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Effect of Different Processes on Chemical, Textural and Sensory Properties of Sakarya Circassian Cheese

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ABSTRACT

In this study, Circassian cheeses were produced by different processes based on traditional methods, and smoke was applied in a traditional oven. Starter culture was added to a group of cheeses for aroma production while smoke aroma was added to another. Chemical, textural and sensory properties were determined during 90 days of ripening. Depending on the manufacturing procedure, total solids content of Circassian cheeses ranged between 51.42-62.38% while ranges for water activity and pH values were found 0.938-0.977 and 4.71-6.82, respectively. Ripening indices were higher for the cheeses manufactured by the traditional method and smoke flavor added. The total value of free fatty acids was the highest in the culture added and non-smoked cheese group. Cheese hardness increased with an increase in total solids and smoking process. Cheese samples produced by the traditional method and non-smoked exhibited the highest overall sensory acceptability. The fumigation process increased the shelf life of cheeses as well as giving a different flavor to the cheese.

Keywords: Circassian cheese, Smoked cheese, Shelf life, Production technology

Sakarya Çerkez Peynirinin Kimyasal, Tekstürel ve Duyusal Özellikleri Üzerine Farklı Üretim Proseslerinin Etkisi

ÖZ

Bu çalışmada, Çerkez peyniri geleneksel yöntemler esas alınarak farklı üretim prosesleri ile üretilmiş ve yöresel bir fırında tütsülenmiştir. Üretilen bir grup peynir için kültür kullanılmış, diğer bir gruba da tütsü aroması ilave edilmiştir. 90 günlük olgunlaşma esnasında peynirlerin kimyasal, tekstürel ve duyusal özellikleri analiz edilmiştir. Çerkez peynirinde üretimin prosedürüne bağlı olarak kuru madde %51.42-62.38, su aktivitesi 0.938-0.977, pH 4.71-6.82 arasında değişmiştir. Geleneksel standart metotla üretilen ve tütsü aroması ilave edilen peynirlerde olgunlaşma oranı daha yüksektir. Kültür ilaveli ve tütsülenmemiş peynirlerde serbest yağ asitleri değeri ise en yüksektir. Tütsüleme işlemi ve artan kuru madde peynirlerde sertliği arttırmıştır. Standart geleneksel yöntemle üretilip tütsülenmemiş peynirler duyusal yönden en çok beğenilmiştir. Peynire farklı aroma kazandırmasının yanında tütsüleme ile peynirlerin raf ömrü uzamıştır.

Anahtar Kelimeler: Çerkez peyniri, Tütsüleme, Raf ömrü, Üretim tekniği

INTRODUCTION

Circassian cheese has been manufactured by Circassian families in the regions of Anatolia densely inhabited by populations of Circassian origin, such as Sinop, Düzce, Bolu, Sakarya, Balikesir, Bursa, Çanakkale, Biga, Hendek and Gönen. This cheese is also produced in the ancestral lands of the Circassians in Caucasia. It reported that it is also produced in Syria, Jordan and Israel where Circassians live. Although there is no certain information about its history, it is estimated that Circassian cheese has been manufactured for considerably long time (at least 150 years). Circassian families used to produce its own cheese until 20–25 years ago, but the amount of cheese produced in households have decreased in recent years with changing social conditions [1, 2].

Circassian cheese can be sold fresh, mature or dried (sundried or oven-dried) form. The method of production is partly reminiscent of Kashar cheese and partly of Mihaliç cheese. Cow, sheep, goat milk or a mixture of these milks can be used for the manufacture. During mastication, Circassian cheese creates an elastic squeaky noise in the mouth not unlike that of Cypriot Hellim Cheese. In some regions, Circassian cheese is manufactured with variety of herbs, whereas in some areas it is smoked. The smoked variety is called Kara Usul Çerkez in Manyas region. Circassian cheese is usually consumed at breakfast, but it is also used to make a popular fried dish similar to Hellim Cheese. Circassian cheese is also used in pastries called *"davar"* and *"mataz"* as an ingredient. It is a highly shelf-stable cheese and can be preserved over long periods [3].

Circassian cheese is generally round and weighing around 0.5 kg (Figure 1). The color of the dried version varies from white to cream. The flavor profile is slightly salty or for salt-free cheese the flavor is savory. It has a soft consistency and is without pores. On the other hand, the smoked version has a light brown exterior and a light yellow or cream interior (Figure 1). Smoked version is slightly salty, has a thin crust and low fat content. The fresh cheeses are of a light yellow color [3].

Figure 1. Circassian cheese

Milk is strained immediately after milking and boiled in 5–6 liter pans called "suwan" for the production of Circassian cheese. Once the boiled milk has cooled to the correct temperature for fermentation, home-made coagulant is added from the edge of the container at a ratio of 3% and mixed in. Sour whey or sour yoghurt can also be used as coagulant in the production of Circassian cheese. Some families add citric acid diluted in water into the milk in order for the curd to form more easily. Furthermore, in some villages, coagulant is added once the milk starts to boil, and it is boiled a little more afterwards. The milk is removed from flame once the whey becomes clear and round lumps start to form on the surface. Some of the whey is removed from the pan and the curd is transferred into baskets by dipping these into the pan (the diameter and height of these baskets are approximately 30 cm in and around 5–10 cm, respectively, round and made of willow branches). The curd is drained in the basket until the target moisture content is reached before salting. After the surface of the cheese is salted, cheese is turned upside down and salt is applied on the other surface. The cheese is offered for consumption in fresh form, after having been rinsed with water on the third day. It can be kept fresh for about 2 weeks. However, to manufacture dried cheese, cheese is hung in a basket in a sunny spot (on the roof or in the garden). It is offered for consumption once dried. Where Circassian cheeses with smooth surfaces, without any trace of the basket and resembling thick pita breads are encountered in markets, is manufactured with plastic molds rather than baskets [1, 3].

Charred Circassian cheese is the smoked version of Circassian cheese, which may be stored for long time periods. Smoking of the cheese is carried out especially in and around the districts of Düzce and Sakarya. Wood from trees such as hornbeam and oaks, which have embers and low tar content, is used for smoking. The smoking process consists of the cheese being placed on a wooden grill hung on hooks and its being charred for 3–4 days on a low-flame hearth. Smoking in dairies is carried out on special shelves in the smoke-room either by covering the cheese with a muslin cloth or leaving in its naked state after salting. Firewood is burned in the middle of this room and the cheese is smoked with the smoke produced. Once the desired smoked flavor is obtained and final moisture content is reached, cheeses are taken out of the ovens and they are ready for consumption [4].

Fumigation of foods is one of the oldest methods of food preservation, but foods are mostly smoked for sensory quality rather than for preservative effect in present day.

In general, fumigation infuses the high-protein food with aromatic components, which lend flavor and color to the food. Fumigation also plays bacteriostatic and antioxidant roles [5,6]. There are reports that phenolic compounds found in smoke inhibit growth of molds on smoked Cheddar cheese. The traditional smoking method involves the use of wood chips obtained from the oak tree. In industrial production, generally chip not including, only made heating at low temperature (By caramelized lactose, smoked flavor is trying to gain in cheese), or the cheese surface incense aroma spray, liquid smoke is applied [7].

Most traditional cheeses are usually produced under poor hygienic conditions with different manufacturing technologies that are dependent on the geographical location. It has to be noted that there is no standardized processing method for smoked cheese production. Raw milk contaminated with foodborne pathogens constitute a risk to human health if used unpasteurized for cheese manufacture [8]. In the past 20 years, several large foodborne illness outbreaks reported due to consumption of raw milk cheeses, thus the safety of raw milk cheese is still questionable [9-11].

MATERIALS and METHODS

Materials

Raw Milk

Raw milk was obtained from the Karagöl farm company. Cheese was produced in the company's business in Sakarya-Sogutlu. The composition of raw milk was 3.05% fat, 11.35% dry matter, 3.03% protein, 4.56% lactose. Titratable acidity of cheese milk was 0.15% and the pH value was 6.55.

Cheese Milk Additives and Culture

Kıtna:whey is kept in a small jar, heartburn is provided. A little salt put into. If it is very sour, the water is added. Previous whey obtained from cheese production, suitably filtered and stored until it reaches certain acidity. This is used as coagulant. Rennin enzyme (Maysan Inc., Turkey) was used to ensure of the milk coagulate. Food grade table salt (NaCl) is used for cheese manufacture. *Lactococcus lactis* subsp. *cremoris and Lactococcus lactis* subsp. *lactis* (CHR Hansen freeze-dried DVS R-703, Istanbul) were used as culture. The cheeses were vacuum-packed in polyamide/polyethylene bags and stored during 90 days of ripening.

Methods

Cheese Production

The test patterns applied and production flow chart in cheese production is given in Table 1 and Figure 2, respectively. Standardized raw milk was heated at 85°C, divided into 2 groups of heated milk. For C and D groups cheese production, a certain amount of milk is conveyed to a tank, culture was added and incubation was carried out. Culture; a portion of the milk was used to be 50U/400 kg at 40°C, it was dissolved in sterile conditions and was used directly. By adding to 0.156% (m/m) the rate from 80% purity lactic acid in milk, coagulation was carried out. The strength of rennet was 1/12000. The salt content was targeted to 0.625% (m/m, salt/milk) thus salting was carried out in tank. Each type of cheese, 40 pieces of 500 grams molds was manufactured. 2 independent trials were carried out to manufacture 8 cheese samples.

Analysis Methods

Milk samples were analyzed for total solids, protein, fat and lactose using an infrared (i.r) milk analyzer (Milkoscan 133B; Foss Electric, Hillerød, Denmark). Total N (TN) and water soluble nitrogen (WSN) were measured using macro-Kjeldahl techniques [12]. The pH of the milk was measured by digital pH meter (Hanna pH 211 marks; Weilheim, Germany). The acidity was measured by the titration method according to TS 1018 [13].

Cheese Yield

Cheese yield was calculated by the following formula;

$$Y = [(KF) + (C\text{-}0.\ 1) X\ 1.016]/\ 1 – S – M(1\text{-}WS)$$

K = Fat recovery for cheese type,
S = Salt %,
M = Moisture %,
WS = Whey solids %,
C = kg casein per 100kg milk (%)

Chemical Analyses

Samples for chemical analyses (8x5 samples) were taken at 0, 15, 30, 60 and 90 days of ripening. Cheeses were analyzed for total solids (Drying/105°C) [14], ash (Gravimetrically/ 600°C) [15], fat g/100 g (Soxhlet extraction) [16], protein (Kjeldahl techniques), salt (Titrimetric method) ,and acidity in °SH (Titrimetric method) [15]. The pH of homogenized cheese mixture was measured by digital pH meter Hanna ph211brands. The a_w was then measured in triplicate at 21°C using an Aqualab Series 3TE dew point electronic water activity meter with an accuracy of ±0.003.

The extent of lipolysis in cheese during maturation was evaluated by free fatty acid (FFA) concentration by titrating the acidity in the cheese fat with 0.05 N ethanolic KOH according to the method of Nunez et al. [17]. Cheeses were analyzed for water-soluble (WSN) nitrogen content according to the methods of Kuchroo and Fox [18]. Ripening of cheese was calculated by the following formula [19].

Ripening index (%) = (% WSN x 100) / % Total Nitrogen

Table 1.Circassian cheese production test pattern

Sample Code	Manufacturing Practice	Analysis
A	Circassian cheese made with traditional methods (Coagulation with Kıtna)	The sensory, chemical and textural analyzes were performed at 0, 15, 30, 60 and 90 days of storage.
B	Circassian cheese made with traditional methods and smoked	
C	After Circassian cheese pre-ripened by culture , acid coagulation applied	
D	After cheese pre-ripened by culture, acid coagulation applied and cheese was smoked	
E	Circassian cheese produced by using of aged whey as a coagulant	
F	Plant production; Circassian cheese produced using of rennin enzyme as a coagulant	
G	Circassian cheese produced by using of aged whey as a coagulant and added smoke aroma	
H	Plant production; Circassian cheese produced using of rennin enzyme as a coagulant and added smoke aroma	

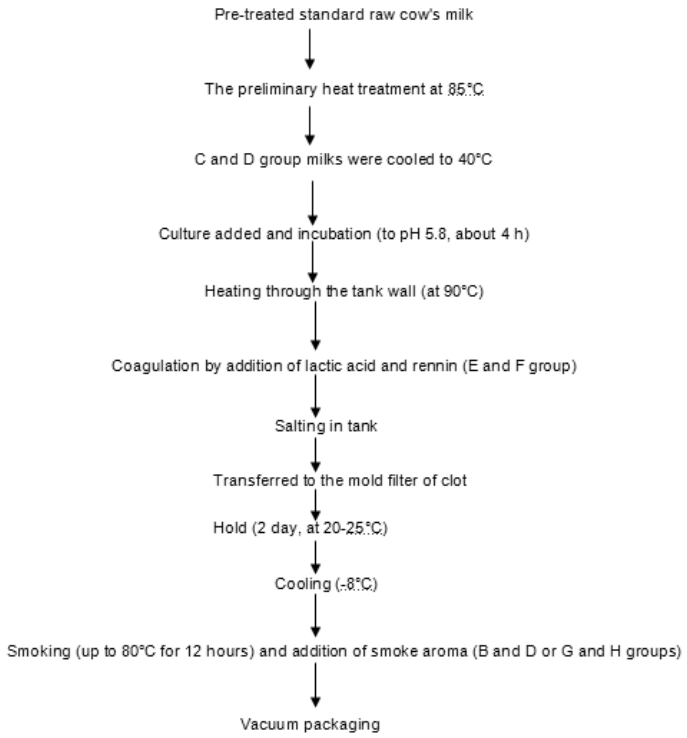


Figure 2.The flow chart of experiment Circassian cheese production

Sensory Analyses

Cheese samples were tested for appearance, color, flavor, taste, texture and acceptability. Sensory evaluation was performed using the preference ranking test. The test was performed by 8 non-trained panelists who were not specifically trained for testing, but had elementary background knowledge of sensory analyses. Appearance, color, flavor, taste, texture and general perception preferences were evaluated using a 9-point unstructured hedonic scale ranging from 1 (dislike very much) to 9 (like very much) and panelists were asked to choose the most and least preferred sample based on their overall impressions. They were familiarized on how hedonic scale operates and used ahead of testing [20].

Statistical Analysis

Data were analyzed using COSTAT (StatSoft, USA) data analysis software. The Duncan multiple comparison test was used to determine differences among the cheeses at a 0.05 statistical level [21].

RESULTS and DISCUSSION

Cheese yield is defined as the amount of cheese, expressed in kilograms, obtained from 100 kg of milk. It is a very important parameter as the higher the recovered percentage of solids, the greater is the amount of cheese obtained, therefore yield is an indicator of gains in economic terms.

Increasing pasteurization temperature >78°C increases yield as whey proteins denatured and trapped in casein micelle. The extent of whey protein denaturation is important, it can influence cheese quality. However, it is obvious that the fat and casein content of the milk are the key constituents of milk that contribute the most towards the yield of cheese. A very simple form of yield is the amount of cheese obtained from 100 L of milk. Yield values of Circassian cheese produced in different processes are shown in Table 2. As seen from the table, the production methods and the additives affected cheese yield. The addition of starter cultures was not a significant effect on cheese yield. Cheese was

immersed in liquid smoke to obtain smoked flavor, thus cheeses manufactured with liquid some exhibited the maximum yield as a result of water migration from the liquid smoke. The smoked cheese produced by the traditional method had the lowest yield. This could be as a result of the water loss by heat during conventional smoking process.

Table 2. Yield values of Circassian cheese produced in different ways

Group	A	B	C	D	G	H	E	F
Yield (%)	10.2	7.1	10.3	7.2	9.1	9.3	11.9	11.7

Total solids, fat, protein contents of cheeses were significantly ($p<0.05$) influenced by production methods such as smoking. Dry matter content of the smoked samples was higher than those of non-smoked. Moisture loss during fumigation, the dry matter content of cheese samples increased. Again, during the addition of smoke flavorings, cheeses received an amount of water, therefore dry matter of E and F groups' samples were lower than that G and H groups. The amount of dry matter of the samples did not show significant changes during storage (Figure 3a).

Aydinol [1] reported that the total solid content of non-smoked Circassian cheese was 60.0%, while smoked Circassian cheese was 62.2%. In market research, Üçüncüoğlu [22] found that total solid content of homemade non-smoked Circassian cheese was between 44.31 to 54.11% Total solids of industrial and non-smoked Circassian cheese ranged from 51.96 to 54.95% while the total solid content of industrial and smoked cheeses were between 55.02 to 57.28%. As seen from the results obtained from the study, the amount of total solids in cheese is more influenced by production conditions.

Milk fat has very important functions in cheese. It influences cheese flavor, texture and microbial development. The hardness of the cheese, the feeling in the mouth, the aroma is significantly affected by the amount of fat [23]. Fat content of the cheese samples are given in Figure 3b. The content of fat in cheese samples has been directly related to the dry matter content. Fat content is higher in cheese samples with high total solids. Therefore, the highest amount of fat was determined in the cheese samples with no added aroma, fumed and manufactured with starter cultures as these cheeses exhibited higher total solid content.

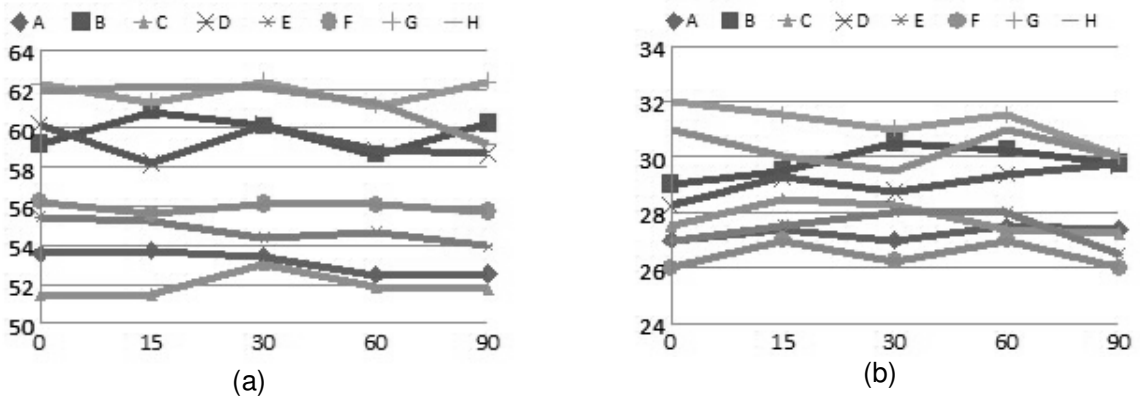


Figure 3. The total solids (a) and fat (b) values of the produced cheese during storage (%)

Total protein content in cheese varies depending on the rate of milk casein and production techniques. Circassian cheese production methods also affected the amount of protein in parallel with the dry matter content (Figure 4a). During the storage, the protein contents of cheeses did not change.

Salt content in the dry matter of the cheese samples is given in Figure 4b. When the added amounts of salt and yields of the cheese were considered, a very large amount of added salt passed through the whey. E and F group cheeses were suspended in brine, therefore the salt content was higher in these cheeses. Several studies reported that the amount of salt of the Circassian cheese varied depending on the manufacturing conditions [1, 2, 22]. The salt content of the cheese samples during storage did not show significant differences.

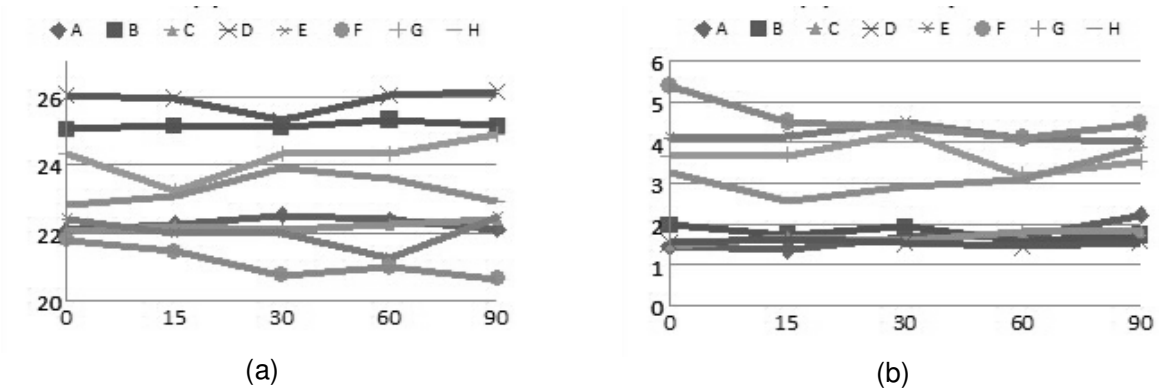


Figure 4. The contents of protein (a) and salt (b) determined in cheese samples during storage period (%)

Acidity

The observed change in titratable acidity during storage of the cheese samples is given in Figure 5. Titratable acidity increased 0.75% for the cheese produced by the conventional method, 0.32% in smoked cheese produced by a conventional method, 0.72% in the culture added cheese, 0.32% in the culture added and smoked cheese samples during the 90 day storage period. Increased acidity in smoked cheeses seems to be lower than the increase in non-smoked cheese. The low acidity of B and D group cheese could be a result of inhibition of microbial activity by incense. A and D group cheeses were manufactured with starter culture which may explain higher acidity values compared to E and H cheeses ($p<0.05$). Also, the acidity of the cheese samples showed a significant increase in during storage ($p<0.05$). This increase is less in the smoked cheese. In many studies about the cheese, the titratable acidity of cheese increased during ripening [1, 2, 22, 25].

The measured pH of Circassian cheese samples during storage is given in Figure 5. An inverse relationship between titratable acidity and pH value of the cheese samples was observed. pH change in smoked B and D cheese samples were lower than non-smoked the A and C samples during storage. The pH decreased for a greater extent for the cheese coagulated with acid whey. It reported that the commercial Circassian cheese samples in Turkish markets exhibited varying pH values [4, 22].

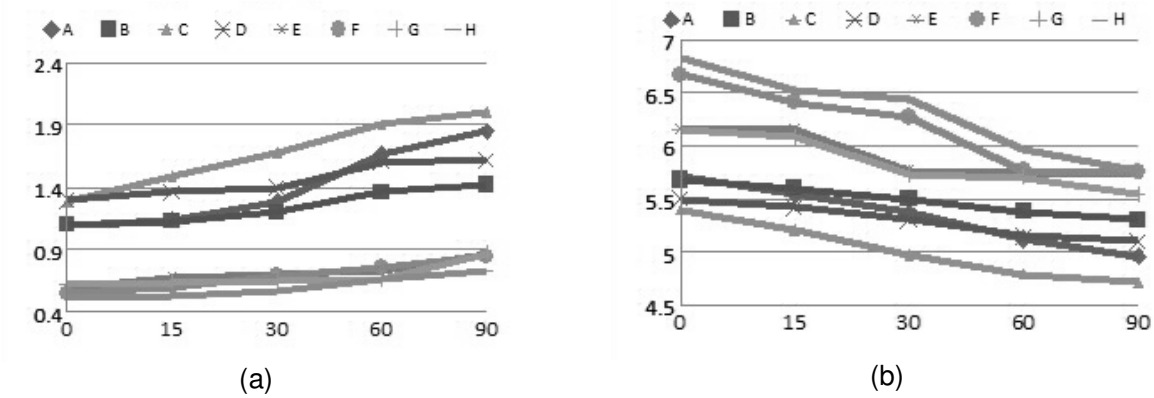


Figure 5. Titratable acidity (LA%) (a) and pH (b) values of the produced cheese

Water activity values vary according to cheeses types, storage conditions and storage time. In general a_w values for cheese lay between 0.87 and 0.98 [24]. The factors such as smoking, flavors, yeast and cultures addition the storage period affected a_w values of cheese samples. Water activity of the samples exhibited a similar trend with the dry matter content (Table 3). Water activity of the cheese samples varies during storage depending on storage conditions and packaging material [1].

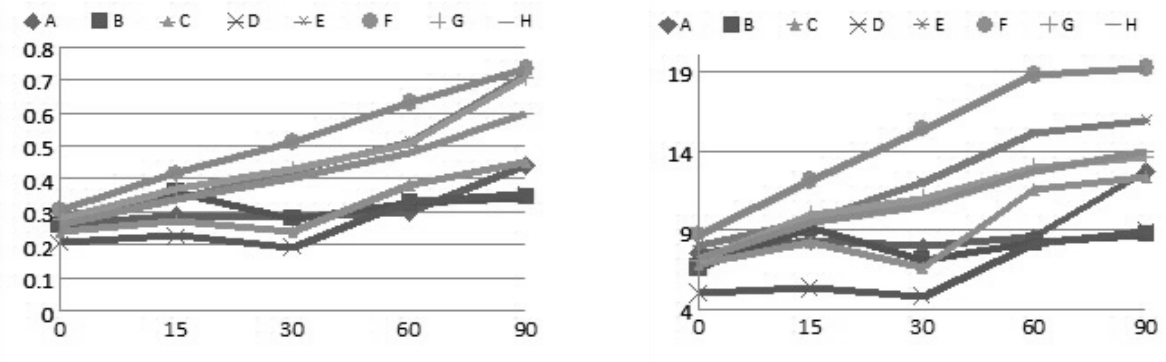
Table 3. Water activity value of cheese samples

Storage (Day)	Cheese Group							
	A	B	C	D	E	F	G	H
0	0.972a-e	0.967b-f	0.977 ab	0.974 a-c	0.973a-d	0.988 a	0.953e-i	0.938hi
15	0.964b-g	0.975 a-c	0.971a-f	0.972a-e	0.964b-g	0.968b-f	0.954d-h	0.945g-i
30	0.960b-g	0.970a-f	0.963b-g	0.964b-g	0.963b-g	0.956c-h	0.932 i	0.940hi
60	0.968b-f	0.961b-g	0.967b-f	0.967b-f	0.971a-f	0.973a-d	0.952f-i	0.938hi
90	0.966b-f	0.960b-g	0.971a-f	0.967b-f	0.961b-g	0.963b-g	0.945g-i	0.938hi

The amounts of water-soluble nitrogenous compounds and degree of maturation of cheese samples are given in Figure 6a and b, respectively. Because fumigation process reduces the amount of water and caused inhibition of the enzyme in the smoked cheese, the soluble nitrogen content in smoked cheese samples were lower. Because of the high water content of the E and F group cheese samples, the amount of WSN in the those cheeses were higher. WSN contents of the cheese samples showed a significant increase in during storage ($p<0.05$).

The degree of maturation increased during storage period for all Circassian cheese samples. The maturation degree in non-smoked A and C group cheese samples was 70% and 82%, respectively, while smoked B and D group cheeses only exhibited 43% and 37% maturation, respectively. According to these results, it can be said that the smoking process reduced the proteolysis rate. This reduction was significant ($p<0.05$). During storage of smoked cheeses, ripening index increased, but the rate was lower compared to non-smoked cheese samples. The ripening degree of E and F group samples of cheese was also higher, because of they have higher amount of water soluble nitrogen and water [1, 26-27].

Besides the positive contribution to aroma, the high amount of the free fatty acid can lead to taste/flavor defects such as rancidity [28]. Total free fatty acids values determined in Circassian cheese samples during storage of given in Figure 7. A significant increase in free fatty acid contents during the shelf life of the cheese was determined ($p<0.05$). After 90 days of storage, the total free fatty acid content were higher in the cheeses manufactured with starter culture and non-smoked. Again, the lowest amount of fatty acid was measured in D group samples that cheese group was manufactured with starter culture and smoked.



(a) (b)

Figure 6. The amounts of water-soluble nitrogenous (a) and maturity index (b) determined in cheese samples

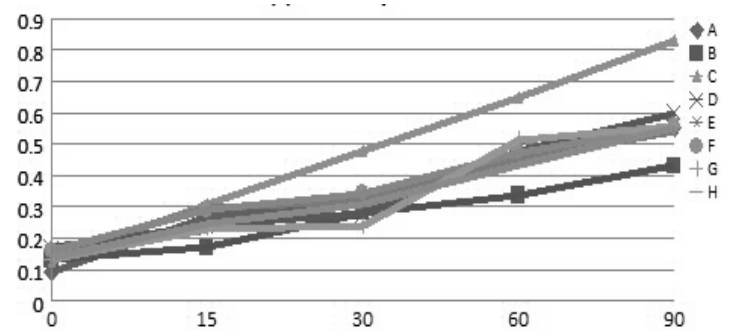


Figure 7. Total free fatty acids values (%) in Circassian cheese samples

Salt and moisture content of the cheese are two important factors affecting cheese hardness. Cheese hardness increases with salt and total solid content of the cheese [29]. Proteolysis rate and pH values are other key factors influencing the texture of the cheese [30]. Hydrolysis by residual coagulant of about 20% of the αs1-casein, which produces the αs1-I peptide, causes a weakening of the casein network [30]; specifically the Phe23-Phe24 or Phe24-Val25 bonds are most susceptible to hydrolysis by residual enzyme. The αs1-I peptide is present in all cheeses during the early stages of ripening. A more gradual change in cheese texture occurs during time period that the rest of the αs1-casein and the other caseins are hydrolyzed. Unlike phase one, which takes only days, phase two occurs over a period of months. However, it has been shown that the β-casein does not change as much during ripening as αs1-casein [31, 32].

The hardness of the Circassian cheeses exhibited significant differences during ripening. A regular change was not observed in the hardness of cheese during storage. However, the hardness values of cheese determined in the 90th day of storage is higher than 1th day. The highest hardness was determined in smoked cheese samples (B and D group). The culture added and non-smoked cheese samples (C group) had the lowest hardness values. The amount of dry matter was the most important factor that determines the hardness of the cheese. Some researchers reported increased cheese hardness during ripening [33, 34] while others reported exact opposite [35, 36].
In the sensory evaluation of cheese samples, taste, texture, appearance, odor, color characteristics were scored and the results are given in Table 4. Cheese taste is developed by the microbial and enzyme activity during ripening. The incense aroma was achieved by applying the traditional method of fumigation on B and D groups cheese samples as expected.

The taste scores of B group cheese samples decreased markedly during storage ($p<0.05$). There are fluctuations in taste scores for other cheeses during storage. C group cheese samples received highest average taste score compared to other samples. Panelists reported for C group cheese sample exhibited a pleasant ripened cheese taste in this group samples. The taste scores of B and D group smoked cheese samples have been lower than those of non-smoked cheese group with 5.80 points at the end of the 90 day storage period ($p<0.05$). The highest taste score is given to E group cheese sample (average 8.3 point). The taste characteristics of the cheese samples were considered as "good" and "very good" during 90 day storage.

The structure of the cheese determines the ratio of intact casein to moisture and pH [30]. When the structure score of cheese samples in Table 4 was evaluated, it can be concluded that starter cultures did not contribute to the formation of the desired structure. The average scores are taken into consideration, smoked cheeses were better than non- smoked cheeses in terms of structure.

In general, the appearance scores of cheese samples during storage initially increase then decreased. Non-cultured cheese samples received a higher score than the others, and fumigation process did not significantly effect on the visual properties. The most popular cheese in terms of appearance was been manufactured by aged whey, exhibited the highest appearance scores. The appearance characteristic of cheese samples did not showed a regular change during storage. Panelists rated the appearance of cheese samples as "good" and "very good". The properties of traditional and industrial Circassian cheese were studied. It was suggested that smoking process has no effect on the appearance of market Circassian cheese [1].

When the odor points of cheese samples were assessed, the odor of smoked cheese samples less appreciated than non-smoked samples. At the end of the storage, C group cheese sample reached to the highest odor score. This group cheese samples were manufactured with starter culture and acid coagulation. Circassian cheeses exhibited significant variations in terms of color ($p<0.05$), but all samples were well-liked by the panelists. E group cheese samples exhibited the most desirable color.

General acceptability of the samples is the sum of the sensory properties such as color, taste, odor and structure. General acceptability points of the cheese sample are given in Table 4. As seen in Table, at the end of the 90 days storage, E group cheese samples, which were manufactured with classical methods without any additives, received the highest overall acceptability score with 41.40 points. D group cheese samples (cultured added and smoked sample) received the lowest acceptability score with 32.00 points at the beginning of the storage. It was found to be important differences between these samples ($p<0.05$). The acceptability of the samples did not show a regular change during storage. The results of this study demonstrated that raw materials, production technology, the added additives, and storage conditions significantly affected the sensory acceptability of the cheese during ripening.

Table 4. Changes in the sensory properties of the Circassian cheese during storage

	Storage (day)	Cheese Group							
		A	B	C	D	E	F	G	H
Taste	0	6.95	7.40	6.80	5.50	8.200	7.00	6.80	6.72
	15	6.20	7.20	6.10	6.80	8.60	7.00	8.20	8.00
	30	6.60	6.20	7.10	7.10	8.60	6.50	7.90	7.30
	60	6.63	5.75	6.60	6.80	8.00	7.75	6.70	6.30
	90	7.00	5.80	7.40	5.80	8.10	7.00	7.70	7.40
Structure and Texture	0	7.90	8.10	6.55	6.50	8.20	6.50	7.90	7.00
	15	7.20	7.60	7.20	7.40	8.40	7.70	7.60	7.00
	30	7.60	7.70	7.10	7.60	8.00	7.50	7.80	7.70
	60	7.88	7.25	7.10	7.40	8.00	7.00	7.60	7.50
	90	7.80	7.90	6.70	7.10	8.40	7.00	8.30	7.90
Appearance	0	6.70	7.70	7.60	6.90	8.300	7.50	7.60	6.50
	15	7.60	7.20	7.30	7.60	8.20	7.00	7.40	7.20
	30	7.60	7.90	7.40	7.50	8.50	8.10	8.00	8.00
	60	8.00	7.50	7.38	7.60	8.10	7.20	8.00	7.60
	90	7.90	7.40	7.40	7.40	8.50	7.50	8.30	7.80
Odor	0	7.30	7.30	7.40	6.60	7.80	6.00	7.00	6.50
	15	7.60	6.90	7.40	7.05	7.60	7.20	7.50	7.60
	30	7.40	6.60	7.80	7.20	8.40	7.200	7.80	7.30
	60	7.00	6.25	6.80	7.60	7.80	6.00	7.40	6.50
	90	7.20	6.60	7.80	6.80	7.60	6.80	7.50	7.40
Color	0	7.30	7.70	7.40	6.50	8.60	7.80	7.70	6.80
	15	7.60	7.05	7.30	7.45	8.00	7.40	7.40	7.00
	30	7.80	7.80	7.90	7.80	8.30	8.20	8.40	8.00
	60	8.13	7.00	6.80	7.60	8.50	8.20	8.20	7.20
	90	7.80	8.00	7.80	7.90	8.80	7.70	8.60	7.50
General Acceptability	0	36.15	38.20	35.75	32.00	41.10	34.80	37.00	35.52
	15	36.20	35.95	35.30	36.30	40.80	36.30	38.10	36.80
	30	37.00	35.80	37.30	37.20	41.80	37.50	38.40	38.30
	60	37.64	33.75	34.68	37.00	40.40	36.15	37.90	35.10
	90	37.70	35.70	37.10	36.00	41.40	36.00	39.80	38.00

CONCLUSION

Traditional products are a country's cultural wealth. Traditional cheeses have an important market in Turkey. In this respect, these cheeses have a characteristic value to be worked on. Circassian cheese production process is also easy to apply, thus local cheese varieties with the different sensory properties and quality properties should be more focused. The smoked flavor is an important distinguishing characteristic of the Circassian cheese among commonly consumed cheeses. Smoking is one of the parameters affecting on the flavor, structure and shelf life of Circassian cheese. The physical and chemical quality parameters such as acidity, total solid, the total free amino acids and total free fatty acid determines shelf life of the cheese. The result of this study suggests that smoked Circassian cheese has a better shelf-life compared to the other samples. The general sensory acceptability of smoked cheese is also rated as good.

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