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Effects of Different Processing Technologies on the Chemical Composition of Seafoods

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The aim of this study was to determine the effect of processing on the chemical composition of seafoods. Raw materials and processed seafoods (canned tuna, dried horse mackerel, smoked salmon, marinated anchovy, and brine-salted bonito) were obtained from different firms and analyzed. Dried and smoked seafoods contained lower amount of moisture but higher amounts of the other components than raw materials ($p<0.05$). Marinated anchovies and brine-salted bonitos also contained higher amounts of fat, carbohydrate and energy ($p<0.05$) than raw material. Except canning with water, all processing technologies decreased the moisture content but increased fat and energy values ($p<0.05$) of the fish. It is concluded that processed seafoods are rich in chemical components and very nutritive, but they are generally not suitable for low-calorie diets due to the high amounts of fat and energy value. Canned tuna with salted water may be advised for low-calorie diets.

Keywords: chemical composition, seafood processing, salting, marinating, smoking, canning, drying

Introduction

Seafoods are very important for a healthy diet and it is popular to consume these foods as raw, frozen, canned, smoked, marinated, salted, and dried all over the world. Processing presents consumer different tastes, and minimizes the waste of seafoods. It is also very important to increase shelf life of such a perishable food since it leads to decrease economic losses. Therefore; a great demand occurred to the seafood processing technology (Ünlüsayın, 1999).

Seafoods represent an excellent option as a major source of nutrients and nutritional factors affecting health, quality of life, general well-being and longevity. It is known that 98% of total mass of seafood flesh consist of water, protein and fat. However ratios of these components change due to the species of fish, and processing technology (Sikorski *et al.*, 1990). Changes of nutrient components in foods occurred due to the processing must be known since they are important for human health (Birkeland *et al.*, 2004).

The aim of this study was to determine the effect of processing on the chemical composition of seafoods. The most popular processed seafoods (canned tuna, smoked salmon, marinated anchovy, brine-salted bonito and dried horse mackerel) were analyzed before and after processing.

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Materials and Methods

Raw materials and canned, dried, marinated, and brine-salted samples obtained from 2 different firms and smoked products from 3 different firms in Istanbul, were subjected to analysis. The results were presented as mean values. With the exception of canned products; samples were transported to the laboratory in ice-boxes. Two different types of canned tuna (canned with vegetable oil / canned with salted water), and two types of marinated anchovy (packaged with vegetable oil / packaged with chili pepper added-vegetable oil) are popular in the market. Therefore, all of the products were analyzed. Moisture content was determined by drying sample at 105°C (Nuve FN500, Turkey) to constant weight. The difference of weight before and after drying was multiplied with 100 and divided to the initial weight of the sample (AOAC 1998a). For the estimation of crude protein, Velp UDK 140 distillation unit and DK6 Heating digester (Velp Scientifica, Italy) were used according to Kjeldahl method. Sample was heated with H_2SO_4 and a catalyst, and then treated with NaOH and boric acid. The amount of nitrogen was estimated after the titration with HCl. It was multiplied with coefficient 6.25 (AOAC 1998b). Fat was measured using Soxhelet system (AOAC 1998c). Crude ash was determined by burning samples at 550°C (Nuve MF100, Turkey) (AOAC 1998d). All analyses were performed in five repetitions. Carbohydrate proportion was calculated mathematically (% car-

bohydrate =100 – the total of other components) and energy value was calculated according to the method of Merrill and Watt, (1973). Data from the different measurements were subjected to t test and statistical differences were determined by the method of Renner (1970). The significance level was chosen as 0.05.

Results and Discussion

Canned tuna, dried horse mackerel, smoked salmon, marinated anchovy, and brine-salted bonito were analyzed before and after processing to determine the effect of processing on the chemical composition. The results of the samples obtained from different firms were presented in Table 1 as mean values.

Moisture, protein and fat values of tuna fish were estimated to be 70.9%, 23.8%, 2.6%, respectively. Similarly Sikorski *et al.* (1990) presented the main components of *Thunnus thynnus* as 67.7-72.6% moisture, 23.3-27.5% protein, and 1.2-8.0 % fat.

Souci *et al.* (2000) reported that the moisture, protein, fat and ash contents of tuna fish after heat-sterilization process as 52.5%, 23.8%, 20.9%, and 2.30%, respectively. These results are similar to our results (Table1). Moisture content of the canned tuna with vegetable oil (CVO) was significantly lower ($p<0.05$) than the raw material.

Energy and fat values of canned tuna with vegetable oil (CVO) were significantly higher ($p<0.05$) than the raw materials and canned samples with salted water (CSW) due to vegetable oil. It is known that, heat-sterilization process affects the food components (Naczk and Artyukhova, 1990), and fat content is different before and after canning procedure (Ackman and McLeod, 1988).

Dried horse mackerels are the other popular processed seafoods. Protein, fat, ash, carbohydrate and energy values of horse mackerels increased significantly ($p<0.05$) after the drying process. Conversely, moisture content decreased ($p<0.05$) as it expected.

The moisture, protein and fat amounts of raw salmon samples were determined as 72.1%, 17.6%, and 7.5%, respectively. Sikorski *et al.* (1990) reported moisture content as 74.0%, protein content as 19.4% and fat content as 5.3% for salmon. Espe *et al.* (2002) described that, structure of the raw material had an important effect on the chemical composition of smoked seafoods.

In this study moisture content of smoked salmons was 60.7%, protein content was 19.9%; fat content was 13.6 %

Table 1. Chemical composition of sea foods before and after processing.

		Moisture (%)	Protein (%)	Crude Fat (%)	Ash (%)	Carbohydrate (%)	Energy (Kcal/100g)
Tuna	**Raw**	70.9± 2.0	23.8± 1.3	2.6± 0.3	2.4± 1.1	0.3± 0.4	160.3± 6.6
	CVO	60.4± 1.8	23.2± 3.6	13.5± 5.2	2.0± 0.6	0.9± 0.8	262.8± 8.2
	CSW	77.8±1.0	17.9± 1.1	2.4± 0.1	1.4± 1.1	0.5± 0.5	125.9± 6.1
Horse Mackerel	**Raw**	67.5± 1.2	15.5± 0.7	15.7± 0.8	1.4± 0.2	0.1± 0.1	237.1± 2.3
	Dried	17.4± 6.5	35.6± 2.2	24.7± 9.7	19.4±3.1	2.9± 0.7	447.1± 8.3
Salmon	**Raw**	72.1± 4.6	17.6± 1.7	7.5± 2.1	2.0± 0.7	0.8± 0.8	173.8± 7.4
	Smoked	60.7± 2.9	19.9± 1.4	13.6± 1.5	4.4± 1.2	1.4± 0.8	247.1± 7.1
Anchovy	**Raw**	73.7± 1.1	17.4± 2.0	6.8± 1.6	1.9± 0.4	0.2± 0.3	163.7± 2.7
	MVO	53.7± 2.5	16.9± 0.7	25.9± 3.0	1.8± 0.1	1.7± 0.8	348.2± 7.0
	MCVO	54.8± 2.1	16.0± 0.7	24.2± 1.8	2.6± 0.3	2.4± 1.1	329.7± 6.9
Bonito	**Raw**	51.4± 2.8	16.8± 0.8	28.9± 1.4	2.2± 0.2	0.7± 0.9	372.2± 8.9
	Brine-Salted	49.4± 0.6	15.7± 1.2	29.9± 1.8	3.8± 1.5	1.2± 0.6	377.4± 8.7

CVO= Canned tuna with vegetable oil

CSW= Canned tuna with salted water

MVO= marinated anchovy with vegetable oil

MCVO= marinated anchovy with chili-pepper added vegetable oil

and ash content was 4.4%. Carbohydrate and energy values were 1.4 % and 247.1 Kcal/100g, respectively, showing that moisture content decreased while the other components and energy value increased ($p<0.05$) after smoking. Similar results were reported for to the smoking process of fish (González-Fandos *et al.*, 2005, İzci and Ertan, 2004); cephalopod species (Ünlüsayın, 2004); and crawfish (Ünlüsayın *et al.*, 2003).

Raw anchovies contain 73.7% moisture, 17.4% protein, 6.8% fat and 1.9% ash similar to Souci et al. (2000). After marinating process, fat contents and energy values of marinated samples were higher ($p<0.05$) than the fresh anchovies due to the vegetable oil which was added into the packages as sauce. Ash and carbohydrate contents of the marinated anchovies with chili pepper-added vegetable oil (MCVO) were higher ($p<0.05$) than the samples packaged with vegetable oil (MVO) due to the dry matter (pepper) content.

The moisture, protein, fat, ash, carbohydrate and energy values of raw bonito were determined as 51.4%, 16.8%, 28.9%, 2.2%, 0.7%, and 372.2 Kcal/g, respectively. Moisture content decreased after brine-salting process. Processing of fish with salt separates water from the tissues (Karl and Schreiber, 1990). Ash content increased ($p<0.05$) due to the salt used in brine-salting process. Crude fat and energy values were also higher in brine- salted products than raw material.

Conclusions

All samples contained protein higher than 15% and processing methods, except canning with salted water, decreased the moisture content but increased the fat and energy values of fish. Therefore, processed seafoods might be very nutritive, but not suitable for low-calorie diets due to the high amounts of fat and energy. Canned tuna with salted water may be advised for low-calorie diets.

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