

SOME CHARACTERISTICS OF CIMI TULUM CHEESE FROM PRODUCING GOAT MILK

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Abstract

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In this study, chemical and microbiological compositions of some cimi tulum cheeses, which are made from goat milk, were investigated during 90 day ripening period. Cimi tulum cheese contains 57.73% total solids; 30.01% fat; 3.51% salt; 22.27% protein; 2.92% water soluble nitrogen and 1.75% lactic acid. Amounts of total solids, fat, salt, protein, water soluble nitrogen and free fatty acids have increased during ripening period.

During the same period salt and fat ratios within the total solids have decreased. Average percentages of fatty acid composition of these cheeses were determined for ripening period of 90 days. Oleic acid took the first place with 31.73% and was followed by palmitic acid with 24.19% and myristic acid with 9.32%. Microbiological changes were also monitored during ripening period. In Cimi cheese 8.361 log cfu/g total bacteria were detected. In addition, average amounts were determined as; 7.301 log cfu/g for Lactobacilli; 7.278 log cfu/g for Streptococci; 0.176 log cfu/g for Enterococci; 5.716 log cfu/g for Coliform; 7.000 log cfu/g for Psychrophilic group; 7.000 log cfu/g for Lypolitic bacteria; 4.173 log cfu/g for Staphylococci genus and 1.623 log cfu/g for yeast. According to these results, difficulties of producing a standard final product out of goat milk alone in traditional conditions and especially likely health hazards were observed, and therefore, not recommended for consumption. However, since this cheese is commonly consumed, standard industrial production conditions should be established.

Key words: goat milk cheese, Turkish cheeses, tulum cheese, cheeses quality

Introduction

In Turkey, apart from commonly consumed cheese types such as, feta (white cheese), kasar and tulum, some other regional cheese types such as, mihalic, otlu, cerkez, kazikli, safak, kopanisti, otlu, sepet, yoruk and cimi are being produced with traditional methods.

Goat milk is mostly mixed with other milk or used alone especially in making cheese and yogurt. Cimi

tulum cheese, which has demand in the market, is made of goat milk in Antalya region between May and October and stored 3-4 months before being introduced to the market (Eralp and Kaptan, 1970; Unsal 1997).

In this study chemical and microbiological composition of Cimi tulum cheese and changes it has during the ripening period was investigated. The study will be a step forward for establishing data for standard hygienic industrial production of Cimi tulum cheese and therefore goat milk as an important nutrient.

Material and Method

Cheese manufacture

Goat milk was immediately renneting with the from goat rennet in order to obtain coagulate in 1-1.5 hours. The curd was broken and drained in cotton draining sacks until the cheese whey is drained. After 3.5 - 4 hours the cheese was broken into pieces as small as possible and added with 0.7- 1 kg of salt for 10 kilos of cheese. Having been mixed well the cheese was filled into the hairless side of goat skins in various volumes. The goat skins were closed and sealed before they were taken to the cold storages of dairy technologies department keeping them in cold chain ($4 \pm 2^\circ\text{C}$). They were left for ripening at $4 - 2^\circ\text{C}$ temperature and 65% humidity. On the 1st, 30th, 60th, 90th days samples of each cheese were analyzed. The experiment was done in four repetitions.

Physicochemical analysis

The total solids (TS) content of the cheese samples was measured by gravimetric method; acidity was determined titrimetrically (% lactic acid) (Anonymous, 1978; Anonymous, 1986). Salt was measured by Mohr titration and the fat was determined by the Gerber method (Anonymous, 1995). The pH of cheese was measured using a pH value with a Beckman Zeromatic type pH meter. Total nitrogen (TN) of cheese was determined by Kjeldahl method (Yaygin et al., 1985) using approximately 1 g. of cheese. The water – soluble fraction (WSN) was prepared essentially as described by Ardo and Polychroniadou (1999), using 20 g of cheese with 100 ml H₂O. The mixture was homogenized for 5 min using an Ultraturrax IP 1842 model. Water-soluble N content of the cheese extract was determined by the Kjeldahl method, using 10 ml of cheese extracts (AOCC, 1999; Katsiari et al., 2001). Ripening degree was calculated as $(\text{WSN}/\text{TN}) \times 100$ (10). Crude protein values were based on Kjeldahl nitrogen with a conversion factor of 6.38, as described by Kurt et al. (1993). Free Fatty Acid (FFA) was determined kind of oleic acid % (Yaygin et al., 1985).

Microbiological analysis

For microbiological analysis, 10 g of cheese sam-

ple were taken and pressed in the mortar with 90 ml of sterilized Ringer (Merck, Germany) solution. Decimal dilutions were prepared in the same solution.

Serial 10 – fold dilutions of samples were plated out in duplicate on Plate Count Agar (Oxoid, UK CM 325) to determine total mesophilic aerob bacteria (TMAB) and psychrophilic aerob bacteria (PAB) and incubated at 30°C for 48 h, and 10°C for 7 d, respectively. Yeast and mould was cultivated on Potato Dextrose agar (Oxoid, UK, CM 139) (pH 3.5) at 24°C for 5 d. Coliform bacteria was determined on Violet Red Bile Agar (Oxoid, UK, CM 107) and Brilliant - Green Bile Broth (Oxoid, UK, CM 031) and incubated at 32°C for 18 - 24 h and 37°C at 24 – 48 h respectively. Staphylococci was determined Mannitol Salt Phenol – Red agar (Oxoid, UK CM 085) at 35°C at 36 h Enterococci was determined Slanetz - Bartley (Oxoid, UK, CM 377). Lypolitic bacteria was determined Tributyrin Agar (Merck, Germany) at $30 \pm 1^\circ\text{C}$ for 72 ± 2 h MRS (Oxoid, UK CM 361), M17 (Oxoid, UK, CM 785) were used for cultivating lactic acid bacteria 35°C for 48 h (Sharpe and Fryer, 1965; Harrigan and Mc Cance, 1966; Tergazhi and Sandine, 1975)

Analysis of fatty acids

Determination of fatty acids was done in two phases. At the first phase, fat was extracted from cheese samples and turned into methyl esters. At the second phase, Analysis of fatty acid methyl esters was realized on gas chromatographer (Carlo Erba Strumen, Tazione Fractovac 2350) (Akalin et al., 1998).

Statistical analysis

Statistical analysis was performed by using the SAS System for Windows V7. This was used in order to determine collection microbial counts (Anonymous, 2005).

Results and Discussion

Chemical analysis

On cheese samples ripening for three months, analysis of total solids, salt, salt in total solids, fat, fat in total solids, total nitrogen, water soluble nitrogen, lactic acid percentage (L.A. %), pH, free fatty acids

ant maturity degrees were carried out. Chemical analysis results are given in Table 1.

As seen in Table 1, total solids of cheese samples shows an increase during the ripening period. Total solids change during the ripening period was found significant at $p < 0.05$. As a result of an experiment carried out in 1970, average total solids in 5 different Cimi tulum cheeses, was found 54 % (Eralp and Kaptan, 1970).

In our experiment, average salt content of the samples was found 3.51%. The change in salt content

also increased.

Titrated acidities increased along with the ripening period. Considering the ripening period, change in pH ($p < 0.05$) was found statistically significant.

During the ripening period, depending on the number lypolitic micro organisms and their activities, fat in the composition decomposes at different ratios. In the study, average amount of fatty acids, which stem from decomposition of fat, was found 12.28% during both cheese making and ripening periods (Table 1). During the ripening period, ratio of free fatty acids

Table 1
Chemical characteristics of Cimi cheese samples during the ageing period of three months

	1 day	30 day	60 day	90 day	$\bar{x} \pm s_x$
% TS	55.52±0.14	56.68±0.14	57.74±0.14	61.01±0.14	57.73±0.33
% Fat	28.97±0.17	29.99±0.17	30.46±0.17	30.63±0.17	30.01±0.40
% Fat/TS	52.17±0.90	52.99±0.90	52.74±0.90	50.21±0.90	52.02±0.20
% Salt	3.83±0.40	3.70±0.40	3.49±0.40	3.40±0.40	3.51±0.94
% Salt/TS	6.90±0.35	6.53±0.35	5.39±0.35	5.54±0.35	6.09±0.85
pH	5.05±0.80	5.19±0.80	5.07±0.80	5.11±0.80	5.10±0.22
% L.A.	1.44± 0.26	1.61±0.26	1.90±0.26	2.04±0.26	1.75±0.52
% T.N.	21.99±0.78	21.57±0.78	22.74±0.78	22.79±0.78	22.27±0.23
% WSN	2.50±0.70	2.85±0.70	2.75±0.70	3.65±0.70	2.92±0.22
% RI	11.28±0.4	11.77±0.44	13.11±0.44	16.0±0.44	13.04±0.64
% FFA	9.93±0.25	11.64±0.25	13.22±0.25	14.29±0.25	12.28±0.47

during the ripening period is statistically important as $p < 0.01$. Salt content in the total solids decreased in the same period. In their experiment in 1970, Eralp and Kaptan determined an average salt percentage of five different Cimi tulum cheeses at 1%. Fat ratios of cheeses depend on the fat ratios of goat milk and their lactation period. Average change in fat ratios of the cheeses during ripening was found significant at $p < 0.05$. Average fat ratio of our experimental cheeses was found higher than those of Eralp and Kaptan's (1970). Amount of protein in the cheese samples showed a significant increase and average change was found $p < 0.05$ statistically.

Water soluble nitrogen resulting from decomposition of proteins, an indicator for ripeness, increased through the entire making and ripening periods. During the ripening period, parallel to the increase in the amount of water soluble nitrogen, degree of ripeness

increased. In this case, high numbers of psychrophilic and lypolitic microorganisms can be given as a reason for the increase in the amount of free fatty acids. However, statistical analysis showed that ripening period had no effects on free fatty acids ($p > 0.05$). Average ripening value based on ripening duration was found 13.04%. We maintain that, high acidity values significant to our experiment are due to using raw milk and microorganisms which had already existed in the milk flora prior to cheese making process.

Fatty acid composition (percentages) determined in cheese samples during ripening (butyric, capronic, caprylic, caprinic, lauric, myristic, palmitic stearic, oleic, linoleic, linolenic) are given in Table 2.

Most fatty acids, which played important roles in creating aroma in dairy products, increased during ripening. Change in total fatty acid amount was found $p < 0.01$ statistically and considered significant.

Within fatty acid distribution of cimi tulum cheeses, oleic acid had the highest average and was followed by palmitic and stearic acids. Palmitic, myristic and stearic acids from double carbon group, oleic acid from non-saturated fatty acid group and linolenic acid, which is also aromatic, have great importance on nutrition physiology. Compared to cow milk, goat milk contains considerably more of those aromatic fatty acids. Similar results were found by Querre et al. (1996), Akalin et al. (1998), Kaya et al. (1999) and also Kinik et al. (1999).

Microbiological Analysis

Changes in microbiological characteristics of cimi tulum cheeses, which were ripening for 90 days, are given in Table 3. A statistically insignificant increase

($p>0.05$) in number of total mezophilic bacteria was observed during ripening.

Enterococci, known as fecal streptococci, may multiply in hot, salty and antibiotic conditions. Statistically, ripening period had no effects on changes in the number of enterococcus bacteria ($p>0.05$). Number of coliform micro organisms, which is an indicator of hygiene level, showed a significant decrease ($p<0.01$) between 30th and 90th days. Such an increase is the result of the acidity increase in the cheese mass and effects on enterococci of metabolites that emerge as a by-product during ripening. Indicating hygiene insufficiency, psychrophilic microorganisms like cold and emit enzymes with lypolitic and proteolitic characteristics. Changes in the number of these bac-

Table 2

Fatty acid amounts of cimi tulum cheeses during storage (%) (n=4)

Fatty Acid	1 st Day	30 th Day	60 th Day	90 th Day	x±sx
C ₄ (Butyric)	5.39 ^b	5.73 ^b	5.82 ^b	7.94 ^a	6.23±1.045
C ₆ (Capronic)	1.65 ^a	1.68 ^a	1.69 ^a	1.56 ^c	1.67±0.086
C ₈ (Caprylic)	2.42 ^d	2.54 ^c	2.66 ^b	2.85 ^a	2.61±0.166
C ₁₀ (Caprinic)	7.99 ^d	8.93 ^a	8.42 ^c	8.81 ^b	8.53±0.384
C ₁₂ (Lauric)	3.73 ^d	4.18 ^b	4.27 ^a	4.03 ^c	4.05±0.214
C ₁₄ (Myristic)	8.67 ^c	9.58 ^a	9.59 ^a	9.46 ^b	9.32±0.398
C ₁₆ (Palmitic)	23.96 ^c	23.89 ^d	24.62 ^a	24.32 ^b	24.19±0.306
C ₁₈ (Stearic)	12.83 ^c	14.03 ^a	12.50 ^d	13.43 ^b	13.19±0.611
C _{18:1} (Oleic)	30.91 ^d	31.01 ^c	32.11 ^b	32.89 ^a	31.73±0.855
C _{18:2} (Linoleic)	1.09 ^a	1.03 ^b	1.09 ^a	1.04 ^b	1.06±0.030
C _{18:3} (Linolenic)	1.47 ^c	1.53 ^b	1.54 ^b	1.59 ^a	1.53±0.045

a, b, c, d means in the same line bearing a common superscript do after significantly ($p<0.01$)

Table 3

Changes (during three month ripening period) in Microbiological Characteristics of Cimi Tulum Cheeses, Which were Made in Different Seasons (n=4)

	1 st Day	30 th Day	60 th Day	90 th Day	x±sx
Total Mesophilic	7.301±0.77	8.301±0.44	9.00±0.42	8.845±0.07	8.361±0.90
Coliform	7.344±0.64	5.301±0.15	4.301±0.83	7.301±0.65	5.716±0.26
Staphylococci	4.322±0.31	4.528±0.74	3.462±0.82	2.903±0.35	4.173±0.27
Enterococci	0.041±0.28	0.462±0.64	0.204±0.70	0	0.176±0.97
Psychrophilic	6.301±0.86	2.301±0.04	7.301±0.48	6.301±0.77	7.000±0.11
Yeast	1.301±0.07	1.477±0.02	1.477±0.38	1.903±0.25	1.623±0.34
Lypolitic Bacteria	7.477±0.04	6.728±0.21	6.477±0.39	5.301±0.81	7.000±0.35
Lactobacilli	7.301±0.12	7.612±0.12	6.954±0.27	6.491±0.08	7.301±0.11
Lactococci	7.278±0.31	7.602±0.43	6.979±0.14	6.477±0.41	7.278±0.55

teria was found statistically insignificant ($p>0.05$). In products without hygiene, Staphylococci is an important source of infections. A statistically significant decrease ($p<0.01$) in the number of staphylococcus was observed during ripening. Also the increase in number of yeast bacteria during ripening was also found significant ($p<0.01$).

Lactobacilli contain bacteria which play an important role in ripening of cheese. Changes in number of lactobacilli during ripening was found insignificant ($p>0.05$). Various researchers report that this genus is dominant (Dale, 1972; Fatichenti et al., 1979; Nunez and Medina, 1979; Arici and Simsek, 1991). Bacteria from genus lactococci exist from the beginning of cheese process throughout ripening. An increase in the number of streptococci during ripening was observed ($p<0.01$).

No significant changes were observed in the number of lypolitic microorganisms. Analysis showed that average number of lypolitic bacteria (7.000 cfu log/g) wasn't affected during cheese making and ripening (Table 3). This situation was also proved statistically ($p>0.05$). Similar observations were reported by various other researchers as well (Gokovali, 1980; Bostan and Ugur, 1992; Kilic et al., 1998).

High number of lypolitic bacteria in cimi tulum cheese can be given as a reason for the increase in the amount of free fatty acids. In addition, Kilic et al. (1998) report that lactic acid bacteria, psychrophilic bacteria and some yeast enzymes are effective on the changes in the amount of free fatty acids. As obviously known, free fatty acids, when insufficient or excessive in the cheese, cause taste problems (Deeth et al., 1983). Since the milk used in making cimi tulum cheese is not heated and goat skin is used as the storage package, various types of microorganisms from the natural milk flora, package or the environment might exist in the cheese mass. Lipases, especially natural or microorganism based ones decompose fat easily and fatty acids emerge. Amount of them affects the taste and aroma of the cheese, thus, its quality. Fatty acid amount values recorded in our experiment are similar to other research results (Korulcuk et al., 1978; Akalin et al., 1998; Kinik et al., 1998). However,

type of milk, cheese type and its process and ripening conditions are all important factors and each factor indeed plays an important role on enzyme effectiveness.

Conclusions

In general, it was proved that seasonal characteristics of the raw milk and ripening period are effective on chemical composition of cimi tulum cheese. Owing to its taste, aroma and look, this cheese has gained popularity among the consumers.

However, microbiologic quality of some traditionally made cimi tulum cheeses, made in the summer (June, July, August, September), having no standard making process and no respect to any hygiene factors, were found quite poor during the ninety-day ripening period. As known, in order to have healthy and edible dairy products, pathogen microorganisms within the product must remain lower than risk levels. In this respect, consumption of these cheeses causes public health and food safety problems. In spite of all these risks, it was observed that cimi tulum cheese is still sold at high prices in the market. We believe that regional goat milk cheeses such as cimi tulum should be focused on in order to establish a hygienically standard production process while in other parts of the world they are handled with special attention in terms of standards, monitoring and hygiene to protect it from any kind of abuses and fakes.

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