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Studies on the effects of processing on food quantity of two selected consumed marine fishes in Iran

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Abstract

Two commonly available species of marine fishes in Iran, *Euthynnus affinis* and *Orcynopsis unicolor* fishes were subjected to canning and their effects on the fishes were observed. The canning processing reduced the protein content for Orcynopsis unicolor the fish type but increased the protein content for *Euthynnus affinis* but made fish less susceptible to spoilage. Fresh and four monthly canned *E. affinis* fish had 22% and 23.9% protein content respectively, while *O. unicolor* had 19.8% and 21%, after four and six months of storage in the can respectively. The results also showed that *Orcynopsis unicolor* had the highest oil content (28.3%) followed by *Euthynnus affinis* (21.4%) which has the lowest oil content due to the processing method. This work also shows that the effect of the treatment on a fish sample is dependent on the fish species. It is concluded that *Euthynnus affinis* nutritional value after four months of storage with highest energy value (293.4 kcal/100 g).

Introduction

Processing is a method applied to the fish from the time of harvest to the consumption period. Processing of fish into forms edible suitable to be used as a supplement in animal food has been neglected in fish culture practices. This may be due to the high technology required in the heat processes and the fact that those involved in actual fish production are ignorant of the different processing methods. The every fish processor must to employ the best method possible in handing fish to maximize returns on processing investment for prevent fish storage and deterioration (Davies, 2005).

The both harmful enzymes and bacteria should be permanently inactivated by heat, in during the canning process, so heat-processed fish keeps for a very long time. However, several unsuitable effects have been occurred during canning such as loss of essential nutrients, formation of undesirable compounds, browning development and lipid and protein damage that can strongly influence the shelf life of canned fish products (Aubourg, 2001; Lukoshkina and Odoeva, 2003).

Fishes are a rich source of valuable protein commonly consumed as an alternative and important source of protein due to the higher cost of other sources of animal protein. Fish has lower cholesterol content when compared with meat Eriksson (1987) and thus often recommended for general consumption especially among the adult population. The marine fish is generally cheaper and more abundant when compared with fresh water fishes, which are relatively more expensive in Iran. The major constituents of fish are moisture, protein and fat with minerals and vitamins occurring in trace amount Pearson and Cox (1976). All fish usually contains very little carbohydrate, while the moisture content is very high. In most fish species the moisture content is between 60 – 80%, protein between 15 – 26% and 2 – 13% for fat. The fat content of fishes varies with species, age, size and also season. Since fish is not normally consumed raw, various processing methods are employed in preparing them for consumption and some of these processes include boiling, frying, roasting, which could have varying effects on their nutrient contents, texture and flavor Holland *et al.* (1993). Previous workers had reported the effects of processing different methods on some fish types. For example, Greenfield and Kosulwat said the type of food and cooking procedures influence the fat and protein contents and other nutrients Greenfield and Kosulwat (1991). The fat content of raw fishes can also influence fat exchanges and interactions between the culinary fat and that of the fish during processing Harris (1997). Data on the macronutrient content of fish is only available for raw fish and there seems to be a scarcity of information on the processed ones Sanchez-Muniz *et al.* (1992). The need to look at the effect of processing on the nutrient composition of fish is therefore high.

Preservation and processing methods such as canning and freezing are technologies that are hardly used in the artisanal sub-sector, basically due

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to cost and non-availability of equipment and cold storage system (Eyabi-Eyabi, 1998). The methods commonly used are the techniques such as salting/ brining, sun-drying and smoking, which also increase fish availability to the consumers (Abolagba *et al*., 1996). Sink (1979) observed that smoke-drying other than lowering the pH of food, the amount of amino-nitrogen lysine and free sulphudryl groups may also be lowered. The heat and dryness associated with hot smoking reduces the water activity of the seafood thereby limiting microorganisms, a prerequisite for spoilage (Abolagba and Osifo, 2004).

This work is thus a preliminary investigation of the effect of common heating processing on the macronutrient content of some marine fishes that are commonly consumed in Iran as the major source of animal protein.

Materials and Methods

Materials and preparation of sample

The fish types used in this study were *Euthynnus affinis* and *Orcynopsis unicolor* in south Iran. These fishes were chosen because they are readily available, cheap, affordable and within the reach of an average Iran. The fishes were purchased from two popular markets (Behbahan) in Iran. They were thoroughly washed, cut into about 75 g-pieces and washed again with tap and distilled water. The 2 categories of fishes, fresh and canned were analyzed for fat, ash, moisture and protein content as described by (AOAC, 2000).

Analytical methods

In this study we analyzed the concentration of the different nutritional components in raw and canned muscle. The results are expressed in g per 100 g wet weight of raw, canned muscle, respectively. Moisture, ash, protein and lipid contents were determined in each specimen's tissue according to (AOAC, 2000). Briefly, the moisture content was obtained by drying the sample overnight at 105ºC, ash was quantified after combustion for 16 h at 550ºC, crude protein content was determined by the Kjeldahl method using a conversion factor of 6.25 (AOAC, 2000), and total lipid was determined with the Soxhlet extraction method using ethyl ether (AOAC, 2000). The energy value, expressed as kcal/100 g edible part, was estimated using factors: 9.02 and 4.27 kcal/g for fat and protein, respectively (FAO, 2003).

Statistically analysis

Analysis of variance was used to evaluate the analysis data and significant differences among means were determined by independent samples-T Test (P = 0.05). Statistical calculation was performed with SPSS 15.0 for windows.

Results and Discussion

The average values of the four main constituents of moisture, fat, protein and ash in *Euthynnus affinis* and *Orcynopsis unicolor* are shown in Figures 1-3 and Tables 1-2. The moisture content (% wet weight) was lower in *Orcynopsis unicolor* (49.6%) than in Euthynnus affinis (51%) after 4 months of storage in the can (Table 1). The crude protein content (% wet weight) was lower in *Orcynopsis unicolor* (19.8%) than in *Euthynnus affinis* (23.9%) after 4 months of storage in the can (Table 1), and the ash between 1.65% and 3.27% (Figures 1 and 3). As can be seen, the total lipid content was always higher in *Euthynnus affinis* (21.4%) than in *Orcynopsis unicolor* (18.4%) (Table 1). The pH levels was 5 in fresh *Euthynnus affinis*, but was higher in canned *Euthynnus affinis* and *Orcynopsis unicolor* fishes (5.5) (Tables 1 and 2). The energy values (% wet weight) was lower in *Orcynopsis unicolor* (281.6kcal/100g) than in *Euthynnus affinis* (293.4 kcal/100 g) (Table 1) after 4 months of storage in the can. Results are expressed as mean of triplicate trials. Data were analyzed by one way analysis of variance.

Canned fish samples have the least moisture content (Figure 2) and this is because the water in the fish forms aqueous/oil mixture during processing and the water is extracted before the processing is completed since the boiling point of the oil is more than that of water hence the reduction in the moisture content. The moisture content of the fresh fish type was more. The reactions of water/oil with food items particularly at high temperature as obtained during processing have been shown to affect important nutrients in the food item as well as causing alteration of the structure of the oil and denaturing of the food nutrients (Eriksson, 1987; Greenfield and Kosulwat, 1991; Kubow, 1992), hence the significant difference recorded in moisture content after the different processing method.

Since fishes are consumed as a major and valuable protein source in food, it is very important that the protein content should not be compromised during table preparation. It is significant to note therefore that all the different processing methods reduced the crude protein contents but the reduction did not follow a particular order or fish type. Canned *E. affinis* after six months of storage had the highest crude protein content (23.9%) while fresh *E. affinis* had the least (22%) (Figure 3 and Table 1). Comparison of proximate composition between fresh and canned

Table 1. Proximate and physicochemical analysis of canned [a]*Orcynopsis unicolor* and [b]*Euthynnus affinis* fishes after four months of storage

Storage time (Months)	Fat (%)	Protein(%)	Ash(%)	Moisture(%)	pH	Carbohydrate(%)	Energy value Kcal/100 g
Four	[a]18.4±1.21	[a] 19.8±1.45	[a] 3 ±0.45	[a] 49.6 ±2.34	5.5	[a] 9.2 ±1.68	[a] 281.6±2.69
Four	[b] 21.4±1.68	[b] 23.9±1.95	[b] 2.40±0.78	[b] 51±2.41	5.5	[b] 1.3±1.46	[b] 293.4±2.86

Results are means ± standard deviation of triplicates.

Table 2. Proximate and physicochemical analysis of canned [a]*Orcynopsis unicolor* and [b]*Euthynnus affinis* fishes after four months of storage

Storage time (Months)	Fat (%)	Protein (%)	Ash (%)	Moisture (%)	pH	Carbohydrate (%)	Energy value Kcal/100 g
Two	[a] 17± 1.05	[a] 22.8 ± 1.23	[a] 3±1.65	[a] 50.8 ±0.67	5.5	[a] 6.4±0.45	[a] 269.8±2.12
Two	[b] 24.5±1.12	[b] 18.4 ±1.44	[b] 2.04±1.69	[b] 52.5±1.98	5.5	[b] 2.56±1.34	[b] 273.84±2.34

Results are means ± standard deviation of triplicates.

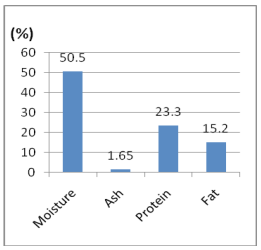

Figure 1. Nutrient contents of canned *Euthynnus affinis* after one month of storage

Results are means ± standard deviation of triplicates.

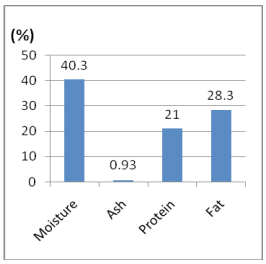

Figure 2. Nutrient contents of canned *Orcynopsis unicolor* after six months of storage

Results are means ± standard deviation of triplicates.

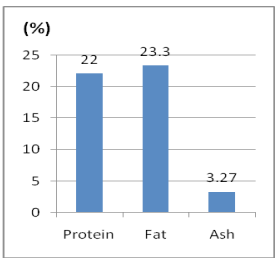

Figure 3.Nutrient contents of fresh *Euthynnus affinis*

Results are means ± standard deviation of triplicates.

fishes showed fat content has been increased and amounts of protein, ash and carbohydrate has been decreased and overally energy value will be increased after three months of storage. Fat and moisture content for anyone species depending on season and location of catch, size, spawning cycles, nutrition, etc., and variability can be expected in the data. Moisture content may also on canned samples depending on drip loss during storage, thus affecting the subsequent moisture determination. This loss in moisture content is reflected as a gain in the other constituents of the proximate composition.

Recent studies suggest that eating fish oil daily reduces the risk of cardiovascular disease death. The most efficient way to add these important oils to your diet is to eat two to three meals per week of fish rich in this omega-3 fatty acid prepared without additional oil. The British Nutrition Foundation has recommended that for a balanced and healthy diet, we should all consume 0.2 g of EPA+DHA daily or 1.5 g on a weekly basis. Fat content in canned *Orcynopsis unicolor* after six months of storage was highest (28.3%) therefore it is recommended for consumption.

Processing is a method applied to the fish from the time of harvest to the consumption period. Processing of fish into forms for human consumption or suitable to be used as a supplement in animal food has been neglected in fish culture practices. This may be due to the high technology required in some of the processes and the fact that those involved in actual fish production are ignorant of the various processing methods. In other to prevent fish spoilage and deterioration, every fish processor must to employ the best method possible in handing fish to maximize returns on processing investment.

Conclusion

The results of the processing methods examined for preparation of fish for human consumption showed that canning is the best when preservation of the fish is of priority but when nutrient conservation is the focus, boiling is a better option. Therefore, it was concluded that *Euthynnus affinis* nutritional value after four months of storage with highest energy value (293.4 kcal/100 g).

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