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Full Length Research Paper

Sensorial, chemical and microbiological quality of anchovy cake

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In this study, fish cake prepared using raw anchovy (*Engraulis encrasicolus*) and its products were stored in a locked bag at a cold temperature of 4 ± 1°C. Moisture, ash, fat, protein, salt, pH, TVB-N, number of TBA, TMA-N and histamine values, number of total aerobic microorganisms (at 5 and 30°C temperature of incubation) and yeast-mold were determined in the raw material during the production period. Sensorial, chemical (pH, TVB-N, number of TBA, and TMA-N values) and microbiological changes during cold storage period of the products were carried out every 3 days and with three replications. In this study, the prepared product was appreciated by the panelists that participated in the sensorial analyses. In addition, as the values obtained from sensorial, chemical and microbiological values were evaluated, the shelf-life of the anchovy cake during cold storage (4 ± 1°C) was found to be 6 days.

Key words: Anchovy cake, shelf-life, chemical, sensorial, microbiological, *Engraulis encrasicolus.*

INTRODUCTION

Sufficient and safe food is required for well-balanced and adequate nutrition of individuals and young generations and therefore, its production and trade is very important. Thus, nations should develop their food and nutrition policies by comprehensively considering this issue relating to their future and many people. It seems both developed and developing countries experience common nutrition problems. Diets of people vary significantly and unequally depending on regions, seasons, socio-economic levels and urban-rural settlements. One of the basic reasons for this is unbalanced income distribution. This factor is effective on nature and incidence of nutrition problems. Furthermore, lack of information on nutrition causes incorrect food selection and incorrect practices in cooking and storage methods and makes the problems on nutrition more serious (Yagmur and Gunes, 2011).

Anchovy accounts for approximately 60% of the total fish production in Turkey, and also 76% of our total sea products are made of anchovy. 90% of anchovy comes from Black Sea Region (ANON, 2002; Boran and Albayrak, 2010). Anchovy is the basic food and basic protein resource for the people living in Black Sea Region. It is very cheap and therefore, eaten by many people. Anchovy may be used in almost all types of dish. Dishes containing anchovy (*Engraulis encrasicolus,* L.,1758), which are prevalently cooked and eaten by Black Sea people, are known as traditional dishes specific to the region in which anchovy is used as basic ingredient for cooking (Boran et al., 2008).

Demand for food, which can be easily cooked and eaten, has increased due to changes in daily life and social nature caused by developing technology and increase in the number of working women (Damarli, 1986).

The objective of this study was to prepare a cake made of anchovy, which may be easily cooked and eaten, and it is believed that it attracts interest due to its different taste including nutritive quality of fish; and also this study aim was to investigate the sensorial, physical and microbiological variations.

MATERIALS AND METHODS

The material used for this study was fresh anchovy (*Engraulis encrasicolus* L., 1758) supplied from Elazığ City's fish market.

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Table 1. Materials used to prepare the anchovy cake.

Used material	Amount
Cutted fish	500 g
Onion (chopped)	1 piece
Garlic (chopped)	10 pieces
Egg	2 pieces
Vetetable oil (sunflower)	200 ml
Water	600 ml
Parsley	1 bunch
Flour	500 g
Salt	20±0,1 g
Black pepper	3 g
Red paprika	5 g
Baking powder	1 packet

The fish was brought to our laboratory for filleting and washing under hygienic conditions. They were dewatered and cut into 2 cm pieces. The ingredients shown in Table 1 except the fish were mixed with the help of a mixer and the fish was added to the mixture. The mixture including the fish was stirred with the help of a spatula. Then, the mixture was placed on a rectangular tray, whose surface had been coated with an oil film and a layer of wax paper on the film previously. Finally, it was cooked into an oven at 175 °C for an hour. The cake was sliced into square shape pieces after it had been cooled at room temperature for an hour and packaged into sealed storage bags to be stored in a refrigerator at +4 ± 1°C.

Sensorial, chemical and microbiological triplicate analyses were conducted once every three days during the storage for determining quality and shelf life of the anchovy cakes. Moisture, ash, fat, protein, salt, pH, TVB-N, TBA number, TMA-N and histamine values, total aerobe microorganisms (at 5 and 30°C incubation temperatures), and yeast-fungi numbers of the samples were determined for the raw material (the fish) during the production. Sensorial, chemical (pH, TVB-N, TBA number, and TMA-N values) and microbiological variations, which might have occurred in the products under cold storage conditions, were investigated.

Cake samples were analyzed from the sensorial aspects also. For this purpose, to quantify the samples, they were scored between 1 and 5 points. The products were described by 10 panelists looking at their color, odour, texture, appearance and taste. The points indicated as:

1 = very bad, 2 = bad, 3 = Normal, 4 = well and 5 = very well (Kurtcan and Gonul, 1987).

pH values of the samples were determined with the help of a pH-meter (AOAC,2002). The amounts of dry matters cake samples were determined by using the drying cabin method and the samples were burned to determine the amount of their ash content (Goguş and Kolsarici, 1992). The soxhelet method was employed to determine the amount of fat of the samples (AOAC, 2002). The amount of crude protein in the samples was determined with the help of Kjeldahl's method (AOAC, 2002). TVB-N amounts in the products produced for the study were determined by the method reported by Varlik et al. (1993) while TBA number was determined with the help of Tarladgis's (1960) method. Histamine ratio was determined by the methods reported by Kose and Hall (2000).

The samples were cultivated in the laboratory under aseptic conditions and the plaques containing 30 to 300 colonies were evaluated. Plate count agar (PCA) media was used in census of total aerobe microorganisms. The plaques were incubated at 30±1 °C for 72 h and 5 ± 1°C for 7 days before evaluation (Harrigan, 1998). Potato dextrose agar (PDA) feeding plate was used for yeast and fungi census and the formed colonies were counted after the cultivated plaques were incubated at 22±1 °C for 5 days (Harrigan, 1998).

RESULTS AND DISCUSSION

Table 1 shows the findings from the chemical and microbiological analyses conducted on the anchovy used in fish cake under our study.

Table 2 shows the average moisture, ash, protein, salt percentages and histamine values, total aerobe micro-organism (at 5and 30°C incubation temperatures), and yeast-fungi numbers of the samples, which were determined for the raw material (the fish) during the production in the study.

Table 3 shows the chemical (pH, TVB-N, TBA number, and TMA-N values) and microbiological variations, which might have occurred in the anchovy cakes under our study during the storage time at +4±1 ºC, while Table 4 shows the sensorial variations. Like other fishes, the chemical compound of anchovy varies depending on age, gender, catching location and seasons. According to some studies, anchovies, which are caught in our nation, contain water ranging between 65.34 and 75%; protein, between 16.60 and 22.10%; fat, between 5.0 and 17.51%, and ash, between 0.90 and 1.93% (Ustun and Turhan, 1997; Koral and Kose, 2005; Ayas, 2006; Gulyavuz Unlusayin, 1992; Boran and Albayrak, 2010). Our findings obtained in this study for nutrition compound are in accordance with these results.

As a result of the scientific studies, which have been conducted in various areas, positive effect of fish in diet on human health has become well-known. Increasing fish consumption in diet is very important with respect to both economy and health. Nations, which are aware of the importance of balanced diet, have been seeking new products which can satisfy consumers sensationally and that can easily be prepared, to enrich their protein resources in food industry. These nations have been making investments for this purpose. Although fish consumption as a food is low in our country, cooking methods for fresh fish are restricted by a couple of cooking ways. Now, processed sea products have become available recently as a result of technologic developments in the relevant industry. Thus, shelf life has become longer and the longer shelf lives have contributed to increase in fish amount consumed as food. The objective of this study was also to make similar contributions. Thus, a fish cake as a new product, which was ready to eat with a different taste and form, was prepared by using anchovy (Figure 1). As understood from the sensorial data given in Table 2, the panelists liked the product which was prepared for the study, and they enjoyed the good taste during the storage time also.

It has been reported that the most important criterion for designating product quality in food storage is that the

Table 2. The findings of the analysis obtained from fresh anchovy, cake mix and cooked cake.

Parameter	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	Salt (%)	Histamine
Fish fillet	72.20±0.24	0.89±0.03	5.49±0.44	20.87±0.05	-	11.02±0.28
Mix cake	58.32±0.70	0.45±0.02	2.58±0.37	4.23±0.50	1.95±0.20	-
Cooked cake	46.59±0.79	1.05±0.05	6.66±0.11	5.80±0.55	2.93±0.32	

n = 3.

Table 3. Chemical and microbiological findings determined during make and storage of product.

Parameter	pH	TVB-N (mg/100g)	TMA-N (mg/100g)	TBA (mg/1000g)	Psycrophile (5°C) (log_{10} cfu/g)	Total aerobe Mic. (30°C) (log_{10} cfu/g)	Yeast-fungi (log_{10} cfu/g)
Fish fillet	6.85±0.04	20.73±1.45	3.96±0.08	3.29±0.13	3.36±0.87	2.30±1.30	3.28±1.25
Mix cake	6.64±0.01	12.05±1.22	2.92±0.14	0.79±0.21	1.48±1.23	2.00±0.80	3.23±0.89
Cooked cake	6.93±0.15	19.59±0.50	3.14±0.07	0.85±0.16	1.00±0.00	1.00±0.00	1.00±0.00
Storage period (day)							
0	6.93±0.15	19.59±0.50	3.14±0.07	0.85±0.17	1.00±0.00	1.00±0.00	1.00±0.00
3	6.81±0.03	19.75±0.75	3.34±0.15	0.87±0.23	1.59±0.11	1.00±0.00	1.91±0.12
6	6.96±0.07	22.13±0.75	3.82±0.40	1.01±0.26	2.40±0.41	4.01±0.16	2.08±0.11
9	7.12±0.12	23.52±1.21	3.87±0.31	1.13±0.13	4.01±0.68	5.15±0.60	3.45±0.34
12	7.13±0.15	24.09±1.45	4.11±0.35	1.25±0.34	4.52±0.19	6.58±0.10	4.49±0.15

n = 3.

Table 4. Anchovy cake prepared by the study findings in the sensory evaluation.

Quality factor	Storage period (day)					
	0	2	3	6	9	12
Color	5.00 ± 0.00	5.00 ± 0.00	4.50 ± 0.00	4.10 ± 0.92	3.25±0.25	-
Odor	4.20 ± 0.84	4.10 ± 0.65	3.50± 1.12	3.10 ± 1.12	1.35±0.12	-
Texture	5.00± 0.00	5.00 ± 0.00	4.23 ± 0.65	3.00 ± 1.05	-*	-
Taste	5.00± 0.00	5.00 ± 0.00	3.80 ± 0.41	3.20± 1.45	-	-
Görünüş	5.00± 0.00	5.00 ± 0.00	4.20 ± 0.82	3.73 ± 1.19	-	-
Appearance	4.84 ± 0.50	4.81 ± 0.70	3.92±0.58	3.43± 1.23	-	-

*,Could not be analyzed; n = 10. mean±STD deviation.

result of sensorial analysis and products, which fails to satisfy sensorial criteria cannot be eaten. The results from other analyses are required to be evaluated along with the results of sensorial analyses (Baygar et al., 2002). The panelists liked the anchovy cake, which was prepared for our study. The anchovy cakes were assessed based on the sensorial criteria until the 6th day of the storage; however, because decays were detected with respect to odour and appearance after the 9th day, they were not assessed with respect to taste and crispness. Sensorial features of the anchovy cakes, which was stored in cold, lost value during storage. It was understood that they could not be eaten on the 9th day while they could be kept as fresh for 6 days. pH value determined in the raw anchovy used for the cakes under study declined after the other ingredients were added and it was obtained as 6,93-7,13 between 0th and 12th day after been cooked.

TVB-N value increases depending on time of storage of fish and fish products. Limit values for TVB-N amounts vary between fishes and other sea products. For example, Huss (1995) reported TVB-N amount contained by newly caught fresh fish as 5 to 20 mg/100g while he reported that limit values for considering it as fresh as 30 to 40 mg/100g. TVB-N value of fresh anchovies, used in the study, was 20.73 mg/100g and were deemed fresh. The value did not exceed the limit for eating during storage because the fish was not the only ingredient in

Figure 1. Anchovy cake packaged.

the preparation.

Although various chemical analyses are employed in determining freshness of sea fish, one of the most frequently used analyses is TMA-N analysis because TMA-N is a good indicator for bacterial contamination in fish. Ludorf and Meyer (1973) consider TMA-N amounts as good up to 4 mg/100 g; as marketable up to 10 mg/100 g and as decayed after 12 mg/100 g. TMA-N value was detected as 3.14 mg/100 in the raw material, which was used in the cake, and as 4.11 mg/100 g in the cake at the end of the storage time. The finding did not exceed the limit value even at the end of the shelf life of the product because the products did not consist of only fish.

One of the variations causing spoilage of a product is fat oxidation. Somewhat bitter taste and yellow-brown color occur in oxidized products. One of the criteria expressing fat oxidation is thiobarbituric acid number. According to researchers, TBA number should be less than 3 in a very good material and should not exceed 5 in a good material. The limit for eating ranges between 7 and 8 h (Varlik et al., 1993; Sinnhuber and Yu, 1958). TBA value, which was obtained in our study, was within the good material class. The reason for quite low TBA amounts obtained during the production and storage was the fact that our product did not consist of only fish.

The United States Food and Drug Administration reported that the presence of histamine exceeding 50 mg/100 g in fish may be harmful to human health (Muller et al., 1992). Histamine amount obtained in the fresh fish used in our study was 11.02 mg/100g. Histamine amount determined in the anchovy cake under study was so low that it was neglected.

In general, the muscle of fish newly caught in healthy waters was sterile. Microorganisms exist generally in skin, gills and intestines. Number of microorganism ranges between 10^2 and 10^6 cfu/cm^2 in skin and 10^3 and 10^9 cfu/g in gills and intestines. Microorganisms may spread over muscles from gills and intestines also depending on the processes applied after the fish is caught, ambient temperature and time. As a result, quality of fish degrades depending on microorganism species and people who eat them may suffer from infection or toxicity. Therefore, information about micro-organisms existing in the muscle of fish is very important as regard health and storage (number and species of microorganisms) (Gram and Huss, 1996; 2000).

Psychrophiles are microorganisms responsible for decay of fish. It was evidenced that the dominant micro flora in the decayed fillets consisted of psychrophile microorganisms in the conducted studies (Clingman and Hooper 1986; Dalgaard et al., 1993). In our study, psychrophiles were obtained as a result of incubation at 5°C of the microbiologically cultivated anchovies, total aerobe microorganism number (mesophiles) was obtained as a result of incubation at 30°C of the microbiologically cultivated anchovies and number of yeast-fungi was found as 1,00 $\log_{10}$ cfu/g. These values were found as 4.53 $\log_{10}$ cfu/g, 6.58 $\log_{10}$ cfu/g and 4.49 $\log_{10}$ cfu/g respectively at the end of the storage time.

Considering the fact that anchovy, which is a cheap protein resource, is caught mostly in eastern Black Sea Region, most of it is eaten as fresh and the rest is used in manufacturing fish flour and oil. Shelf life of the product, which was prepared in a cake form, was determined as 6 days under refrigerator conditions. Any product similar to the anchovy cake, prepared in our study, was not seen in our literature reviews. The anchovy cake, prepared in our study, is a different product and may be preferred by adults and children, who generally do not like eating fish. Thus, this cake or similar products may contribute to an increase of fish in diets. Furthermore, people may acquire a food habit including processed sea products.

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