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The Microbiological, Chemical and Sensory Features of Vacuumed-Packed Wels Catfish (*Silurus glanis* L.) Pastrami Stored Under Ambient Conditions (20°C)

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Abstract: This study was carried out to monitor sensory, chemical and microbiological changes of fish pastrami during storage at 20°C. Therefore, pastrami samples were prepared under hygienic conditions and vacuum packed then stored at 20°C. Sensory results of both raw and fried samples were quite sufficient. Vacuumed wells catfish (*Silirus glanis* L.) pastrami samples were analyzed for chemical, microbiological and sensory features on 0, 7, 14, 30, 45, 60 and 90th days of storage. The microbiological analysis of pastrami samples showed that the mean TVC was ranging between 4.40-6.30 log cfu g^{-1}. The mean numbers of *Lactobacilli*, *Staphylococci-Micrococci*, coliform and yeast and mold were ranging between 3.46-6.08, 4.07-6.21 log cfu g^{-1}, <10 and <10 cfu g^{-1}, respectively. The chemical analyses showed that the pastrami samples contained 26.07-35.66% moisture, 11.36-36.62% total fat, 25.36-41.18% protein, 9.66-12.96% ash and 8.23-11.67% salt. pH value of the samples were between 5.44 and 5.97. As a result, we conclude that high quality of fish pastrami can be produced by following good hygienic conditions along with utilization of high quality raw material and additives. Vacuumed samples of this kind of pastrami might be kept 90 days or more than this period at 20°C.

Key words: Pastrami, microbiology, fish, *Silurus glanis* L., vacuumed

INTRODUCTION

Pastrami (pastirma) is the most popular dry-cured meat product produced in Turkey, also consumed in various countries such as Greece, Armenia and Egypt. It is categorized as an intermediate moisture food (Leistner, 1988). Muscles are cleaned from tendon and fat, then cured, dried, pressed and coated with garlic, paprika, red pepper and water-containing paste (cemen) and again dried. The production process of pastrami approximately extends over a month-period (Anonymus, 2002; Gökalp *et al*., 1999; Aktas and Gürses, 2005). Pastrami production in Turkey has been developed during last decade, reached to industrial scale, as the developments seen in the food industry of Turkey in the same period and nowadays, the small family pastrami producing premises replacing with modern pastrami factories (Anil, 1998).

Pastrami has special taste and palatability opportunities. That is because of reduced water activity it has a quite long storage-life. The moisture content of the product is reduced by 50% during processing, which also increases the fat, vitamin and mineral contents of product by 80-90% (Dogruer, 1992). Due to its technology, the microflora of the product is dominated by lactic acid bacteria, which reduces the pH of the product. Therefore, in the final product, low pH and a_w value and the antimicrobial activity of coating material (cemen) the growth of pathogen bacteria is inhibited (Dogruer, 1992; Dinçer, 1988; Dogruer *et al*., 1995).

Cemen is a covering material mainly consists of the Fenugreek (*Trigonella foenum-graecum* L.) flour, blended red pepper, blended garlic and sufficient amount of water. According to Turkish standards Cemen is a curing and coating material with 50% Fenugreek (*Trigonella foenum-graecum* L.) flour 35% garlic and 15% red pepper (Tekinsen and Dogruer, 2000). Cemen has the ability of protecting product from insects and worms and also provides a special taste, aroma and colour of the product. The combination of meat and cemen also increase the appetite of consumer (Anonymus, 2002; Tekinsen and Dogruer, 2000).

Fish meat has greater protein quality, nutritional and biological values than the other meat species

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(Gögüs, 1988). That is because of low energy content of fish meat, it is suitable for being used by dietetics. Fish meat is also very rich in vitamins and minerals (Inal, 1992). While fish meat includes the majority of B vitamin complex (especially thiamin and riboflavin), due to its fat content (fish oil), is also considered to be a sufficient and balanced source for vitamins melting in the oil (Gögüs, 1988; Inal, 1992). However, fish meat has a very limited storage period, therefore, a fish meat product with long shelf-life might be very valuable for consumer and processors.

Although, there are lots of publications regarding to pastrami produced from large animal meat (Anar *et al*., 1992; Soyutemiz *et al*., 1992; Aksu *et al*., 2005; Dogruer, 1992; Arslan *et al*., 1999), very limited numbers of publications related with fish meat pastrami are available (Arslan *et al*., 1997a, b; Arslan and Kök, 2001; Kök and Arslan, 2003; Yapar, 1992).

Wells catfish (*Silurus glanis* L.) belongs to the genera of *Siluridae*. Wells catfish meat has a great taste and high protein value. It survives in the lakes and rivers of the Middle and Eastern Europe as well as Western Asia. Although, it is considered as a fish of fresh water, sometimes this fish can be seen in the bitter water of Black sea and Baltic Sea shore. Due to it is nature, as a very aggressive carnivore, it may utilize some feed sources that the other fish species cannot use (Çelikkale, 1988).

This study was carried out to monitor sensory, chemical and microbiological changes of fish pastrami during storage at 20°C. Vacuumed (*Silirus glanis* L.) pastrami were sampled at 0, 7, 14, 30, 45, 60 and 90th days of the storage and were analyzed for chemical, microbiological and sensory features.

MATERIALS AND METHODS

The experimental trials were carried out 3 times and a total of 3 cat fish (*Silurus glanis L.*) (weight between 28-51 kg), 1 for each trial, were used. The reasons why only 1 fish is used for each trial were, the fish was very large and the chemical, physical and microbiological properties of the samples were required to be similar.

Newly harvested fish were brought to the laboratory in ice and then weighted. The fish were skinned following washing fresh water, head removal and evisceration. The meat was filleted and the weights of filets were measured. Following weight measurements, fillets were washed and cut into pieces (approximately 250 g) with similar length and thickness. In addition, filet muscle samples were aseptically trimmed in order to be used for pH measurement and microbiological analysis. Pastrami samples were prepared according to TSE regulation (Anonymus, 1991, 2002) (Fig. 1), then vacuum packed and stored at 20°C. The microbiological, chemical and sensory analyses were carried out in order to provide sufficient data for quality parameters of pastrami. Analyses were carried out on 0, 7th, 14th, 30th, 45th and 90th days of storage life.

Microbiological analysis: A 10 g of sample was removed from each fish pastrami and put in into a sterile stomacher bag (Interscience, Baglight, 400 mL) including 90 mL of mL 0.1% peptone water (PW, Oxoid CM 0009) and homogenized in a Stomacher (Bagmixer, Interscience, France). Serial dilutions were carried out by using 1/4 ringer solution (Oxoid, BR 0049), then the dilutions were plated out on suitable media. Pour plating method was utilized for microbiological analysis (AOAC, 1990; APHA, 1992).

Plate count agar (PCA, Oxoid CM 325) plates were used to determine Total Viable Count (TVC) in samples. To be able to determine the numbers of *Staphylococci/Micrococci*, Coliforms, *Lactobacilli*, *Lactic streptococci* and yeast and moulds, Mannitol Salt Agar, (MSA; Oxoid CM 85), Violet red bile agar (VRBL; Difco B 12) M.R.S agar (Oxoid CM 56), M 17 agar (Oxoid CM 785) and Potato Dextrose Agar (PDA; Difco B 13) plates were used, respectively. The plates were incubated at 30±1°C for 3 days for PCA, 37±1°C for 2 days for MSA, 35±1 for VRBL for 3 days, for M 17 at 30±1°C for 2-3 days and for PDA at 22±1°C for 5 days. MRS agar plates were poured as double layered (AOAC, 1990; APHA, 1992).

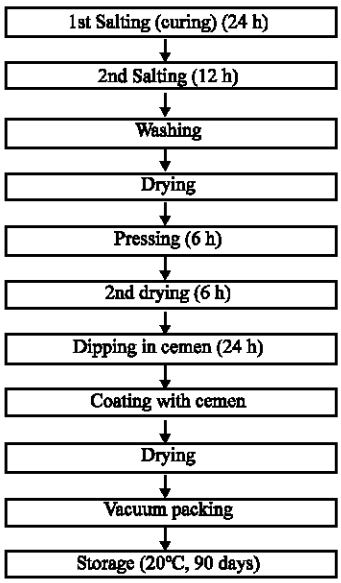

Fig. 1: Pastirma processing

Pour plate technique was used to enumerate appropriate colonies. The microbiological results were evaluated as colony forming unit in per gram (cfu g^{-1}).

Chemical analysis: Physico-chemical features of the fish pastrami, such as pH, moisture, ash, fat, protein and salt contents, were determined by AOAC (1990) methods.

Sensory analysis: The sensory analysis of fried and raw pastramis were carried out on 0, 7, 14, 30, 45 and 90th days of storage life by evaluating appearance, smell, taste, aroma and general acceptance. The samples both fried and raw were evaluated by 10 panelists from 1-5,

1 = Very bad
2 = Bad
3 = Normal
4 = Good
5 = Very good (Kurtcan and Gönül, 1987)

Samples from the same fillets were divided into 2 groups, such as to be consumed raw and fried. Then samples be consumed fried were fried in a pan including corn oil. Raw pastrami samples were consumed with out any treatment.

Calculating the yield of pastrami: The yield was calculated as muscle weight used/the weight of pastrami produced×100 (Yucel, 1993).

Statistical analysis: Duncan (1955) statistical analysis test was used to determine the differences between the samples taken at the sampling days based on the microbiological, sensory and chemical data (Kutsal *et al*., 1990).

RESULTS

Vacuumed wells catfish (*Silirus glanis* L.) pastrami samples were analyzed for chemical, microbiological and sensory features on 0, 7, 14, 30, 45, 60 and 90th days of storage.

Microbiological analysis: The microbiological analysis of pastrami samples showed that the mean TVC was ranging between 4.40 and 6.30 log cfu g^{-1} for each sampling day. The mean numbers of *Lactobacilli*, *Staphylococci-Micrococci*, coliform and yeast and mold were ranging between 3.46-6.08, 4.07-6.21 log cfu g^{-1}, <10 and <10 cfu g^{-1}, respectively (Table 1).

Chemical analysis: The chemical analyses showed that the pastrami samples contained 26.07-35.66% moisture, 11.36-36.62% total fat, 25.36-41.18% protein, 9.66-12.96% ash and 8.23-11.67% salt. pH value of the samples were between 5.44 and 5.97 (Table 2).

The mean pH, moisture, fat, protein, ash and salt values of pastrami samples were found to be variable. The mean pH of the samples was 5.72±0.056 at the beginning and then reduced to the levels of 5.44±0.026 at the end of the storage. Although, a decrease in the pH values was observed, it was not a linear reduction. Some sampling days (e.g., 14th day) there was a significant increase in the pH values. Similar trends with a significant reduction was observed in the moisture content ($p<0.01$) at the end but on 14th day again there was a significant increase in the moisture content of the samples. The fat contents of pastrami samples were quite variable. It increased dramatically on the 7th day of storage, but then reduced significantly on the 14th day of the storage then increased on the 30th day of the storage and remained relatively stable by the 60th day of storage. Then reduced to the levels of 17.34±1.19 on the 90th day of storage.

Sensory analysis: The sensory evaluation of fried pastrami showed that the mean sensory scores were generally, normal and good. However, there was an increase in the taste panel results at 90th day in compare to 45th day. Sensory results of both raw and fried samples were given at Table 3.

Calculating the yield of pastrami: A total of 38.65 kg pastrami was produced from 68.75 kg fillet obtained from 115 kg fish. The yield was determined as 56.18% (Yucel, 1993).

Table 1: The mean values (±SX) obtained from microbiological analysis of wells catfish

Days	Total viable count	Lactobacilli	*Micrococci/Staphylococci*	Coliform	Yeast and molds
0	6.30±1.25^{a}	6.08±1.17^{a}	6.21±1.51^{a}	<10	<10
7	5.37±0.38^{b}	5.0±0.590^{b}	5.48±0.30^{b}	<10	<10
14	4.58±0.52^{c}	3.95±0.46^{c}	4.62±0.25^{c}	<10	<10
30	4.52±0.26^{c}	4.14±0.46^{c}	4.50±0.14^{c}	<10	<10
45	4.50±0.14^{c}	3.98±0.64^{c}	4.44±0.10^{c}	<10	<10
60	4.49±0.11^{c}	3.46±0.52^{c}	4.40±0.31^{c}	<10	<10
90	4.40±0.05^{c}	3.52±0.36^{c}	4.07±0.06^{c}	<10	<10
Mean	4.88±0.83	4.30±1.06	4.82±0.90	-	-
p-value	***	***	***	-	-

$^{a-c}$Mean values within a column with no common superscript differ significantly ($p<0.05$); ***$p<0.001$

Table 2: The mean values (±SX) obtained from chemical analysis of wells cat fish

Days	pH	Moisture	Fat	Protein	Ash	Salt
0	5.72±0.056^{b}	35.66±0.51^{a}	11.36±1.18^{d}	39.60±0.68^{a}	12.96±0.60	11.67±0.46
7	5.91±0.006^{a}	26.69±0.64^{d}	31.26±3.75^{ab}	32.04±3.47^{b}	10.09±1.13	09.17±1.18
14	5.97±0.006^{a}	31.95±0.46^{b}	16.20±0.76^{cd}	39.96±1.02^{a}	11.70±0.43	10.35±0.42
30	5.77±0.008^{b}	28.51±0.34^{c}	31.84±1.92^{ab}	29.79±0.83^{bc}	09.71±1.03	08.23±0.96
45	5.59±0.019^{c}	27.58±0.31^{cd}	36.62±1.78^{a}	25.36±0.80^{c}	09.99±1.42	08.67±1.33
60	5.57±0.013^{c}	26.07±0.87^{d}	26.40±1.38^{b}	37.45±1.36^{a}	09.66±0.59	08.26±0.45
90	5.44±0.026^{d}	30.92±0.63^{b}	17.34±1.19^{c}	41.18±1.02^{a}	10.76±0.56	09.66±0.50
P	***	***	***	***	-	-

$^{a-d}$Mean values within a column with no common superscript differ significantly ($p<0.05$); (***$p<0.001$)

Table 3: The consumer acceptance for raw and fried pastrami

Pastrami	0 day	7th day	14th day	30th day	45th day	60th day	90th day	p-value
Raw	3.99±0.12^{bc}	4.00±0.16^{bc}	3.76±0.11^{e}	4.02±0.09^{abc}	3.98±0.13^{bc}	4.27±0.12^{ab}	4.36±0.07^{a}	*
Fried	3.57±0.12^{d}	3.78±0.13^{bcd}	3.63±0.11^{cd}	3.63±0.09^{cd}	3.91±0.11^{bc}	4.03±0.10^{ab}	4.30±0.07^{a}	***

$^{a-d}$Mean values within a column with no common superscript differ significantly ($p<0.05$); ***$p<0.001$, *$p<0.05$

DISCUSSION

Fish and its products take an important role in animal originated food due to their nutritional and biological values and protein quality. However, that is because of its structure and fatty acid types it can easily spoil. Therefore, any experimental work, which increases fish storage period and nutritional value could be accepted by the processor and consumer.

Although, there were quite a lot work carried out on pastrami produced from red meat animals, the number of studies on fish pastrami is very limited (Arslan *et al*., 1997a, b; Arslan and Kök, 2001; Kök and Arslan, 2003; Yapar, 1992).

In the research presented here TVC reduced from 6.30-4.40 log cfu g^{-1} under anaerobic conditions. There was a statistical significance between the TVC results obtained from the pastrami samples 0 and the other sampling days and between 7th day and the other sampling days of storage ($p<0.01$). But no statistical differences were observed between sampling days after 14th day of storage. This might be due to the adverse effects of anaerobic conditions created by packaging, fermentation and drying process occurring during storage period and the inhibitory effects of cemen.

The numbers of *staphylococci/micrococci* reduced consistently during storage period. The levels of *staphylococci/micrococci* reduced to 4.07 log cfu g^{-1}. There was a significant difference ($p<0.01$) in the numbers of *Staphylococci/micrococci* between day 0 and day 7. The significance between the sampling days for *staphylococci/micrococci* was similar with the significance observed in TVC. Some members of the Micrococcaceae family are utilized as starter cultures in meat products, such as *Staphylococcus carnosus*, *Staphylococcus xylosus*, *Micrococcus varians* (Hammes and Hertel, 1998; Hammes and Knauf, 1994; Jessen, 1995; Leucke, 2000). These microorganisms have proteolytic and lipolytic activity (Fadda *et al*., 2001; Geisen *et al*., 1992; Johansson *et al*., 1994). Although, we did not identify the *staphylococci/micrococci* types in the products, it could be considered that *staphylococci/micrococci* group bacteria observed in the microbiological examinations played an important role in chemical processes occurring during fermentation in pastirma processing. The predominance of *stapylococci* in dry sausages and pastrami could be explained by different oxygen demand of *micrococci* and *staphylococci*. Especially in pastrami during pressing and drying of the muscles, the low redox potential probably enhanced the inhibition of *micrococci* since *staphylococci* are facultative anaerobic (Kotzekidou, 1992). As a consequence the anaerobic environment provided by vacuum packaging might cause this reduction in the numbers of *staphylococci/micrococci*. Our results presented here were found to be slightly higher than those obtained by Arslan *et al*. (1997a) and Kök and Arslan (2003), which might be due to the different initial loads of species used in cemen and raw fish samples.

The numbers of *lactobacilli* in this study were variable during the storage period consistently. But its number reduced from 6.08-3.46 log cfu g^{-1} during 90 days of storage.

From the results, it could be stated that higher numbers of lactobacilli were available on the fish pastrami samples and this level reduced significantly ($p<0.01$) by the 14th day of storage. During the following storage period no statistical differences observed in the numbers of this bacteria.

Although, lactic acid bacteria used as starter cultures (*Lactobacillus plantarum*, *Lactobacillus sakei*, *Lactobacillus curvatus*, *Lactobacillus pentosus*) in meat production, they have weaker lipolytic and proteolytic activity than the Micrococcaceae (Johansson *et al*., 1994; Kreockel, 1995). Lactobacilli present in the natural floura of fish and cemen pastrami could act as starter cultures in processing stages, especially in drying and fermentation processes providing acidity, taste and flavour.

The numbers of coliforms during the storage period found to be >10 cfu g^{-1}, which was in agreement with the results of Arslan *et al*. (1997a, b) and Arslan and Kök (2001), who produced pastramis by using rainbow trout and *Barbus esocinus*. A study conducted by Yapar (1992) in rainbow trout showed that coliform bacteria were present in the pastrami samples in the 2 sampling days (day 0 and 5). This might be due to lower garlic concentration used in cemen formulation. Some researchers have indicated that garlic has a considerably high antibacterial activity (El-Khateib *et al*., 1987; Fernandez-Lopez *et al*., 2005, Salam *et al*., 2004).

The numbers of yeast and moulds were found to be >10 cfu g^{-1} during the storage period. Similar results were observed by Arslan and Kök (2001, 2003), on pastramis produced from sliced *Barbus esocinus* and *Barbus esocinus* pastramis hold in cemen for various treatment periods. The numbers of yeast and moulds and coliforms were found to be in agreement with Turkish Standards regulations (Anonymus, 2002).

The differences in the microbiological results of studies presented here might be due to the differences in cemen structure, holding time in cemen, the hygienic quality of ingredients used in cemen, production hygiene, the moisture contents of pastrami.

The chemical analyses showed that the pastrami samples contained 26.07-35.66% moisture, 11.36-36.62% total fat, 25.36-41.18% protein, 9.66-12.96% ash and 8.23-11.67% salt. pH value of the samples were between 5.44 and 5.97 (Table 2).

The protein contents of the samples were not consistent during the storage period. The differences in the protein level between the sampling days are given at Table 2.

The pH values of pastrami samples seemed to be fluctuant during storage and there were significant differences in the pH values between sampling days ($p<0.001$). El-Khateib *et al.* (1987) reported similar reduction in pH values during the storage and concluded that it was a result of the activities of *Lactic acid* bacteria. As the proteins spoiled, the pH values of the meat increase. Although, the pH values of the pastrami samples were fluctuant, no increase was observed. This situation indicates there was no spoilage in the protein content of the pastrami samples. Sensory analyses also showed that no spoilage was observed in the pastrami samples.

The moisture contents of pastrami samples were also variable during storage. There were great differences in moisture contents between the sampling days ($p<0.01$). This situation might be explained due to the variations in the thickness of pastrami samples and the fat contents of samples. During processing of pastrami, with addition of salt, the moisture content of the muscle decreased as compared to raw material. There are three possible explanations for this observation: irreversible denaturation had occurred during drying; the structure of myofibrillar proteins was destabilized with the increase in ionic strength; action of endogenous muscle proteinases, which can increase during the processing period. At higher salt concentration in the muscle, proteins may denature, resulting in stronger protein-protein bonds, shrinkage of the muscle and dehydration. This has been attributed to contribution of hydrophobic interactions to the stabilization of the native conformation, probably via a modification of the water structure (Aktas *et al*., 2005). Reduced moisture level causes low water activity level. The water activity (a_w) of salted and dried meat products, such as raw ham and sausage, is lower than in fresh meat (Leistner *et al*., 1981). The knowledge of water activity is a very important factor to guarantee the required stability towards microbial spoilage of the product and to ensure safety by avoiding any threat to the health of the consumer. It is also important for the modeling of the drying processes because it provides the driving force for the mass transfer (Comaposada *et al*., 2000). In this study, we used vacuum packaging material therefore, the moisture reduction of the samples were not expected to be great. About 5% of moisture loss observed in this study. A work carried out by Arslan *et al*. (1997a) showed that vacuum packed pastrami samples lost about 5% of their moisture during 90 days of storage period, samples without vacuum packaging lost nearly 15% of their moistures during 90 days of storage. The moisture results obtained this study were in agreement with Turkish standards (Anonymus, 2002). Various proteins offer a certain number of potential reaction sites. Since, the pastrami is rich in protein, this component affects the sorption values positively, since protein as a macromolecule is rich in polar sites. Hence, the structure of pastrami formed during the salting and drying would be more suitable to bind additional water. The mechanisms of water sorption by proteins are well documented in the literature (Caurie, 1981; Lemaguer, 1987). It has been conclusively established that the amount of sorbed water depends primarily on the number and availability of 2 types of hydrophilic groups which are capable of binding (Aktas and Gürses, 2005).

There were no significant differences in the salt levels observed in the pastrami samples analyzed on different sampling days ($p>0.05$). Our results were similar with the results of various authors (Arslan *et al*., 1997a; Arslan and Kök, 2001).

It was found that the salt contents of pastrami samples were variable during the sampling days but at the end of the storage, it reduced from 11.67±0.46-09.66±0.50. This result is in agreement with others research Arslan *et al.* (1997a) reporting that salt content of vacuum packed fish (*Cyprinus caprio* L.) pastrami reduced from 10.50±1.26-7.93±0.39. However, they reported that when the pastrami samples were not vacuum packed, the salt content increased from 7.56±0.75-10.48±0.97 during 90 days of storage period. Therefore, it could be explained that although, there was a significant reduction in the moisture content of pastrami samples during 90 days of storage (from 35.66±0.51-30.92±0.63), this reduction did not affect salt content as expected. Arslan *et al.* (1997a) reported that when aerobic packaging was used moisture content reduced in a greater extent, which caused increased salt content of pastrami samples at the end of 90 days of storage period. Arslan and Kök (2001) reported that the salt content of sliced and vacuum packed fish pastrami (*Barbus esocinus*) samples reduced from 9.1-7.53% at the end of 90 days of storage. They also reported that the moisture content of pastrami samples increased from 36.31-37.63% during this storage period. In another study conducted by Arslan *et al.* (1997a) reported that the salt content of vacuum packed and stored at 30°C fish (*Cyprinus caprio* L.) pastrami samples had lower increase (from 10.23-12.02%) in salt content during 90 days of storage period. Whereas, packed samples, without vacuum packaging, had higher increase in salt content (from 7.75-14.48%) within 45 days of storage period.

The fat contents of pastrami samples were not stable during storage. There were significant differences in the fat levels between sampling days. These differences might be due to the moisture and protein levels of pastrami samples.

Ash content of pastrami samples did not show any significant differences ($p>0.05$) during storage period. The differences in ash levels might be due to the salt and moisture levels of pastramis.

Organoleptic features of wells cat fish pastramis were found to be in the degree of good at the taste panels. In this study, each pastrami group was compared within the pastrami group during sampling days. Beside this fried and raw pastrami samples were compared based on the days sampling carried out. There were differences in the organoleptic features between the samples analyzed on different days (Table 3). In general, raw pastrami samples had higher scores than fried samples. This was probably due to the volatile compounds occurring during heating and producing fish smell and flavor. In addition fried samples were found to be harder than those obtained from raw samples. The organoleptic analysis were carried out by the method of Kurtcan and Gönül (1987). The reason for choosing this method was the usability of this test in fish pastrami samples. Because, this product is not a commercial product at the moment and it is generally produced for experimental purposes.

As a result, it could be said that pastrami samples produced from wells cat fish had reasonably acceptable microbiological, chemical and organoleptical features. In addition, vacuum-packed pastrami retained its good quality features at least 90 days at 20°C.

Increasing shelf-life of easily perishable fish meat, preparing it as ready to eat product and therefore, provide it for consumer and processors any time of the year is a very important feature for fish industry. Therefore, producing fish pastrami would provide consumer a very high protein containing product with special and authentic taste and flavor with increased shelf-life and economical value.

CONCLUSION

As a result, we conclude that high quality of fish pastrami can be produced by following hygienic conditions along with utilization of high quality raw material and additives. Vacuumed samples of this kind of pastrami could be kept 90 days or more than this period at 20°C.

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