±0.34b</td>
<td>49.6±0.29a</td>
<td>5.5</td>
<td>9.2±0.45b</td>
<td>281.6±0.96b</td>
</tr>
<tr>
<td>Six</td>
<td>28.3±0.32b</td>
<td>21±0.26a</td>
<td>0.93±0.23b</td>
<td>40.3±0.45b</td>
<td>5.5</td>
<td>9.47±0.69b</td>
<td>376.58±0.79b</td>
</tr>
</tbody>
</table>

Results are means ± standard deviation of triplicates. Means within the same column that have no common letters are significantly different (P<0.05).

TABLE 4: Proximate and physicochemical analysis of canned E. affinis fish after different months of storage.

<table>
<thead>
<tr>
<th>Storage time (Months)</th>
<th>Fat (%)</th>
<th>Protein(%)</th>
<th>Ash(%)</th>
<th>Moisture(%)</th>
<th>pH</th>
<th>Carbohydrate(%)</th>
<th>Energy value Kcal/100g</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>15.2±0.21a</td>
<td>23.3±0.27a</td>
<td>1.65±0.11a</td>
<td>50.8±0.36a</td>
<td>5.5</td>
<td>9.35±0.25a</td>
<td>276.4±0.89a</td>
</tr>
<tr>
<td>Two</td>
<td>18.4±0.26b</td>
<td>24.5±0.29b</td>
<td>2.04±0.21b</td>
<td>52.5±0.34b</td>
<td>5.5</td>
<td>2.56±0.27b</td>
<td>273.84±0.96b</td>
</tr>
<tr>
<td>Four</td>
<td>21.4±0.31b</td>
<td>23.9±0.28b</td>
<td>2.40±0.18b</td>
<td>51±0.36b</td>
<td>5.5</td>
<td>1.3±0.21b</td>
<td>293.4±0.87b</td>
</tr>
</tbody>
</table>

Results are means ± standard deviation of triplicates. Means within the same column that have no common letters are significantly different (P<0.05).

other proximate constituents. Low ash and fat, and high protein content values obtained from proximate analysis as shown in Tables 3 and 4 agreed with other analyses reported in previous studies (Effiong and Mohammad 2008; Mumba and Jose 2005; Abdullahi 2001).

Statistical analysis: The analysis of variance was used to analyse the data and significant differences among means were tested by independent samples T-test (P=0.05). The statistical analysis was performed using SPSS 15.0.

CONCLUSION

This study showed differences in nutritional values between fresh and canned fish. Reduction in protein content was observed after three months of storage; indicating better nutritional value of fresh fish. It may be concluded that these fishes are suitable for the human diet. It can also be concluded that energy value after four months of storage in E. affinis (293.4 kcal kg⁻¹) and after six months of storage in O. unicolor (376.58 kcal kg⁻¹) were the highest.

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REFERENCES


