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Microbial and Chemical Quality of Vacuum-Packed Frozen Fillets of Narrow-Barred Spanish Mackerel (*Scomberomorus commerson*) and Silver Pomfret (*Pampus argenteus*) Marketed in Iran

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Abstract: During storage and transportation of the vacuum-packed frozen fish fillets, temperature conditions may be less than ideal and temperature abuses may occur. This condition can lead to a decrease in microbial and chemical quality of the products. In the present study, microbial and chemical quality of vacuum packed frozen fillets of Narrow-barred Spanish mackerel (*Scomberomorus commerson*) and Silver pomfret (*Pampus argenteus*) marketed in Iran were investigated. Total mesophilic and total anaerobic counts were in the range of 2.48-5.86 and 0-3.85 log cfu/g for Silver pomfret and in the range of 3.30-5.99 and 0-3.89 log cfu/g for Narrow-barred Spanish mackerel, respectively. The mean values for total psychrotrophic counts were 2.88±0.55 and 3.19±0.61 log cfu/g for Silver pomfret and Narrow-barred Spanish mackerel, respectively. The TBA value, as an indicator of degree of lipid oxidation, was in the range of 0-1.25 and 0-1.20 mg/kg for Silver pomfret and Narrow-barred Spanish mackerel, respectively. The mean values for TVB-N and TMA-N were 24.15±5.46 and 2.99±1.67 mg/100 g for Silver pomfret and 26.48±6.61 and 3.06±1.85 mg/100 g for Narrow-barred Spanish mackerel, respectively.

Key words: Fish freezing · Quality · Silver pomfret · Spanish mackerel · Vacuum packaging.

INTRODUCTION

Fishes are perishable and, as a result of a complex series of physical, chemical and bacteriological changes occurring in muscle, easily spoil after harvesting. These interrelated processes are usually accompanied by the gradual loss or development of different compounds that affect fish quality. The quality changes are highly affected by many factors, the most important of which is temperature. If fresh fish is not properly stored, exposure to ambient temperature can cause serious deterioration in quality. Commercially, chilling or icing continues to play a major role in slowing down bacterial and enzymatic degradation of fish muscle. However, this process is not designed to eliminate totally the changes in quality, since it only offers protection for 2–3 weeks, depending on the species [1-3].

Freezing of seafood is an excellent method of preservation with wide applications. Freezing inhibits the activity of food spoilage organisms and the low storage temperature greatly slows down the enzymatic and biochemical reactions that normally occur in unfrozen foods. Freezing accomplishes these objectives in two ways; by lowering the temperature of the food and by the removal of water by converting it into ice. Therefore, freezing is an excellent process for keeping the original quality of foods, such as fish, for long periods of time. In addition, freezing and subsequent frozen storage are particularly useful in making seasonal species of fish, like herring and mackerel, available all year round. Ideally, there should be no distinguishable differences between fresh fish and frozen fish after thawing. If kept under appropriate conditions, fish in the frozen state can be stored for several months or more without appreciable changes in quality. However, it is now well recognized that deteriorative changes take place in fish and seafood during freezing, frozen storage and thawing, which influence the quality of final products [2].

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Vacuum packaging is a method of storing food in an airless environment, usually in an air-tight pack or bottle to prevent the growth of microorganisms. The vacuum environment removes atmospheric oxygen, protecting the food from spoiling by limiting the growth of aerobic bacteria or fungi and preventing the evaporation of volatile components. Vacuum packaging is commonly used for long-term storage of fresh, dried and frozen foods. Frozen fish fillets could also be vacuum packed and distributed globally in the frozen state independent of season and distance from the fishing grounds. The quality of these products depends mainly on the processing and temperature conditions during storage, distribution and marketing [3].

In recent years, due to the high consumer acceptability, two species of fish are usually vacuum packaged and marketed in Iran during the whole year; Narrow-barred Spanish mackerel (*Scomberomorus commerson*) and Silver pomfret (*Pampus argenteus*). During storage and transportation of the vacuum-packed frozen fish fillets, temperature conditions may be less than ideal and temperature abuses may occur. This condition can lead to a decrease in microbial and chemical quality of the products. To the best of our knowledge, there is no information on the microbial and chemical quality of these products. Therefore, the present study was carried out to generate information on the microbial and chemical quality of vacuum packed frozen fillets of Narrow-barred Spanish mackerel and Silver pomfret marketed in Iran.

MATERIALS AND METHODS

Sampling: During the year 2010, a total of sixty samples of vacuum packed frozen fillets of Narrow-barred Spanish mackerel and Silver pomfret were purchased from popular supermarkets and transported to the laboratory in containers with ice bags for microbial and chemical analysis.

Microbial Analysis: A 10 g portion of the samples were aseptically transferred into sterile stomacher bag and homogenized in 90 ml sterile saline (0.85% NaCl) for 60 sec in a stomacher (Bagmixer 400W, Interscience, St. Nom, France). Tenfold serial dilution of fish homogenates were used for enumeration of bacteria. Total mesophilic and total psychrotrophic bacteria were enumerated using nutrient agar, incubated at 35 °C for 24 h and at 7 °C for 10 days, respectively. For total anaerobic count, nutrient agar plates were incubated anaerobically at 30 °C for 2 days. The results were expressed as Log_{10} cfu/g of the samples [4].

Chemical Analysis: The Thiobarbituric acid (TBA) assay was carried out using a spectrophotometric method [5]. Fish sample (5 g) was mixed with 100 ml of 10% trichloroacetic acid (w/v) and homogenized in a blender for 30 sec. After filtration, 2 ml of the filtrate were added to 2 ml of 0.02 M aqueous TBA in a test tube. The test tubes were incubated at 100°C for 1 h; then the absorbance was measured at 532 nm by using UV–vis spectrophotometer. TBA value was expressed as mg malonaldehyde (MA) per kg of fish sample. Trimethylamine-nitrogen (TMA-N) values were obtained by the picrate method [6]. This involves the preparation of a 7.5% (w/v) trichloroacetic acid extract of fish muscle. Results were expressed as mg TMA-N/kg muscle. The total volatile basic nitrogen (TVB-N) was determined through direct distillation into boric acid using a Kjeldahl-type distillatory [7]. The acid was titrated with 0.1 N H_2SO_4 solution.

RESULTS AND DISCUSSION

Microbial properties of vacuum packed frozen fillets of Silver pomfret and Narrow-barred Spanish mackerel are presented in tables (1 and 2). As shown, total mesophilic and total anaerobic counts were in the range of 2.48-5.86 and 0-3.85 log cfu/g for Silver pomfret and in the range of 3.30-5.99 and 0-3.89 log cfu/g for Narrow-barred Spanish mackerel, respectively. No statistical difference in total mesophilic and total anaerobic counts were observed between these two species. However, there was statistically significant difference ($p<0.05$) in total psychrotrophic counts between Silver pomfret and Narrow-barred Spanish mackerel, where the mean values for total psychrotrophic counts were 2.88±0.55 and 3.19±0.61 log cfu/g for Silver pomfret and Narrow-barred Spanish mackerel, respectively. Seafood products are susceptible to attack by microorganisms and they are always contaminated by a variety of such organisms present in the food production chain. They are subjected to further contamination during preparation for freezing as a result of contact with the hands of factory staff during preparation, packaging, transport and with air or water. Lowering the temperature to below the freezing point inhibits the growth and activity of many but not all microorganisms.

Table 1: Microbial and chemical quality of vacuum packed frozen fillets of Silver pomfret

	Minimum	Maximum	Mean	SD	Median
Total mesophilic count (log cfu/g)	2.48	5.86	4.59	0.76	4.66
Total psychrotrophic count (log cfu/g)	2.00	3.91	2.88	0.55	2.99
Total anaerobic count (log cfu/g)	0.00	3.85	2.17	1.3	2.60
TVB-N (mg/100 g)	16.80	37.80	24.15	5.46	22.40
TMA-N (mg/100 g)	1.10	7.20	2.99	1.67	2.65
TBA (mg/kg)	0.00	1.25	0.37	0.33	0.29

Table 2: Microbial and chemical quality of vacuum packed frozen fillets of Narrow-barred Spanish mackerel

	Minimum	Maximum	Mean	SD	Median
Total mesophilic count (log cfu/g)	3.30	5.99	4.61	0.86	4.70
Total psychrotrophic count (log cfu/g)	2.14	4.99	3.19	0.61	3.16
Total anaerobic count (log cfu/g)	0.00	3.89	1.99	1.28	2.44
TVB-N (mg/100 g)	16.80	49.00	26.48	6.61	26.60
TMA-N (mg/100 g)	1.10	7.90	3.06	1.85	2.45
TBA (mg/kg)	0.00	1.20	0.43	0.30	0.40

Converting most of the water into ice with the concomitant increase in concentration of the dissolved substances reduces the water activity of the food to the point where no microorganisms can grow. While, the level of 10^6 cfu/g is usually considered the total viable count limit of acceptability [8], it seems that the microbial properties of vacuum packed frozen fillets of Narrow-barred Spanish mackerel and Silver pomfret marketed in Iran are practically acceptable.

Although biochemical reactions slow down at lower temperature, they will, unlike microbiological activities, progress even at low commercial freezer storage temperatures. The TVB-N is produced from degradation of proteins and non-protein nitrogenous compounds, mainly as a result of microbial activity. In the present study TVB-N values were in the range of 16.8-37.8 and 16.8-49.0 mg/100 g muscle for Silver pomfret and Narrow-barred Spanish mackerel, respectively. The level of TVB-N in freshly caught fish is generally between 5 and 20 mg N per 100 g muscle. However, the levels of 30-35 mg N per 100 g muscle are considered the limit of acceptability for ice-stored cold water fish [9-10]. Although, some samples in the present study contained higher level of TVB-N than the reported limit of acceptability, the overall means of TVB-N in both species were lower than this limit; 24.15±5.46 and 26.48±6.61 mg/100 g muscle for Silver pomfret and Narrow-barred Spanish mackerel, respectively.

The TBA index is widely used as an indicator of degree of lipid oxidation. Nishimoto *et al.* [11] reported 4 and 27 mg of malonaldehyde (MA)/kg muscle of mackerel, for good and low quality fish, respectively. In the present study, the TBA values (Tables 1 and 2) for Silver pomfret and Narrow-barred Spanish mackerel were found to be lower than that reported for mackerel [11], but higher than that reported for European eel (0.04-0.08 mg MA/kg muscle) [8]. Aubourg [12] reported that TBA values may not give actual rate of lipid oxidation since malonaldehyde can interact with other components of fish such as nucleosides, nucleic acid, proteins, amino acids of phospholipids and other aldehydes which are end products of lipid oxidation. This interaction can vary with fish species.

TMA-N is often used as an index in assessing the shelf-life and keeping quality of seafood products because rapidly accumulates in the muscle under refrigerated conditions. The TMA-N production in fish tissue during cold storage could be used as an indicator of bacterial activity and it is an accepted deterioration measure. The pungent odour of spoiled fish has been often related to TMA tissue levels, also with the number of spoiling organisms present in many fish species and the rejection limit is usually from 5 to 10 mg TMA-N/ 100 g muscle [13]. As shown in tables (1 and 2), the concentrations of TMA-N ranged from 1.1 to 7.2 mg/100 g in Silver pomfret and from 1.1 to 7.9 mg/100 g in Narrow-barred Spanish mackerel. All of these results are below the limit indicated by Sernapesca [14] of 15 mg TMA-N/100 g.

To the best of our knowledge, this is the first report on the microbial and chemical quality of vacuum packed frozen fish fillets marketed in Iran. Based on these results, the prevalent post catching and processing practices as well as temperature conditions during storage, distribution and marketing are considered adequate and are warranting good quality products.

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