

Compositional and Microbiological Characteristics During Ripening of Çeçil Cheese, a Traditional Turkish Cheese

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The aim of this study was to investigate some physical and chemical (dry matter, fat, fat in dry matter, salt, salt in dry matter, acidity %, pH, protein, water-soluble protein, ripening degree, lipolysis and ash) and some microbiological (total aerobic mesophilic bacteria, coliform group bacteria, lactic acid bacteria, *S. aureus*, yeast and mould) properties during the ripening time (1, 30, 60 and 90 days) of Çeçil cheese. Dry matter, fat, salt, pH, acidity, total protein, water-soluble protein, lipolysis (acid degree value) and ash values of samples analyzed were found as 48.68, 10.60, 8.08, 5.76, 0.27, 27.69, 2.69, 1.45, 10.02 %, respectively. In the samples, average of total aerobic mesophilic bacteria, lactic acid bacteria, yeast and moulds, coliform bacteria and *Staphylococcus aureus* were determined to be 6.65, 5.57, 3.54, 0.87 and 1.35 log cfu/g, respectively. *S. aureus* and coliform bacteria were determined in days 1st and 30th of ripening. According to the results, while ripening time was of great importance ($p < 0.01$) on dry matter, salt, salt in dry matter, pH, lipolysis, lactic acid bacteria, coliform, total aerobic mesophilic bacteria and *S. aureus*, acidity %, water-soluble protein, fat, fat in dry matter, ripening degree, ash and yeast and mould were found insufficient ($p > 0.05$).

Key Words: Çeçil cheese, Chemical & Microbiological properties.

INTRODUCTION

Çeçil cheese is a traditional Turkish cheese made from raw and fat cow's milk. It is also known as fat Civil cheese and named as Çarzof Civil cheese in Erzurum province of Turkey¹. Civil cheese is a popular cheese variety in Turkey. Çeçil cheese and Civil cheese are produced especially in East Anatolia Region of Turkey. Civil cheese is produced from whey or skim milk. But, Çeçil cheese is produced from raw and fat cow's milk. No starter culture is used in Çeçil cheese and typically consumed fresh or after only a brief period of ageing.

Çeçil cheese is made from raw and fat cow's milk. Milk is allowed to rest overnight at about 18-20 °C to increase acidity by natural microflora. Then, acidity of the milk is adjusted to 22 Soxhlet Henkel (°SH) with the second part milk after resting at 18-20 °C for 12 h. Milk is heated up to 35 °C. Then for coagulation, calf rennet is added slowly to skim milk (ca. 100 L milk/4 mL rennet). For coagulation of milk in Çeçil cheese making enzyme is mostly used. As the heating process is

slowly increased with a slow agitation, the curd forms at about 55-60 °C. Curd particles are facilitated to stick to ladle within the process of mixing until the temperature reaches about 65-70 °C. The formed curd particles are taken out and put into another vessel to soak these particles in the whey and then rotated by hand to give thread like structure. This process continues for 25-30 min. Then, the cheese block is transferred onto a clean surface by handling. Finally, Çeçil cheese is cut into pieces and salted in a brine solution or dry salt.

The microbiological and physicochemical characteristics of some varieties such as White cheese²⁻⁷, Kasar cheese⁸⁻¹³ and Tulum cheese¹⁴⁻²¹ have been investigated in detail. But, Çeçil cheese has received little attention. There is only one research about physical, chemical and microbiological properties of Çeçil cheese. The objective of this study was to determine chemical and microbiological characteristics during ripening of Çeçil cheese samples.

It is estimated that 50 varieties of cheese are traditionally manufactured in different areas of Turkey²². Although some cheeses produced in small family business are also manufactured in dairy plants but most of local cheese are not. So, it can not be obtained desirable quality. It is aimed in this research to establish quality standards for the manufacture of Çeçil cheese which is a local cheese.

EXPERIMENTAL

In this study, cow's milk was supplied by Managing Directorate of Faculty of Agriculture, Atatürk University. Cheeses were manufactured at the Pilot Plant of Food Engineering Department, Faculty of Agriculture, Atatürk University.

The chemical composition of each sample was determined using the following methods: dry matter, salt²³, fat²⁴, titratable acidity^{23,25}, pH, ash²⁶, protein, water-soluble protein^{26,27}, ripening degree²⁶ and lipolysis (acid degree value)²⁸. All analyses were performed in duplicate.

Çeçil cheese samples were analyzed for total aerobic mesophilic bacteria (TAMB)²⁹, lactic acid bacteria (LAB), coliform bacteria, yeast and moulds³⁰ and *Staphylococcus aureus*^{31,32}. Total viable counts were determined on plate count agar (PCA) after incubation at 30 ± 1 °C for 48 h, lactic acid bacteria (LAB) on MRS agar incubated at 30 °C for 48-72 h, coliforms on violet red bile agar (VRBA) incubated at 35 °C for 24 h, yeasts and moulds on potato dextrose agar (PDA) incubated at 20 ± 1 °C for 5 day and *Staphylococcus aureus* Baird Parker agar incubated at 37 ± 0.1 °C for 48 h. All determinations were made in duplicate and expressed as cfu/g cheese.

RESULTS AND DISCUSSION

The results of chemical and physical characteristics throughout ripening (1, 30, 60 and 90 days) of Çeçil cheese samples are shown in Table-1. The ripening time significantly ($p < 0.01$) affected dry matter, salt, salt in dry matter, pH and

TABLE-1
CHEMICAL CHARACTERISTICS OF ÇEÇİL CHEESE DURING RIPENING PERIOD

Characteristics	Replication	Ripening time (day)				Mean values and standard deviation
		1	30	60	90	
Dry matter(%)	1	47.06	49.110	49.41	47.62	48.68 ±1.48
	2	47.45	51.560	49.63	47.62	
Fat (%)	1	10.00	10.100	10.50	10.50	10.62 ± 0.55
	2	10.10	11.500	11.25	11.00	
Fat in dry matter (%)	1	21.24	20.550	21.25	22.05	21.80 ± 0.83
	2	21.28	22.300	22.67	23.09	
Acidity (%)	1	0.27	0.270	0.32	0.27	0.27 ± 4.08
	2	0.27	0.180	0.27	0.32	
pH	1	6.11	5.590	5.63	5.80	5.76 ± 0.22
	2	6.12	5.590	5.63	5.61	
Salt (%)	1	6.20	6.760	7.95	8.70	8.08 ± 1.54
	2	6.31	8.600	9.47	10.70	
Salt in dry matter (%)	1	13.17	13.760	16.08	18.16	16.59 ± 3.14
	2	13.30	16.680	19.08	22.47	
Protein (%)	1	28.85	29.330	29.56	25.9	27.69 ± 1.90
	2	27.92	28.360	26.88	23.75	
Water soluble protein (%)	1	2.94	2.720	3.91	3.12	2.69 ± 0.98
	2	2.23	3.520	1.23	1.38	
Ripening degree (%)	1	10.52	9.270	13.22	12.05	9.48 ± 3.06
	2	7.98	12.410	4.58	5.81	
Lipolysis (ADV)	1	0.98	0.982	1.69	1.92	1.45 ± 0.42
	2	0.98	1.660	1.38	2.00	
Ash (%)	1	8.98	8.590	9.26	9.11	10.02 ± 1.29
	2	9.46	11.240	11.41	12.08	

lipolysis values of the Çeçil cheese. Fat, fat in dry matter, titratable acidity, protein, water-soluble protein, ripening degree and ash was not affected ($p > 0.05$) by the ripening time.

Dry matter content of samples significantly increased until the 30th day of ripening ($p < 0.01$) and then no change observed significantly ($p > 0.05$) throughout the storage period. The increase in dry matter content can be attributed to loss of moisture in the cheese samples at the ripening period. In the cheese samples average of dry matter value was found as 48.68 g/100 g cheese. Dry matter in cheese is effected by many factors, such as milk quality, conditions of cheese production and degrees of ripening³³. Dry matter in Çeçil cheese was higher than those found in Çeçil cheese (named as Civil cheese in Mus province), Civil cheese and Çarzof Civil cheese (Çeçil cheese produced in Oltu district of Erzurum), which were 43.36, 36.06 and 46.32 g/100 g cheese, respectively³⁴⁻³⁶.

The mean fat and fat in dry matter contents were 10.62 and 21.8 %, respectively. Bakirci and Andic³⁴ determined the fat content and fat in dry matter in Çeçil

cheese 2.78 and 6.38 %, respectively. These differences may be derived from the different fat content of milk used in the manufactures. The percentage of salt in the cheese samples increased ($p < 0.01$) significantly throughout ripening. The highest mean value of the salt content was 9.7 % at the 90th day of storage. Yazici and Dervisoglu³⁷ was found that salt contents of cheese increased significantly until the 60th day of storage ($p < 0.05$) and then did not change significantly ($p > 0.05$) throughout the storage period. The concentration of salt and its distribution in the cheese mass are important parameters that affect the quality and acceptability of Çeçil cheese.

The higher the salt content the more salt in dry matter was found in the cheese samples ($p < 0.01$). The mean value of salt in dry matter was 16.59 %.

The lowest value of ash content was 9.22 % at the 1st day and the highest was 10.595 % at the 90th day of ripening time. The ash content were slightly higher during cheese ripening ($p > 0.05$). Ozdemir *et al.*³⁶ found that the minimum, maximum and average of the ash content in 26 Çarzof Civil cheese samples were 5.39, 12.49 and 7.84 g/100 g cheese. The pH of Çeçil cheese rapidly decreased until 30th day of ripening and continued to decrease at a slower rate throughout the storage. The ripening time had a significant influence on the pH ($p < 0.01$). The mean value of pH was determined as 5.76.

Titrateable acidity of the samples slightly decreased ($p > 0.05$) until at the end of ripening time. In the samples average of titrateable acidity which were lower than those found in Çeçil cheese and Çarzof Civil cheese, 0.64 and 0.62 %, respectively^{34,37} was found 0.27 %. For Çeçil cheese samples, the minimum, maximum and mean values of total protein content was found 24.825 % (90th day), 28.845 % (30th day) and 27.69 %, respectively. These values are higher than the values found in Civil cheese by Sengül *et al.*³⁵. They determined that total protein of Civil cheese ranged between 3.01 and 5.57 g/100 g cheese, average 1.25 g/100 g cheese. The ripening period had no significant influence on the water-soluble protein content of Çeçil cheese ($p > 0.05$). Water-soluble protein of the cheese samples increased slightly until 30th day of storage followed by a slight decrease throughout the storage period. Isin *et al.*³⁸ determined that water-soluble nitrogen content increased during ripening.

The minimum, maximum and mean value of ripening degree was found 8.9 % (60th day), 10.84 % (30th day) and 9.48 %, respectively. The mean value of ripening degree was found by Bakirci and Andic³⁴ 9.90 ± 4.86 % in Çeçil cheese, by Caglar *et al.*³⁹ 8.67 % in Civil cheese, by Altun *et al.*⁴⁰ 2.22 % in Kelle cheese and by Ozdemir *et al.*⁴¹ 3.9 % in Örgü cheese. The lipolysis value of cheese samples increased ($p < 0.01$) significantly during the ripening time. The mean lipolysis rate of samples analyzed were found 1.45 ADV. In some cheese the reasons of different lipolysis rates are variety of milk type, production methods, ripening condition, cultures which were used and cheese compositions. Bakirci and Andic³⁴ found that the minimum, maximum and average of the lipolysis rate in Çeçil cheese samples were 0.61 ADV, 4.92 ADV and 1.86 ± 1.33 ADV.

Table-2 shows the total aerobic mesophilic bacteria (TAMB), yeasts and moulds, total coliforms, *Staphylococcus aureus* and lactic acid bacteria (LAB) numbers (expressed as cfu/g) and the mean values (expressed as log₁₀ cfu/g) and standard deviations for the main microbial groups in Çeçil cheese during ripening. The ripening time significantly ($p < 0.01$) affected total bacteria, total coliforms, *Staphylococcus aureus*, lactic acid bacteria numbers and yeasts and moulds was not affected ($p > 0.05$) by the ripening time.

TABLE-2
MICROBIOLOGICAL CHANGES IN ÇEÇİL CHEESE SAMPLES
DURING RIPENING PERIOD (cfu/g)

Characteristics	Replication	Ripening time (day)				Mean values and standard deviation
		1	30	60	90	
TAMB (cfu/g)	1	1.8×10^7	7.0×10^6	2.0×10^6	4.0×10^6	6.65 ± 0.39
	2	1.3×10^7	6.0×10^6	2.0×10^6	1.3×10^6	
LAB (cfu/g)	1	6.5×10^6	2.0×10^5	7.5×10^4	2.7×10^5	5.75 ± 0.74
	2	7.1×10^6	1.1×10^6	1.0×10^5	5.5×10^5	
<i>S. aureus</i> (cfu/g)	1	< 10	1.2×10^3	< 10	< 10	3.54 ± 1.19
	2	5.0×10^2	3.0×10^3	< 10	< 10	
Yeasts and moulds (cfu/g)	1	1.0×10^4	2.0×10^5	2.0×10^3	1.5×10^4	0.87 ± 1.04
	2	1.0×10^2	8.0×10^2	5.5×10^2	1.9×10^4	
Coliforms (cfu/g)	1	1.9×10^2	< 10	< 10	< 10	1.35 ± 1.73
	2	3.2×10^2	5.0×10^1	< 10	< 10	

While the lowest total bacteria count was found as 2.0×10^6 cfu/g, the highest TAMB count was determined as 1.8×10^7 cfu/g. The ripening time had significant effect on the total aerobic counts of cheese samples at level of ($p < 0.01$). Bakirci and Andic²⁴ reported that the total bacteria counts of Çeçil cheese samples (Civil cheese produced from skim milk in Mus province, Turkey) ranged varying from 1.0×10^6 to 9.20×10^8 cfu/g, with average 2.6×10^8 cfu/g. LAB count of Çeçil cheese were found as average 5.75 log₁₀ cfu/g. Sengul⁴² found that the number of total LAB of Civil cheese samples between 1.1×10^4 and 8.0×10^7 cfu/g, with an average of 7.0×10^6 cfu/g. Mean counts of coliforms was 1.35 log₁₀ cfu/g and reached maximum level in cheese samples when they fresh, then decreased at the 30th day significantly ($p < 0.01$); the counts continued to drop slightly at the 60th and 90th day of storage. Sert and Kivanc⁴³ found that the minimum and maximum numbers of coliform bacteria in 24 Civil cheese samples were < 10 and 7.9×10^3 cfu/g, respectively. Coliform bacteria are not expected to exist due to heating process in the production of Çeçil cheese.

The mean number of *Staphylococcus aureus* in Çeçil cheese was determined as 3.54 log₁₀ cfu/g. *S. aureus* counts dropped to levels below 10 cfu/g until the 90th day of ripening. Sengul⁴² determined that *S. aureus* counts of Civil cheese ranged between < 10 cfu/g and 1.6×10^5 cfu/g. However, the presence of *S. aureus* is undesirable in foods⁴⁴ *S. aureus* is considered as the third most important cause of

disease in the world amongst the reported food-borne illnesses⁴⁵. The ripening time had no significant ($p > 0.05$) effect on the counts of yeast and mould in the cheese samples and mean value of counts were determined as $0.87 \log_{10}$ cfu/g. Counts of yeast and mould were lower, relative to the LAB. Sert and Kivanc⁴³ determined that the Civil cheese samples contained a wide range of yeast and mould varying from 8.5×10^5 cfu/g to 8.5×10^6 cfu/g, with an average of 3.7×10^6 cfu/g.

As a result, it was found that as fresh and ripened for 1 month Çeçil cheese samples contain coliform and *S. aureus*. The counts of samples ripened for 60 and 90 days were < 10 cfu/g. As a result, heating process (*ca.* 60 °C) used in Çeçil cheese making were insufficient for decrease microbial load. For this, cheese samples must be ripened minimum 60 days.

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