Effect of vacuum-packing method on the shelf – life of *Capoeta umbla* sausages

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Abstract

The effect of vacuum packing on the shelf-life of sausages produced from *Capoeta umbla* were investigated during storage periods. For this purpose, microbial, chemical and sensory changes were analyzed throughout the storage time. The microbial flora of the sausages comprised mainly mesophilic bacteria, psychrotrophic bacteria, lactic acid bacteria, yeast and molds. *Escherichia coli*, *Staphylcoccus aureus* and coliforms were not detected in the sausage samples. Total volatile basic nitrogen (TVB-N) and thiobarbituric acid (TBA) increased gradually with storage time while the concentration of moisture was not affected during the storage period. Application of vacuum-packing at 4±1°C extended the shelf-life of sausage samples by approximately 30 days.

Keywords: Fish sausage, *Capoeta umbla,* vacuum packed, shelf-life

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Introduction

Fish meat is a wholesome food type because of including high–quality protein, essential vitamins and healthful polyunsaturated fatty acids. However, the high protein concentration can cause a risk in the decomposition processes. Shelf-life of highly perishable food products like fish is limited due to chemical effects of atmospheric oxygen and the aerobic microorganisms. Vacuum packing has become popular as a protection technique during refrigeration. Shelf life quality of aquatic food products can be improved by vacuum packing technique. Moreover, the microbial ecology of food basically depends on the environment, used equipment, food type, handling practices, processing, packaging and storage temperature (Parry, 1993; Krizek et al., 2004; Ozogul et al. 2004; Sachindra et al., 2005).

Relished meat products like sausage have become popular in the world recently. Shelf life quality of sausages has been considered an important property for consumers in the recent times. Microorganisms gain access in to sausage from meat, species and other ingredients, from environment, equipment and handlers during processing affect the microbiological status of the product. Comminuting also adds microbial contamination to sausages. However, processing conditions like heat treatment reduce the microbial level in food, and recontamination takes place during post-processing, handling and storage of sausages. Fish sausages can be produced by using similar methods and process of meat sausages. Aquatic food industry has been developing by processing and minced fish products. Different attempts have been made to produce new food products from various minced fish such as production of fish ball from croaker, fish cake, fish sausage, fish chips (Korkeala et al., 1989; Sachindra et al., 2005; Dincer and Cakli, 2010).

Information on shelf-life quality of fish sausage is very limited. The main purpose of the present study was to determine the effect of vacuum packing on microbial, chemical and sensory profiles and shelf life of fish (*Capoeta umbla* Heckel, 1843) sausage during storage period. By this way, increase of both low commercial importance of *Capoeta umbla* because of including plenty of inters muscular bones and the number of alternative products for consumers was aimed.

Materials and methods

The compositions (%) of sausage were minced fish meat (66.0), soybean flour (2.54), potato starch (2.54), red paper (0.11), black paper (0.20), pimento (0.05), coriander (0.13), ginger (0.05), sugar (0.15), salt (2.0), sodium nitrite (0.01), ascorbic acid (0.02), sodium polyphosphate (0.20), ice (18.0) and fat (50% sun flower+50% beef fat) (8.0). The minced fish meat was mixed with all other ingredients in a bowl cutter to obtain sausage batter. The batter was then stuffed into natural casings (from sheep) with diameter 1.5 cm, by using manual filler. The stuffed sausages were linked to a length of 10 cm each and smoked (at 75±3°C convection

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oven with 71±3°C internal temperature held) for 30 minute and cooked (in 85±3°C convection boiler with 75±3°C internal temperature held) for 10 minutes. And finally, cooked sausages were immediately cooled in the cold water (1:1, 6-7°C).

Non-vacuum packaging: The sausage samples were placed in polyethylene bags. Their wrapping was careful, but purposely not airtight, simulating normal conditions in households, preventing samples mainly from desiccation.

Vacuum-packaging: samples were wrapped in high barrier nylon polyethylene bags and vacuum-packed in a vacuum packaging machine (Henkelman, Boxer 42).

The fish sausage samples were divided in 100 g portions in bags air and vacumm. After packing, samples were immediately stored at 4±1°C. Sausage samples from air and vacuum packaging were drawn on the 0, 3, 5, 7, 10, 14, 21, 28, 42 and 56th day of storage evaluated.

The samples were analysed for microbial profile using standard procedures (APHA, 1992; Halkman, 2005) for total mesophilic count (30°C, 3 days) and psychrotrophic count (7°C, 10 days) on plate count agar, yeast and molds on potato dextrose agar (21°C, 5 days) *Staphylcoccus aureus* on Baird packer agar (37°C, 2 days), coliforms by MPN method in brilliant green bile broth (37°C, 2 days), *Escherichia coli* on chromocult TBX agar (30°C 4 hour after 44°C, 1 day) and lactic acid bacteria on MRS agar (37°C, 2 days). Microbiological data was transformed into logarithms of the number of colony-forming units.

pH and moisture content were measured by using standard methods, following AOAC (1990). TBA was determined by a selective third-order derivative spectrophotometric method (Tarladgis et al., 1960). TBA content was expressed as mg of malondialdehyde (MDA)/kg for sausage samples. Determination of total volatile basic nitrogen (TVB-N) was based on the method of Varlik et al. (1993).

Seven experienced panelists from Firat University, who were familiar with the sensory assessment of seafood products, evaluated the sensory quality. Sensory analysis was performed using the methods of Kurtcan and Gonul (1987). Panelists were asked to evaluate sample taste, odour, colour, apperance and texture on a 5 point hedonic scale ranging from very poor (1) to very good (5). The overall acceptability calculated was made up of: texture 40% and taste, odour, colour and apperance each with 15% (Dondero et al., 2004).

The significant effects of vacuum packed and storage time on the quality of fish sausage, as measured by the microbiological, chemical and sensory evaluations, were determined by the ANOVA method using SAS program (SAS,1999) at $p<.05$.

Results

The changes in microflora of fish sausage during storage under vacuum and air conditions at 4±1°C are given in Figure 1. Total Plate Counts (TPC) (log cfu / g) increased from an initial level of 2.61±0.3 to

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6.86±0.5 during 0-14 days period in air; to sausage packed in vacuum. Depending on time, this increase were statistically significant for under air condition packed after 7th day and for vacuum packed after 21st day ($p<.05$). Psychrotrophic counts increased from 2.44±0.23 log cfu/g to 7.56±0.54 log cfu/g between 0 and 14th days in air samples during storage; to 7.42±0.25 log cfu/g and 56th days in vacuum packed samples. Lactic acid bacteria (LAB) counts increased from 0.9±0.2 log cfu/g on day 0 to 2.8±0.21 log cfu/g on day 14 in air conditions samples; to 6.58±0.2 during 0-56 days period in fish 3.38±0.17 log cfu/g on day 56 in vacuum packed samples. Coliforms and *Staphylcoccus aureus* from non-detectable level at storage periods. *Escherichia coli* were not determined in both air and vacuuum conditions sausage samples. Yeast and molds, the counts increased from initial level of 1.24±0,16 log cfu/g on day 0 to 2.22±0.2 log cfu/g on 14th day in air conditions samples; to 2.56 log cfu/g on 56th day in vacuum packed samples.

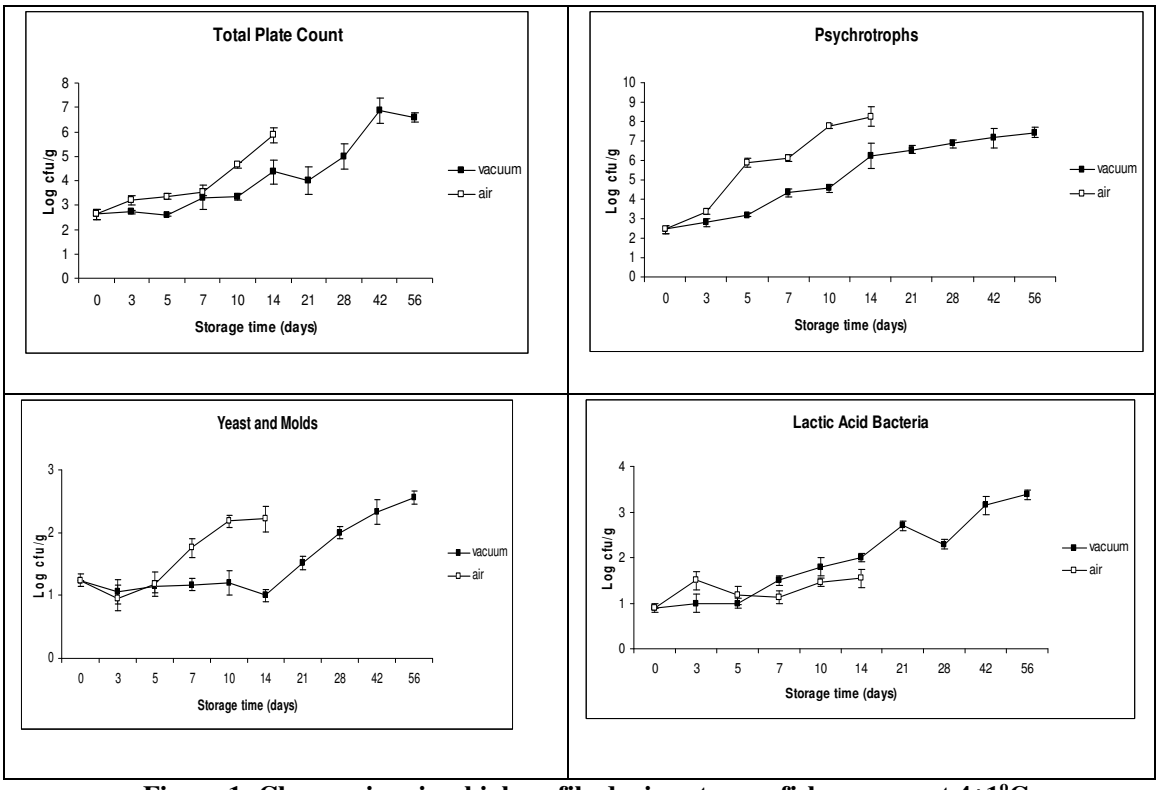

Figure 1: Changes in microbial profile during storage fish sausage at 4±1°C

The change in TVB-N, TBA, pH and moisture of fish sausage during storage under vacuum and air conditions at 4±1°C are given in Figure 2. At the beginning of the storage, the TVB-N value was 15.36±0.96 mg / 100g for fish sausages. The TVB-N increased up to 30.52±1.52 mg / 100g for sausage in air, 34.67±1.54 mg / 100g for sausage in vacuum

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packed on the last day of sensory acceptability for each storage condition. The statistical analysis of the TVB-N data showed that significant differences (p□$.05$) were found between fish sausage stored in air and vacuum packed, particularly after 7 days of storage. The TBA increased from 0.76±0.07 on day 0 to 2.29±0.23 on 14th day for air conditions samples; to 2.67±0.51 on 56th day for vacuum packed samples. The pH value increased from 6.41±0.02 on day 0 to 5.90±0.15 on day 14 in air conditions sausages; to 5.89±0.12 on day 56 in vacuum packed sausages. The moisture content was 65.53±1.2% on storage day 0 in fish sausage. The moisture content differences for both vacuum packed sausages and air condition packed sausages were not statistically significant (p>$.05$).

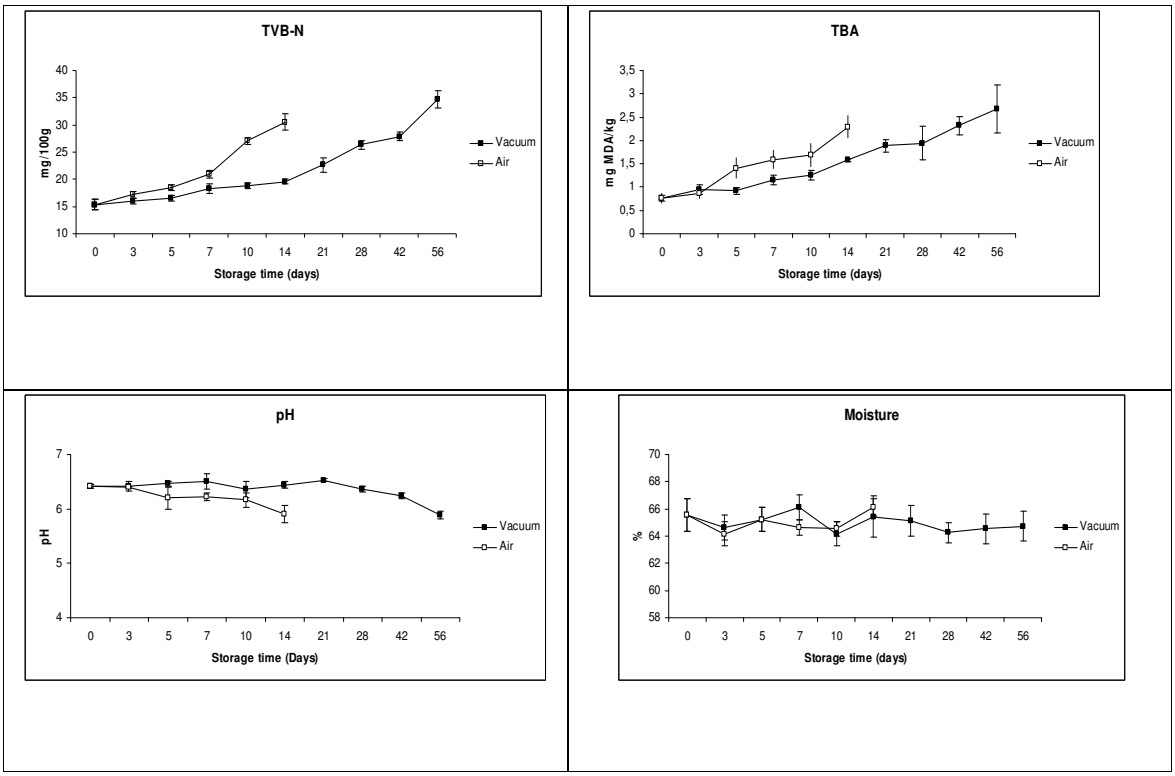

Figure 2: Changes in chemical profile during storage fish sausage at 4±1°C

Results of the sensory analyses of fish sausages are shown in Figure 3. Shelf life values were 14 and 56 days for samples stored at air and vacuum respectively. After 3rd day of the storage, decrease of shelf life of sausage samples and the difference of shelf life between vacuum packed sausages and air condition packed sausages were statistically significant (p<$.05$).

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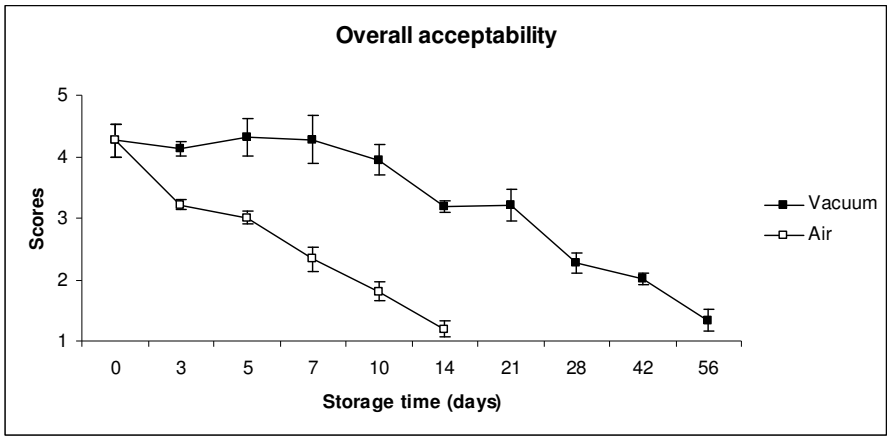

Figure 3:Changes in sensory analysis during storage fish sausage at 4±1°C

Discussion

Sachindra et al. (2005) reported that for sausage samples TPC value initially was 4.09 and this value exceeded the eatable limit on 16th day for under air condition packed sausages and on 32nd day for vacuum packed samples. 10^6 numbers / g was reported the acceptable limit of TPC bacteria for sausages (Adams et al., 1987; Goktan, 1990; Sekin and Karagozoglu, 2004). In the present study, the acceptable TPC limit was exceeded in air conditions on 14th and vacuum conditions on 56th day. Psychrotrophic counts increased both in air samples and in vacuum packed samples during storage. There is no any limit for numbers of psychrotrophic counts (Baumgart, 1990). It was observed that psychrotrophic count (log cfu / g) was 0.5 on day 0, 3.4 on 48th day in vacuum packed frankfurter sausage stored at 4°C (Blickstad and Molin, 1983). These differences can be due to the meat source differences. Korkeala et al. (1989) stated that LAB bacteria are dominant in the spoilage flora of emulsion sausages packed in vacuum. Acceptable limit of LAB bacteria are 10^6 in sausages (Baumgart, 1990). During the conservation period, number of LAB did not exceed the limit value for our study. Sachindra et al. (2005) informed the LAB values were 5.2 log cfu/g on 32nd day for under air condition packed sausages and 1.00 log cfu/g on 16th day for vacuum packed sausages. In a study on vacuum packed cooked sausage had 43 days shelf -life of during storage (Korkeala et al., 1987). We obtained similar results in our study. Coliforms and *Staphylcoccus aureus* from non-detectable level at storage periods. *Escherichia coli* were not determined in both air and vacuuum conditions sausage samples. These results demonstrate that cooking and smoking process were effective in the microbial counts in the fish sausage. Similar results can be seen in different studies (Simard et al., 1983; Sachindra et al., 2005). Yeast and molds, the counts increased from 14th day in air conditions samples, on 56th day in vacuum packed samples. Vacuum packing has shown

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substantially inhibitory effects on the growth of yeast and mold during storage (Sachindra et al., 2005).

According to Huss (1995) acceptable TVB-N level is 35-40 mg N / 100g. In the present study, it was understood that the TVB-N value for air condition packed sausages was close to acceptable limit on 14th day and for vacuum packed sausages it was close to acceptable limit on 56th day. Effects of vacuum packing on increasing of TVB-N value were reported (Ozogul et al., 2004). The TBA test is widely used to measure lipid oxidation in food products (Yu et al., 2002). Acceptable limit value of TBA content is between 7-8 mg MDA/kg (Sinnuber and Yu, 1958). Although the value of TBA increased for air and vacuum packed sausages, it was lower than the limit value during the storage period. pH values of air and vacuum packed sausages showed increase and decrease during the storage. It was determined that there was no significant difference for pH during the study period ($p>.05$). Stamatis and Arkoudelos (2007) reported that pH values of vacuum packed *Scomber colias japonicus* had increases and decreases during for 15 days of storage time. The moisture content were not statistically significant ($p>.05$). It was presented that the moisture content can be changeable due to used additive agents and their amount, but it generally is between 62- 68 % (Raju et al., 2003; Rahman et al., 2007).

The spoilage patterns described by the panellist were softening of texture before off odours developed and presence bitter, sour, rancid flavours (Dondero et al., 2004). Shelf life values were 14 and 56 days for samples stored at air and vacuum respectively. Dinçer and Çaklı (2010) reported that the shelf life of fish sausages produced from rainbow truth meat was 14 days at between 0-4°C storage temperatures. Sachindra et al. (2005) stated that vacuum packed sausages produced from buffalo meat had a 32 days shelf life and air condition packed sausages had a 16 day shelf life and the differences of effect between vacuum packing and air condition packing on shelf life on sausages were statistically significant.

In the present study, meat of *Capoeta umbla* can be used as a source of sausage and shelf life differences of two different packing techniques at 4±1°C were investigated. According to the results of the present study air condition packed sausages are eatable for 4 days and vacuum packed sausages can be eatable for 56 days during storage period at 4±1°C. Also, microbiological, chemical and sensory quality criteria of fish sausages were determined in storage conditions. By this study, it was understood that economic importance of noncommercial fish species because of inters muscular bones and the number of alternative products for consumers can be increased.

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