



Research Article

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# Comparison of Nutritional Value of Fresh and Processed two Fish Species



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## Abstract

**Objectives:** Two species of tune fishes (*Auxis thazard* and *Thunnus tonggol*) were selected for evaluation of nutritional values and some of physicochemical properties in before and after process.

**Methods:** In this study, measuring the chemical composition of fresh and canned fish, were carried out with the methods AOAC and AOCS.

**Results:** Results showed that fat amounts in all samples were increased after processing, but the ash and protein amounts were decreased ( $P < 0.05$ ). Moisture amount was decreased for *A. thazard* after canning and in storage during time ( $51 \pm 0.19\%$ ) but it was not changed in *T. tonggol*. The obtained results showed that energy value after 3 months storage was higher ( $293.4 \pm 5.2 \text{ kcal/100g}$ ) in canned *A. thazard* than in canned *T. tonggol*. Fresh *A. thazard* oil had significantly ( $P < 0.05$ ) higher peroxide and acidic values and fresh *T. tonggol* oil had higher iodine value ( $P < 0.05$ ).

**Conclusion:** It can be concluded that canned *A. thazard* oil after 3 months storage had significantly ( $P < 0.05$ ) the lowest iodine value ( $156.36 \pm 4.30 \text{ gr I}_2/100\text{gr}$ ) and the *T. tonggol* oil had highest iodine value ( $293.4 \pm 5.2 \text{ gr I}_2/100\text{gr}$ ) after 1-month storage.

**Keywords:** Fresh and canned fish; Physicochemical properties; Storage period; *Auxis thazard*; *Thunnus tonggol*

## Introduction

The fish and its products as health food and has increased during the last two decades [1]. The effect of feed composition may be influencing the nutritional composition and nutritional value of fish [2]. The main health benefits of fish for people are related their high content of fat and n-3 long-chain polyunsaturated fatty acids [3]. Nutrient composition of different fish species may be affected by variation in their physiology [4]. Moreover, the values of these two indices in the study agree with the results of [5] which confirm that wild fish is clearly favorable for human nutrition. Fish is a good source of animal protein and it provide about 30 to 80% of the protein intake [5]. Fish nutritive quality is important attributes which can be affected by many factors such as food availability in ecosystem, feed composition, water quality, species and method of processing and preservation. Fish is perishable when caught, therefore need to process and preserved to slow down spoilage. Several processing techniques such as smoking, freezing, chilling, salting, drying and fermentation have been employed by processors [6,7]. The higher values of the parameters in oven dried samples which incidentally have the least moisture content in this study implies that there are affected by dehydration [8,9]. All the element in studied species where higher than those

reported by Adejonwo on *Pseudotolithus spp* on some important commercial fishes of Jebel reservoir Ahmed et al. [10]. The drying methods showed concentration of the required nutrients in human diets by the panel list. To improve fish nutrients quality, drying by heat should be encourage [11]. Canned fillets with a 2% saline solution and placed in the autoclave, sterilization time was 45min with F0 6min and center temperature reached  $121^\circ\text{C}$  [12]. For ash content, no significant differences were observed in either salmon or Chilean jack mackerel compared to the control samples; these results are consistent with those found by Hosseini et al. [13] for Caspian white fish (*Rutilus frisii kutum*). The cooking method can be affecting factors to maintain the nutritional quality of fish. Although significant changes were observed in the proximate composition, the nutritional quality of cooked fillets was not affected compared to the control [14]. Some cooking methods used in the processing can influence of fish nutrient composition. The texture of fried and boiled fish fillets significantly differs from that of the roasted fillets [15]. The aim of this study was to assess the nutritional value and oil properties of two canned and fresh fish species *A. thazard* and *T. tonggol*.

## Materials and Methods

The all canned fish samples (18 pieces) used in this study were produced at 2014, in Majid tuna factory, situated in 10Km Shushtar, Khuzestan Province, Iran.

### Sampling fish species

In this study, two species of tuna *A. thazard* and *T. tonggol* the family Scombridae, after fishing fresh into sealed ice bags were transferred to food chemistry laboratory, Behbahan Khatam Alanbia University of Technology, Iran. And then in the freezer were stored at temperature -18 °C until laboratory analysis. This study carried out in Behbahan city, southern Iran in 2014.

### Analysis of samples

In this study, measuring the chemical composition of fresh and canned fish, were carried out with the methods AOAC [16]. To determine the samples moisture and dry matter contents, the oven was used. To determine the amounts of crude protein and crude fat, respectively Kjeldahl and Soxhlet methods were used. By putting samples in an electric furnace, at a temperature of 550°C for 4 hours the ash content was determined. The pH of samples using were measured using a pH meter (JENWAY 3015 Model) based on the protocol of AOAC [16]. Energy values using the equations in kcal were measured by method of Atwater.

### Measuring raw energy of samples

Energy values using the equations in kcal were measured by method of Atwater.

### Lipid extraction

For the total lipid extraction, 3g of sample was extracted according to the method of Folch by chloroform: methanol (2:1).

**Determination of the refractive index of oil:** The refractive index of oil samples was obtained with the refractometer at 25°C.

**Acidic value:** The number of oil acidic determined by the method of AOCS, were reported as the percentage of oleic acid.

**Peroxide value:** The peroxide value was determined, and the results were reported in terms of meq O<sub>2</sub>/kg oil.

**Iodine number:** Hanus method was used for calculation of iodine number and the results were reported in I<sub>2</sub>/100g of oil.

### Statistical Analysis

All measurements were carried out in triplicate, and averages of the data were calculated using the software SPSS (version 15).

**Table 2:** Analysis of pH, proximate composition and energetic values in canned tuna fish (*A. thazard*).

Fish	Moisture	pH	Ash	Protein	Fat	Carbohydrate	Energy (kcal/100g)
Canned One Monthly	51.69± 0.19 <sup>a</sup>	5.5± 0.20	2.30± 0.24 <sup>a</sup>	23.12± 0.13 <sup>a</sup>	15.45± 0.22 <sup>a</sup>	7.35± 0.42 <sup>a</sup>	276.45± 4.3 <sup>a</sup>
Canned Two Monthly	52.46± 0.21 <sup>b</sup>	5.5± 0.20	1.61± 0.32 <sup>a</sup>	21.67± 0.12 <sup>b</sup>	17.78± 0.35 <sup>b</sup>	6.46± 0.32 <sup>b</sup>	272.54± 4.1 <sup>a</sup>
Canned Three Monthly	51.60± 0.19 <sup>a</sup>	5.5± 0.20	1.60± 0.21 <sup>b</sup>	20.69± 0.25 <sup>c</sup>	20.66± 0.25 <sup>c</sup>	5.30± 0.45 <sup>c</sup>	290.01± 5.2 <sup>b</sup>

Mean values are obtained from three samples analyzed in triplicate. Different superscripts in the same column indicate significant differences (P<0.05). Location and year of the search: Behbahan, Iran. 2014.

The statistical difference between the means, were compared with Duncan test in the significance level (P<0.05).

## Results and Discussion

As shown in Table 1, Fresh fish *A. thazard* (23.7%) protein content was found higher than fresh and canned *T. tonggol*. Results showed that fat contents in canned *A. thazard* and *T. tonggol* found high for three monthly canned fish (20.66% and 25.85%, respectively).

**Table 1:** Analysis of pH and proximate composition in fresh fish species *A. thazard* and *T. tonggol*.

Fish species	pH	(%) Fat	(%) Protein	(%) Ash
<i>Auxis thazard</i>	5±0.20	14.1±0.21 <sup>b</sup>	23.7±0.24 <sup>a</sup>	2.77±0.26 <sup>a</sup>
<i>Thunnus tonggol</i>	5±0.20	16.3±0.18 <sup>a</sup>	21.9±0.11 <sup>b</sup>	2.10±0.17 <sup>b</sup>

Different superscripts in the same column indicate significant differences (P<0.05). Location and year of the search: Behbahan, Iran. 2014.

Results in Table 2 in present study agreed with other analyses reported in previous studies such as it has been reported main compounds of fish *T. thynnus* (76.7-72% moisture, 23.3-27% protein, 1.2-8% fat), this is agreed with analyzed amounts of protein in two fish species of present study, but fat content was lower than obtained results in our research, that can be related to nutrition and fish species [10]. Also reported values of moisture, protein, fat and ash after thermal sterilization 52.5%, 23.8%, 20.9% and 2.3% respectively that agreed with present results for two monthly canned *A. thazard* fish [13] (Table 2). Results in Table 3 showed that amount of moisture in canned fish *T. tonggol*, was decreased (47.3% + 0.25). Because in the canning process, the water in fish meat with oil mixed, and water before the canning was moved, and boiling point of water was much less than oil and thus moisture content were reduced [11]. The reaction a mixture of water and oil with nutrients, especially at high temperatures during the canning lead to that change nature of nutrients (protein and oil) [12]. This is reason of significant difference in samples moisture contents. Fat, moisture and protein contents in fish depends on fishing season and place and size of the spawning period [12], and in results will be affected [13]. Home compounds bluefin tuna fish *T. thynnus* reported (23% protein and 8.21% fat) with two kinds of fresh fish protein analysis match, but the amount of fat less than the results that can be related to nutrition and fish species [13]. The results in Table 3 showed that the energy value for three monthly canned fish was higher than any other time.

**Table 3:** Analysis of pH, proximate composition and energetic values in canned tuna fish (*T. tonggol*).

Fish	Moisture	pH	Ash	Protein	Fat	Carbohydrate	Energy (kcal/100g)
Canned One Monthly	50.70± 0.32 <sup>a</sup>	5.5± 0.20	1.30± 0.18 <sup>a</sup>	22.58± 0.22 <sup>a</sup>	17.16± 0.12 <sup>a</sup>	3.16± 0.32 <sup>a</sup>	257.40± 4.1 <sup>b</sup>
Canned Two Monthly	51.68± 0.24 <sup>b</sup>	5.5± 0.20	1.64± 0.16 <sup>a</sup>	21.14± 0.24 <sup>b</sup>	18.08± 0.14 <sup>b</sup>	6.70± 0.12 <sup>a</sup>	274.08± 4.1 <sup>b</sup>
Canned Three Monthly	47.7± 0.25 <sup>b</sup>	5.5± 0.20	0.99± 0.11 <sup>b</sup>	18.19± 0.26 <sup>b</sup>	25.85± 0.15 <sup>a</sup>	7.72± 0.21 <sup>b</sup>	331.16± 4.6 <sup>a</sup>

Different superscripts in the same column indicate significant differences (P<0.05). Location and year of the search: Behbahan, Iran. 2014.

And especially energy value of canned *T. tonggol* fish was the highest (331.16±4.6kcal/100g). It should be expected that thermal processing lead to out of water molecules from samples, because the temperature was higher than boiling point of water. Candella et al. [17] reported because the fish is a source of protein, it is important that its protein content is not reduced during the preparation of the fish. However, it should be noted that all methods of processing, reduce the amounts of crude protein and fat, but this reduction does not depend on the specific method or type of fish.

Table 4 showed average of peroxide, acid, iodine values and refractive index of *A. thazard* and *T. tonggol* oil after canning process. Peroxide value of two fresh fish species oil, showed that there were significant differences between them (P<0.05). The

maximum amount of the peroxide value was found for *T. tonggol* oil. The raw fish lipid peroxide value between 3 and 20mg of oxygen per kg of oil have been reported [15], that is acceptable for human consumption [15]. Acidic number is one of oil quality important factors. If acidic value be low, oil quality is high. Table 4 showed the average peroxide, acidic, iodine values and refractive index of canned *A. thazard* and *T. tonggol* during different storage conditions. Peroxide and acidic numbers in three monthly canned *T. tonggol* oil found highest and lowest values were found in one monthly canned *A. thazard* (P <0.05). Iodine number in one monthly canned *T. tonggol* oil found highest and lowest values were found in three monthly canned *A. thazard* so that the differences was statistically significant (P<0.05). Results in Table 5 showed that the acidic number of fresh *A. thazard* oil was significantly (P <0.05) less than fresh *T. tonggol* oil.

**Table 4:** Averages of peroxide, acidic, iodine and refractive values of fresh and canned fishes *A. thazard* and *T. tonggol*.

Fish Species	Peroxide Value	Acidic Value	Iodine Value	Refractive Index
	(meq O2/1kg)	(mgKOH/g)	(gI2/100gr)	(25 °C)
Canned Auxis thazard one monthly	4.72±0.87 <sup>a</sup>	2.86±0.75 <sup>a</sup>	176.2±3.63 <sup>a</sup>	1.13±0.006 <sup>a</sup>
Canned Auxis thazard three monthly	5.69±0.77 <sup>b</sup>	3.82±0.39 <sup>b</sup>	155.36±4.30 <sup>b</sup>	1.11±0.01 <sup>a</sup>
Canned Thunnus tonggol one monthly	6.29±0.83 <sup>b</sup>	5.11±0.75 <sup>c</sup>	141.42±3.40 <sup>c</sup>	1.12±0.003 <sup>a</sup>
Canned Thunnus tonggol three monthly	7.71±0.79 <sup>c</sup>	7.81±0.79 <sup>d</sup>	126.3±2.53 <sup>d</sup>	1.10±0.009 <sup>a</sup>

Mean values are obtained from three samples analyzed in triplicate. Location and year of the search: Behbahan, Iran. 2014.

**Table 5:** Averages of peroxide, acidic, iodine and refractive values of *A. thazard* and *T. tonggol* fresh fishes.

Fish Species	Peroxide Value	Acidic Value	Iodine Value	Refractive Index
	(meq O2/1kg)	(mgKOH/g)	(gI2/100gr)	(25 °C)
Fresh <i>A. thazard</i>	3.85±0.81 <sup>b</sup>	2.89±0.76 <sup>b</sup>	169.18±7.55 <sup>a</sup>	1.24± 0.05 <sup>a</sup>
Fresh <i>T. tonggol</i>	5.71±1.05 <sup>a</sup>	4.71±0.85 <sup>a</sup>	143.23±6.49 <sup>b</sup>	1.32±0.08 <sup>a</sup>

Mean values are obtained from three samples analyzed in triplicate. Different superscripts in the same column indicate significant differences (P<0.05). Location and year of the search: Behbahan, Iran. 2014.

Fat, protein and ash contents in fresh fish species *A. thazard* and *T. tonggol* showed significantly differences (P<0.05). Moisture contents in one monthly and two monthly canned fish *A. thazard* found significantly differences (P<0.05). Moisture contents in three and two monthly canned fish *A. thazard* found significantly differences (P<0.05). Moisture contents in one- and three-monthly canned fish *A. thazard* found not significantly differences (P<0.05). Ash contents and energy value in one- and three-monthly canned fish *A. thazard* found significantly differences (P<0.05). Ash content and energy value in two- and three-monthly canned fish *A. thazard* found significantly differences (P<0.05). Ash contents and energy value in one and two monthly canned fish *A. thazard* found not significantly differences (P<0.05). Protein, fat and

carbohydrate contents in one and two monthly canned fish *A. thazard* found significantly differences (P<0.05). Protein, fat and carbohydrate contents in one- and three-monthly canned fish *A. thazard* found significantly differences (P<0.05). Protein, fat and carbohydrate contents in two- and three-monthly canned fish *A. thazard* found significantly differences (P<0.05). Moisture, ash, protein and carbohydrate contents in one monthly and three-monthly canned fish *T. tonggol* found significantly differences (P<0.05). Moisture contents in three and two monthly canned fish *T. tonggol* found significantly differences (P<0.05). Moisture contents in one and two monthly canned fish *T. tonggol* found not significantly differences (P<0.05). Fat content and energy value in one- and three-monthly canned fish *T. tonggol* found

significantly differences ( $P < 0.05$ ). Fat content and energy value in two- and three-monthly canned fish *T. tonggol* found significantly differences ( $P < 0.05$ ). Fat content and energy value in one and two monthly canned *T. tonggol* found not significantly differences ( $P < 0.05$ ).

Peroxide, acidic and iodine values in one monthly and three-monthly canned fish *Auxis thazard* found significantly differences ( $P < 0.05$ ). Refractive index in one monthly and three-monthly canned fish *Auxis thazard* found not significantly differences ( $P < 0.05$ ). Peroxide, acidic and iodine values in one monthly and three-monthly canned fish *Thunnus tonggol* found significantly differences ( $P < 0.05$ ). Refractive index in one monthly and three-monthly canned fish *Thunnus tonggol* found not significantly differences ( $P < 0.05$ ). Peroxide, acidic and iodine values in fresh *A. thazard* and *T. tonggol* fish species found significantly differences ( $P < 0.05$ ). Refractive values in fresh *A. thazard* and *T. tonggol* fish species found no significantly differences ( $P < 0.05$ ). After the canning process, the hydroperoxides content (10.82 meq active  $O_2$ /kg oil) of oils extracted from cooked tuna was higher than that of fresh samples (2.50 meq active  $O_2$ /kg oil). Sardine PV levels changed, but not significantly, during the canning step. These results not agreed with our study results.

pH in *T. tonggol* and *A. thazard* canned fish were statistically same but in two fresh fish species pH was found lower than canned two fish species. The fat content in fish *T. tonggol* was decreased after canning process. The ash content in fresh fish *A. thazard* was found higher than that of fresh and canned *T. tonggol* (2.77 + 0.26). Based on the results, a greater nutritional value was obtained in *A. thazard* compared with fresh and canned *T. tonggol* in related to mineral contents. Increased amounts of fat in two canned fish species agreed with the results [16]. The after canning process, protein and moisture contents were decreased in all time periods after processing and the amount of fat also was increased. The white muscle in fish Albakor was found to contain the higher amount of fat than other tuna species [18].

The results showed that the protein contents in fresh fishes *A. thazard* and *T. tonggol* was 23.7% and 21.9%, that were decreased to 20.69% and 18.19%, respectively for canned fish three monthly. The results found in agreement with another study. Maximum acidic value reported was 7% for fish oil. The iodine number of fresh two fish species oil were observed significantly differences ( $P < 0.05$ ). The fresh *A. thazard* fish oil iodine number was higher than *T. tonggol* oil. The cause can be related to high levels of unsaturated fatty acids, especially (DHA) in *A. thazard* oil in comparison with the *T. tonggol* oil. The results [19] and [17] agreed with our study results. According to study Endo et al. [20] fish oil iodine number was in the range of 55-188g/100. Differences in the iodine number of fish oil was related to fishing seasons, fish genus, different species of fish, type of fish. Table 4 were showed that there is no significantly difference between refraction index in samples oil ( $P < 0.05$ ). It can be related to high levels of unsaturated fatty acids, especially (DHA) in *A. thazard*

oil in comparison with the *T. tonggol* oil as can be seen in Table 5, showed no significantly different [20-22].

## Conclusion

The results showed that lipid indexes after canning process were increased in both types of fish, but protein and ash contents were decreased. Moisture content in *T. tonggol* after canning process was decreased but did not change in fish *A. thazard*. The results showed that the energy values in three monthly canned fish were found highest. Especially the energy value in canned *A. thazard* found more than *T. tonggol*. Also, peroxide and acidic numbers in *T. tonggol* oil found highest ( $P < 0.05$ ). There is between two fresh fish species oil iodine numbers significantly difference ( $P < 0.05$ ). So that iodine number in fresh *A. thazard* fish oil found higher than *T. tonggol* oil. Peroxide and acidic numbers in three monthly canned *T. tonggol* oil found highest and lowest values were found in canned one monthly canned *A. thazard* ( $P < 0.05$ ). Iodine number in one monthly canned *T. tonggol* oil found highest, but lowest values were found in canned three-monthly canned *A. thazard* ( $P < 0.05$ ), so that the differences were significant. Also, there is not significantly differences between the oil samples refractive index in canned two fish species in time different periods ( $P < 0.05$ ).

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