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Use of Raw, Thermized and Pasteurized Cow's Milk for Making Siirt Herby Tulum Cheese*

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Abstract: In this study, Siirt Herby Tulum Cheese was made from raw, thermized, and pasteurized cow milk collected from a farm. Production and packing were accomplished in under 24 hours. Pasteurization was performed at 72˚C for 1 minute, followed by termization at 68˚C for 1 minute. Cloth formation was done at 32˚C for 90 min. The clot was divided into 1x1x1 cm pieces, incubated for 45 min, and then filtered for 15 min. First, pressure was applied to the strained curd, which was then mixed with 1% salt and less than half the weight of milk for 12 hours. Sirmo (*Allium* sp.) was added to the curd, and a second pressure was applied for 12 h at the same weight as the milk. Chickpea-sized cheese samples were tightly packed in a plastic screw cap box and matured at 4 °C for 120 days. The curd efficiency was calculated as the ratio of curd to milk. The yield percentages for raw, thermized, and pasteurized milk curds were 26.7, 38.6, and 21.1, respectively. Dry matter levels were similar (45% on average) in all three cheeses. Pasteurized milk cheeses achieved acceptable microbiological quality on the first day, thermized milk cheeses on the 60th d, and raw milk cheeses on the 90th d. During the process, raw milk cheeses' pH climbed from 5.4 on the first d to 7.1 on the 120th. These values were measured in pasteurized milk. Pasteurized cow's milk improved acidity and pH to an acceptable level. It was determined that Siirt Herby Tulum Cheese may be made from pasteurized cow's milk, with a minimum of 20% fat, 20% protein, 45% dry matter, and a maximum of 2% salt. The proposed method has the potential to improve manufacturing standards, hygiene, and cost-effectiveness. It is possible to conduct additional research on the subject and build the best industrial manufacturing procedure.

Keywords: Cow's milk, Siirt herby cheese, thermization, pasteurisation, ripening

Çiğ, Termize ve Pastörize İnek Sütünün Siirt Otlu Tulum Peyniri Yapımında Kullanımı

Özet: Bu çalışmada, bir çiftlikten alınan inek sütünün çiğ, termize ve pastörize formları kullanılarak Siirt otlu tulum peyniri üretildi. Üretim ve ambalajlamanın 24 saat içerisinde tamamlanması sağlandı. Süt, 72˚C 1 dk süreyle pastörize edildikten sonra 32 ˚C'de 90 dk süreyle mayalandı. Pıhtı 1x1x1 cm pıhtı büyüklüğünde kırılarak 45 dk bekletildikten sonra 15 dakika süreyle süzüldü. Süzülen telemenin % 1'i kadar tuz eklenen teleme 12 saat süreyle süt ağırlığının yarısı kadar ağırlık altında birinci baskı uygulandı. Teleme kırılarak sirmo (*Allium* sp.) eklendi ve kullanılan sütün ağırlığına eşit ağırlık altında 12 saat süreyle ikinci baskı uygulandı. Nohut büyüklüğünde ufalanan peynir örnekleri plastik vida kapaklı ambalajda 4°C'de 120 gün süre ile olgunlaştırıldı. Pıhtı kırmadan sonra kendiliğinden süzülen teleme miktarının süte oranı kullanılarak teleme randımanı hesaplandı. Çiğ, teremize ve pastörize süt telemelerinde % randıman sırası ile 26,7, 38,6 ve 21,1 olarak tespit edildi. Her üç peynirde de benzer kuru madde düzeyi (ortalama %45) tespit edildi. Pastörize süt peynirlerinin ilk günde, teremize süt peynirlerinin 60. günde ve çiğ süt peynirlerinin 90. günde uygun mikrobiyolojik kaliteye ulaştığı gözlendi. Süreç içerisinde çiğ süt peynirlerinde pH ilk günde 5,4 iken 120. günde 7.1'e yükseldi. Pastörize sütte ise bu değerler 6,1 ve 5,9 olarak ölçüldü. Pastörize inek sütü kullanmakla yeterince asitlik ve pH gelişimi gözlendi. Pastörize inek sütü kullanılarak içeriğinde en az %20 yağ, %20 protein, %45 kuru madde ve en fazla %2 tuz olacak şeklide Siirt otlu tulum peyniri üretiminin yapılabileceği görüldü. Daha standart, hijyenik ve ekonomik üretim yapılması için önerilen metot yararlı olabilir. Konunun daha fazla araştırılması ve ideal endüstriyel üretim prosesinin geliştirilmesi sağlanabilir.

Anahtar Kelimeler: İnek sütü, Siirt otlu peyniri, termizasyon, pastörizasyon, olgunlaştırma.

1. Introduction

Türkiye has 193 cheese kinds, making it one of the countries with the most. Although the basic production processes for these cheeses differ slightly, the resulting product exhibits distinct characteristics (1). Cheese's contribution to tourism can be increased by standardizing its production in Anatolia, ensuring its hygiene, and ripening it (2-4). The proportion of traditional cheeses among the 753 thousand tons of cheese produced in Türkiye is unknown (5). The most common type of herby cheese is Van Herby Cheese, which has a Geographical Indication Certificate (6). Other herby cheeses include Urfa, Bitlis, Hakkari, Trabzon, Erzincan keçene, and Siirt. Siirt Herby Cheese is often made from raw sheep milk or a combination of sheep and goat milk. While sirmo (sirik, *Allium* sp.) is the most common herb added to cheese, it has been noted that herbs such as heliz (*Ferula orientalis*) and

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ciriş (*Eremurus spectabilis*) are also used depending on the consumer's preferences (7).

Scientific research has led to the achievement of industrial production and national consumption of Van Herby Cheese (8–16). For other regional herby cheeses, there was only one available scientific study (17). Official documents specify the minimum technical and hygienic standards for cheeses, and official inspections are conducted in accordance with these standards (18–20). Herby cheeses' chemical and microbiological quality attributes were examined, and any potential health problems were highlighted. It has been demonstrated, therefore, that the sanitary quality and contents of regional cheeses made by non-commercial businesses are subpar (21-33). According to reports, Siirt Herby Cheeses sold at points of sale do not meet norms for chemical and microbiological quality (34–37).

Studies on Van Herby Cheese have indicated that using cow's milk is appropriate (10,11,13, 14). These days, big businesses sell their cow's milk-based Van Herby Cheeses over the country. When it comes to the number of sheep and goats, Siirt is one of the major provinces. But getting enough milk and making enough herby cheese to sell nationwide seems to be a challenge. Thus, in this investigation, pasteurized cow's milk was utilized. This will likely be the first experimental study utilizing pasteurized cow's milk on Siirt Herby Tulum Cheese. We think the results could help in the future to enhance the product's technological production process.

Models of Van Herby Cheese production have been thoroughly examined (8–16). Following the pasteurization of various milks, herby cheeses were vacuum-packed and their chemical alterations were monitored for ninety d. According to reports, there are no appreciable differences in the finished product's qualities when using goat milk either by itself or in conjunction with cow milk (15). Using raw and pasteurized cow, sheep, and goat milk, Tunçtürk et al. (38) created both raw milk cheese using the conventional method and cheese samples using the model industrial production method employing pasteurization and starting culture. They then looked at the changes that occurred over the ripening phase. No recommendations for technological processes were given as a consequence of the investigation. An experimental study on Siirt Herby Cheese used sheep's milk. According to studies, additional study is required before cheese can be sold (17). The development of a technological procedure appropriate for cow's milk could aid in the national production and promotion of Tulum cheese flavored with herbs. Cow's milk was used in this investigation to prepare samples of raw, thermized, and pasteurized milk cheeses, which were then matured for 120 d at +4°C. With the understanding that the samples' physical, chemical, and microbiological characteristics complied with applicable regulations and laws, every attempt was made to manufacture and package the cheese in less than a day.

2. Material and methods

Materials

Raw milk: The milk, which was milked on a farm near Siirt's city center, was filtered with a cloth strainer and sent to the laboratory within an hour, where it was separated into three equal pieces. Portions were utilized to make raw, thermized, and pasteurized milk cheeses. The created cheeses were packed tightly into 100 ml sample containers, leaving no air space. Cheese samples were ripened at +4°C for four months and analysed once a month.

Rennet: Rennet was purchased from a local market, brought to the laboratory and kept at room temperature.

Herb (Sirmo, Sirik, *Allium* sp.): Citizens harvested herbs from the plateaus and sold them in the market. After being sorted and cleaned with drinking water, the herbs were chopped to about 5 mm size and mixed into the curd at a rate of 3% (w/w) between the first and second presses.

Salt: Local rock salt used in cheese production was employed.

Press material: Plastic containers filled with water were used on the curd and curd formed into a bundle in a filter cloth.

Making herb cheese using raw milk: Raw cow milk was heated to 35°C. Calcium chloride (200 ppm, w/v) was mixed into the milk. The rennet was added to the milk at 32°C and left for 90 minutes. The clot was sliced to 1x1x1 cm size and left for 45 min. The clot was placed in a press towel and filtered for 15 min. The resulting curd was crumbled into chickpea-sized pieces and mixed with 1% of the curd's weight in salt. The salted curd was subjected to the initial pressure for 12 h with a weight equal to half that of the milk. The curd was crushed to the size of chickpeas, and 20% of the milk solids were combined with Sirmo (*Allium* sp.). For 12 h, the curd was subjected to a second pressure equal to the weight of the milk. At the end of the pressing, the curd, which had crumbled to the size of chickpeas, was securely packed into plastic containers.

Making herby cheese using thermized milk: Raw sheep milk was therified at 65˚C for 1 minute and immediately cooled to 37˚C. All other processes were applied as in raw milk cheese making.

Making herb cheese using pasteurized milk: To make herby cheese, raw sheep milk was heated to 65˚C for 1 minute before cooling to 37˚C. All other processes were carried out in the same manner as for manufacturing raw milk cheese.

Making herby cheese using pasteurized milk: Raw sheep milk was pasteurized at 72°C for 1 minute and then cooled to 37°C. All other processes were carried out in the same manner as when manufacturing raw milk cheese.

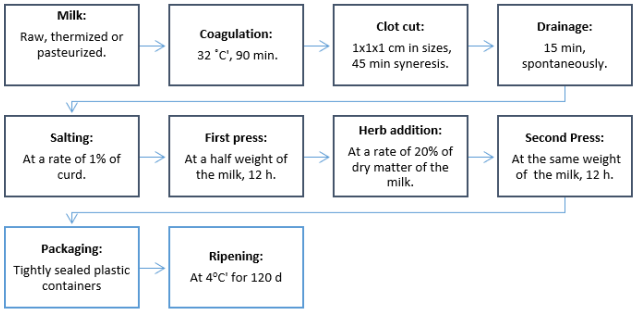


Figure 1: Experimental Siirt Herby Tulum Cheese making.

Raw milk analyses: Raw milk pH was measured using a handheld pH meter (AZ 8685, Taiwan). Acidity was determined using the titrimetric method, and the findings were reported as %LA. Milk was also examined using a milk analyzer (Lactoscan LS, Nova Zagora, Bulgaria) (39).

Coagulant Strength determination: Coagulant strength was determined by diluting the coagulant (Yayla Rennet, Tuzla Istanbul) by one-tenth. Raw milk was heated to 35°C. 1 mL of diluted coagulant was added to 10 mL of hot milk, and the clot formation duration was measured. The coagulant strength was determined using the formula (40).

Analysis of milk, curd and cheese samples

The pH and acidity of the samples were determined according to Sadler and Murphy (39), dry matter was determined gravimetrically according to TS EN ISO 5534/AC (41), fat was determined using the Van Gulik method (TS ISO 3433) (42), and salt was determined gravimetrically according to TS EN ISO 5943;2007 (43).

Microbiological tests were conducted on 10 mL of raw milk and 10 g of cheese. Cheese samples were homogenized by external hand maceration in 90 ml of sterile physiological saline (FTS) in a sterile sample bag. One of the homogenates was employed in serial dilution. The pour plate technique (44) was used to inoculate 1 mL samples from repeated dilution tubes. Coliform group bacteria were counted on solid media using TS ISO 4832 (45), then spreaded onto Violet Red Bile Lactose Agar (VRBLA, Oxoid CM0107). After 24 h of incubation at 30 °C, pink-red colonies with a pink precipitation ring were counted. The coagulase test and counting of Coagulase-positive staphylococci were carried out in accordance with TS EN ISO 6888-1 (46). Baird Parker Agar (BPA) petri plates were utilized, which were then incubated at 37°C for 48 h. The real number was determined by performing a coagulase test on ten black lustrous colonies with a diameter of 1.5 - 2.5 mm and a translucent zone surrounding them.

Statistical analysis

One-way analysis of variance (ANOVA) followed by a Duncan test was done to verify differences between means using IBM SPSS Statistics 28 (IBM Corporation, Somers, NY, USA). Differences were considered significant at the probability level $p < 0.05$.

Results

The raw milk analysis findings are shown in the table. When the analytical values were evaluated, it was found that they were within the cow's milk criteria, with no anomalous values detected. It was found that the fat ratio was 3.29%, the protein ratio was 3.1%, and the density was 1.034. The pH of raw milk was found to be 6.8, and the acidity was 0.18 (%, lactic acid). In raw milk curd, the pH of the strained curd prior to the first pressing is 6.0; in thermized milk curd, it is 6.2, and in pasteurized milk curd, it is 6.8. The three curds' relative acidities were found to be 0.25, 0.21 and 0.18.

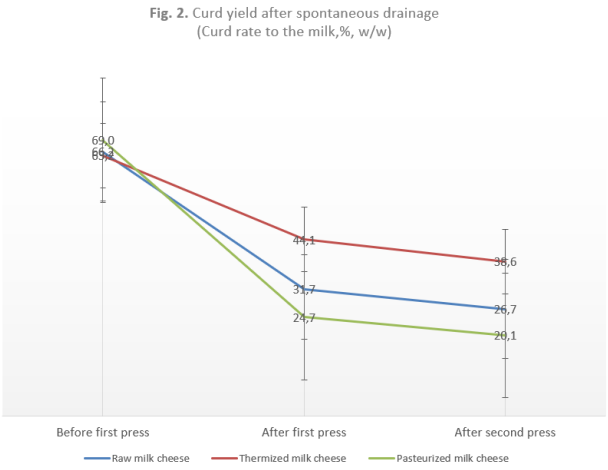
Table 1: Analytical results acquired after 15 minutes of spontaneous draining of the curd formed from cow milk used to make cheese.

	pH	Acidity (lactic a., %)	Dry matter (w/w, %)	Protein (w/w, %)	Yağ (w/w, %)	Laktoz (w/w, %)	Minerals (w/w, %)	Density (w/w, %)	Freezing point(°C)	Conductivity (Ω' cm')
Raw milk	6,9	0,18	13,6	3,25	3,29	4,88	0,74	1,031	-0,566	6,19
Raw milk clot	6,0	0,25	ND*	ND	ND	ND	ND	ND	ND	ND
Thermized milk clot	6,2	0,21	ND	ND	ND	ND	ND	ND	ND	ND
Pasteurized milk clot	6,8	0,18	ND	ND	ND	ND	ND	ND	ND	ND

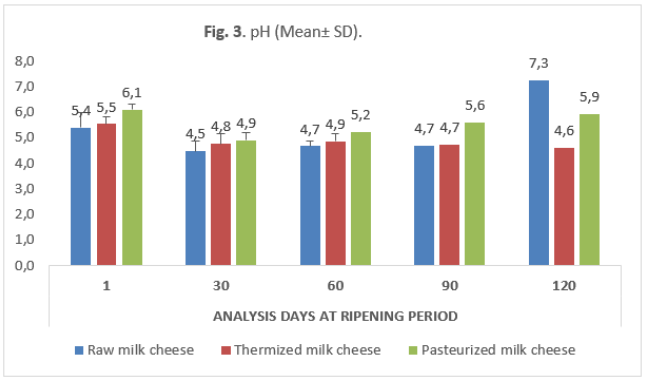
*: Not determined.

The microbiological investigation of raw milk revealed the presence of Coagulase-positive staphylococci at 3.9 log cfu/ml and coliform group bacteria at 6.3 log cfu/ml. Tables and figures have not used to display these results.

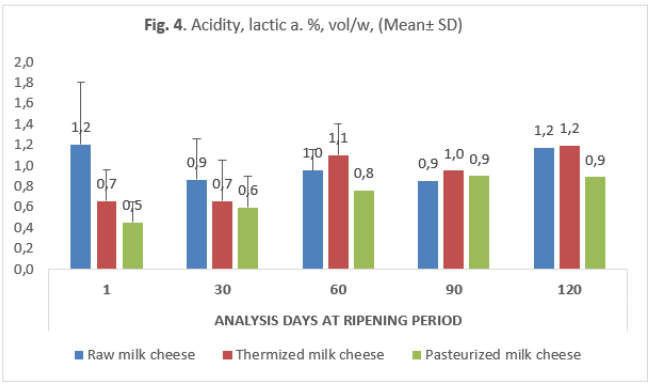
Weights were taken three times after the clot was extracted. The collected values were proportioned to the weight of the milk used to get the efficiency percentage. Following spontaneous filtration, the curd's yield values (%) after the first and second pressings were determined to be as follows: 31.7 and 26.7 for the raw milk cheese samples, 44.1 and 38.6 for the thermized cheese samples, and 24,7 and 20.1 for the pasteurized cheese samples. Figure 2 provides the values.



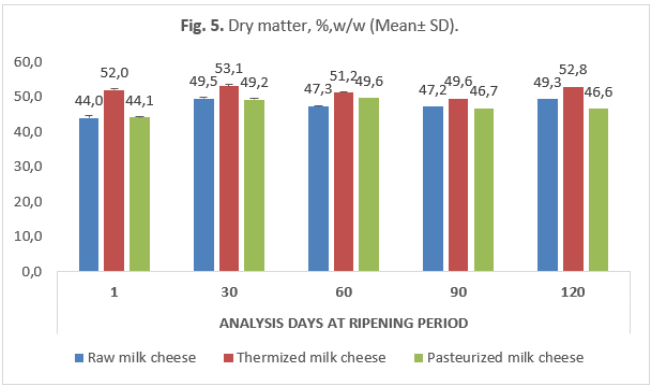
Three distinct cheeses were created by preparing three distinct curds in the same way. The cheeses were then sealed in plastic sample containers with lids and allowed to ripen at 4 °C. Analyses were carried out on ripening d 1, 30, 60, 90, and 120. At every level of the analysis, it was discovered that the pH values that were acquired from the analyses varied. Pasteurized milk cheeses were shown to have a higher pH than other varieties from the first to the ninety-first d. Up to this point, there was a statistically significant difference ($p<0.05$) in the pH values of the two samples. On the other hand, raw milk cheese was found to have an abnormally high pH (7.3) on d 120. The pH of pasteurized milk cheese was found to be 5.9, whereas that of thermized milk cheese is 4.6. In Fig. 3, pH values are displayed.



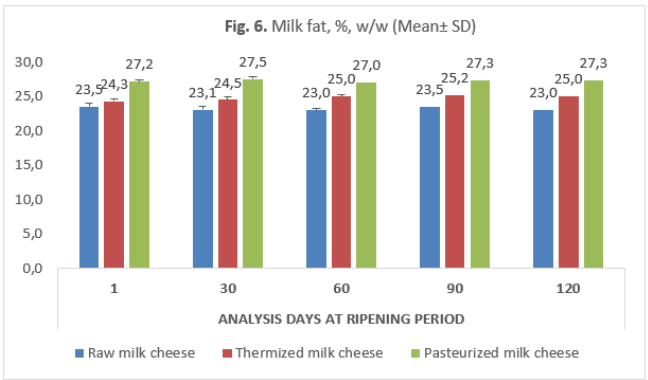
For every d of analysis, distinct acidity values were found for each of the three types of cheese. Every one of these numbers was shown to be statistically distinct from the others. The acidity value of raw milk cheese is 1.2 on the first d it is prepared and packed; for thermized milk cheese and pasteurized milk cheese, it is 0.7 and 0.5, respectively. The acidity of the processed milk cheese rose and the raw milk cheese fell during the next d, approaching one another. The value difference between these two cheeses has dropped to 0.1%, notwithstanding a statistical difference between them. On the 120th d of ripening, the acidity values (1.2) of raw milk and thermized milk cheese were comparable; however, in pasteurized milk cheese, this value was found to be 0.9 (Figure 4).



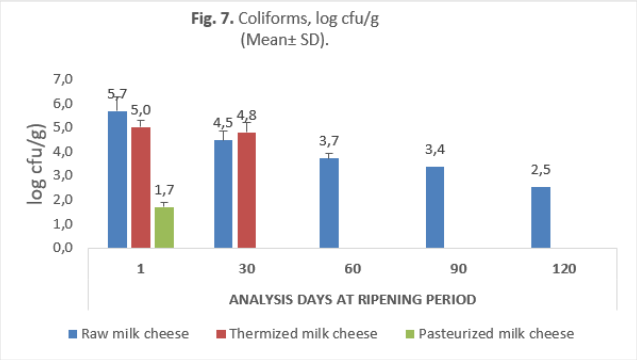
The dry matter levels of the cheeses made from heated milk had the greatest values when ordered from high to low. A statistical confirmation of this difference was also found ($p<0.05$). There was no apparent distinction between pasteurized and raw milk cheese. It was noted that the samples' moisture loss was not appreciably low. Figure 5 provides the values.



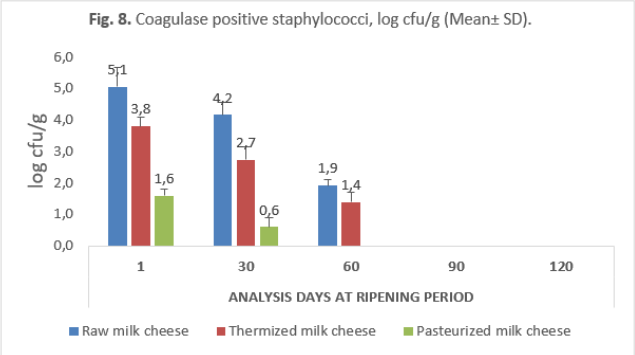
For every d of analysis, distinct fat values were found for each of the three varieties of cheese. Every one of these numbers was shown to be statistically distinct from the others. The cheese's percentage fat value is 23.5 in raw milk cheese on the first d it is prepared and packaged; it is 24.3 in thermized milk cheese and 27.2 in pasteurized milk cheese. There was a statistically significant difference ($p<0.05$) in the fat content of the cheeses. Throughout the ripening phase, the values stayed quite stable (Fig. 6).



In the cheese that was packed, the amount of salt that was added at a rate of 1% of the curd weight prior to the first pressing was measured at 2.05%. The salt levels in its packaging did not alter as it ripened, and these results have not been reported before. The raw milk and fermented milk cheeses were found to contain very high levels of coagulase-positive staphylococcus populations. In raw milk cheese, the degree of contamination was found to be 5.1 log cfu/g, but in therified milk cheese, it was found to be 3.8 log cfu/g. In raw milk, these values were found to be 3.9 log cfu/g (the datum has not been given in Tables or Figures). During the cheese production step, an increase in Coagulase-positive staphylococci was found. Pasteurized milk cheeses had a contamination level of 1.6 log cfu/g, which is acceptable and less than what needed to be counted on the 60th d. In raw milk cheeses, the number declined significantly until the 60th d, however it only dropped to 1.9 log cfu/g. Even on the 60th d, a large quantity of Coagulase-positive staphylococci (4.2 log cfu/g) was found in raw milk cheese. On the 90th d of ripening, it was noted that the amount of coagulase-positive bacteria in all samples dropped below the countable threshold (>10 cfu/g) (Fig. 7).



Both raw milk and fermented milk cheeses have extremely high concentrations of coliform bacteria. In raw milk cheese, the degree of contamination was found to be 5.7 log cfu/g, while in the thermized milk cheese, it was found to be 5.0 log cfu/g. In raw milk, these values were found to be 6.3 log cfu/g. Coagulase-positive staphylococci were found to be more prevalent throughout the cheese production phase. The allowable contamination level in pasteurized milk cheeses was found to be 1.7 log cfu/g, and on the 30th d, it dropped below the countable limit. In raw milk cheeses, the number dropped gradually until the 120th d, although it only dropped to 2.5 log cfu/g. On the 30th d, there were even more Coagulase-positive staphylococci (4.8 log cfu/g); nevertheless, on the 60th d, the amount was seen to fall below the countable level (Fig. 8).



Discussion and Conclusion

Siirt Herby Tulum Cheese is packaged without the use of mold cheese; instead, the cheese is crushed and pushed into the container, unlike other herby cheeses, which employ Cacik (Cacık in Turkish) (17, 37). To get rid of extra salt from the cheese, cheese molds are cleaned in water after being dry salted. After that, the molds are broken apart and imprinted on the package. The likelihood of the cheese becoming tainted rises in this situation. The conventional production method's use of raw milk could be another cause of infection. We think it's difficult to keep cheese from getting contaminated in unsuitable places, like under the stairs or in a home.

There may be variations in the quality of the final product if milk is used in production without consideration for variables like breed, age, race, season, and mixing ratios that affect the content of milk. As a result, before milk is turned into cheese, it must be standardized (23). The technology used to produce Siirt Herby Cheese can be improved by carrying out in-depth research on this topic.

The tissue in herby cheeses breaks up into little lumps either on its own or when pressure is applied. The cheeses have to be completely dried out and seem semi-dry in order to acquire this texture. To achieve this, a large quantity of salt and press weight are employed, and the press time is increased by three to four d. The cheeses are kept at about 20°C during this time to guarantee that the acidity rises and ripening starts (5,6,10,23). We think that extensive manual processing and a prolonged production process are unsuitable for sanitary and modern production. Because of this, we believe that, as was done in this study, it would be suitable to complete the production in a d and package the product the same d. There is no prior research on this topic pertaining to herby tulum cheese that we are aware of. The findings of microbiological and chemical analyses indicate that herby tulum cheese can be made from pasteurized cow's milk in less than a d (Fig. 3–8).

Only the values for moisture, dry matter, fat in dry matter, and salt in dry matter are included in the Herby Cheese Standard (47). Values for dry matter, fat, ash, and salt are included in

the Geographical Indication Certificate (5) for Van Herby Cheese. Values for pH and acidity are absent from both papers. The Herby Cheese Standard does not include an ash value. The pH, acidity, and protein content of cheeses are not covered by the law. This suggests that when developing processes, there is no set norm for acidity and pH.

The table displays the results of the milk and curd analyses. It was found that milk had a density of 1.031, a fat content of 3.29%, and a protein content of 3.1%. It was found that raw milk has a pH of 6.8. The pH of the curd filtered before the first pressing in the samples was found to be 6.0 in the case of raw milk curd, 6.2 in the case of thermized milk curd, and 6.8 in the case of pasteurized milk curd. It has been noted that this is a typical occurrence and that the bacteria found in raw and heated milk both multiply and lower pH levels while cheese is being made. Similar to this, it was found that the acidity of raw milk curd dropped to 0.25% and the acidity of curd milk curd to 0.21%, despite the fact that the acidity of raw milk (lactic acid) was 0.18%. The acidity of pasteurized milk (0.18%) stayed constant with that of raw milk. The same explanation that applies to pH also applies to this circumstance. By eliminating the tainted flora, pasteurization stopped the pH drop and acidity rise. Nonetheless, it is known that curd has a high enough acidity in both raw and heated milk to raise acidity and lower pH during the production stage. This is not the right environment for making cheese the normal, healthful way. Ultimately, we noticed a discernible drop in indicator microorganisms (coagulase positive staphylococci and coliform) in the samples we prepared on the 60th ripening d (Figures 7,8). Similar to raw milk, thermal milk is not ideal for making cheese right away. But more thorough study needs to be done on this topic, including a look into what kind of milk can be used to make cheese after thermization rather than pasteurization. It was believed in this investigation that the high microflora load of milk (3.9 log cfu/ml coagulase positive staphylococcus and 6.3 log cfu/ml coliform) prevented termization from offering adequate assurance. Pasteurized milk cheeses did not exhibit a fall in pH or an increase in acidity. In this instance, using starter culture and/or ripening culture in cheeses ingested after ripening is required, as all scientific research recommend.

According to the Turkish Food Codex Microbiological Criteria Communiqué (19), as a hygienic requirement, the amount of Enterobacteriaceae in pasteurized milk may not exceed 10 log cfu/ml. The rule for pasteurized milk does not include any values for coagulase positive staphylococcus or coliform. Given that the study's raw milk had 6.3 log cfu/ml coliforms and 3.9 log cfu/ml Coagulase-positive staphylococci - both of which were significantly higher than the maximum permitted quantity of *Enterobacteriaceae* (10 log cfu/ml) - it is recognized that raw milk of this quality should not be used to process thermized milk into cheese without pasteurization. It was shown that the samples' bacterial population, including Coagulase-positive staphylococci and coliform, which are regarded as markers, was high even during the ripening period (Figure 7,8). The number of colonies in the milk at 30°C (per ml) must be < 500,000 if raw milk from species other than cows is to be utilized in the making of raw milk cheese without any heat treatment (24). The coliform count (6.3 log cfu/ml) in the milk utilized in this investigation was found to be even higher. It was shown through the examination of cheese samples obtained from sales locations that Siirt Herby Cheeses' hygienic quality did not meet requirements (37). According to Gülmez et al. (17), pasteurized sheep milk is required for the manufacturing of Siirt Herby Tulum Cheese, as raw or matured milk is not acceptable.

Twenty pieces of Siirt herby tulum cheese were measured for pH at a minimum of 4.4 in Siirt province sales points. The highest value measured was 6.3, while the average was 5.3 (37). A different earlier study found that throughout the course of 90 d of ripening, the pH of herby cheese dropped from 4.89 to 4.52 (15). The pH level of the herby cheese samples taken at the sales point has been reported to be at least 4.2, average 5.3, and maximum 6.8, based on the results of numerous other studies (4,7,8,21,28,36). The pH value of 7.3 found in this study's experimentally manufactured raw milk cheese on the 120th d of ripening is noticeably higher than the values found in other research. It is unacceptable for cheese to have this pH level. Thermized milk cheese and pasteurized milk cheese were found to have pH values of 4.6 and 5.9 on the 120th d, respectively (Fig. 3.4). The samples were produced using pasteurized milk, however neither a starting culture nor a ripening culture were utilized. Nonetheless, pH dropped and acidity rose. The bacteria that caused the fermentation were those that survived pasteurization and subsequent contaminations during processing and were spread by herbs, yeast, and/or the indigenous b of milk. Pasteurized milk cheeses were found to have a pH that dropped until the 30th d and then climbed, reaching 5.9 on the 120th d (Fig. 3). It has been previously documented that Siirt Herby Cheeses produced with pasteurized milk had changes in pH and acidity (17). This was taken to mean that the pH was rising and ripening was still ongoing. It was determined that thermized milk cheeses had superior pH stability. Making pasteurized milk cheeses with milk that has starter culture in it is more appropriate (9,13,14, 17). We think it would be good to ascertain the acceptable pH ranges for cheeses, including herby cheeses, that are sold after ripening in their packaging.

The acidity of the herby cheeses marketed in the Siirt city center was found to be at least 0.8 in earlier tests; the highest was found to be 4.1, and the average was 1.9 (37). According to reports from other researchers that examined herby cheeses bought from sales points, several samples had acidity values as low as 0.11% (13), 0.18% (23) and 0.24 (14). These values

are unique to curd cheese, thus it's possible that matured tulum cheese has different causes for them to exist. It could be argued that protein deterioration or overripening neutralize acidity. According to a study, throughout the ripening stage, the acidity (%, lactic acid) increased from 0.62% to 1.05% (15). In a recent study, it was shown that during the 120-d ripening phase, the acidity of Siirt Herby Cheese—which is made with sheep's milk—rose to a level of 0.8% lactic acid. The findings of this investigation showed that on the 120th d, the discrepancies between raw and pasteurized milk cheeses closed and equalized (17). We think that when making Siirt Herby Cheese, it would be advantageous to adjust the acidity to reference standards.

Herby tulum cheeses are produced differently and have similar chemical compositions to other tulum cheeses, but according to the Tulum Cheese Standard (48), their dry matter content must be at least 45% and their moisture content no more than 45% (or 50% in the case of low-fat and fat-free tulum cheeses). The Herby Cheese Standard (47), however, claims a greater moisture value (maximum 60%). The value of this is comparable to that of white cheese. According to Gülmez et al. (17), samples of Siirt Herby Tulum Cheese prepared with sheep's milk had varying levels of dry matter (41–46%). In their examination of samples of herby cheese obtained from sales locations in Siirt's city center, Gülmez et al. (37), discovered that the cheeses' dry matter content was at least 34.6%; they recorded a maximum of 57.9% and an average of 49.6%. There are significant variations in the dry matter ratios of the cheeses that are sold, according to research. It was noted in other earlier research that the dry matter ratio of the Siirt Herby Cheeses sold was not typical (34–36). According to reports, the dry matter content of the cheeses sold at Bitlis, Hakkari, and Van Herby Cheeses varies significantly (21-28,29,30, 32). Cheeses packed in airtight packaging have very little moisture loss (8,12,14, 17). Despite using cow's milk in this investigation, the cheeses' dry matter content was only about 50% (Fig. 5). This data leads us to assume that, similar to other tulum cheeses, it would be OK to market herby cheeses with a dry matter standard of at least 45% and ideally at least 50%.

The percentage of milk fat in dry matter is stated to be at least 45% in the Herby Cheese Standard (47), at least 16.75 percent at most 19.21 percent, and on average 17.29 percent in the Van Herby Cheese Geographical Indication Certificate (5). According to Gülmez et al. (17), samples of Siirt Herby Tulum Cheese prepared with sheep's milk had an average fat content of 18%. In their examination of herby cheese samples obtained from sales locations in Siirt's city center, Gülmez et reported similar outcomes. It was noted in raw, pasteurized, and thermized sheep's milk milk cheeses in an earlier experimental investigation by et al., and it was stated that only pasteurization could offer adequate sanitary guarantee. In their examination of twenty samples of herby cheese obtained al. (37) discovered that the cheeses' dry matter included a minimum of 31.2% fat; the highest percentage they recorded was 63.5%, and the average was 46.8%. It was noted in other earlier research that the dry matter ratio of the Siirt Herby Cheeses sold was not typical (34–36). The dry matter contents of the cheeses sold at Bitlis, Hakkari, and Van Herby Cheeses have reportedly been shown to differ significantly (21–28,29,30, 32). It has been noted that there can be a 20–30% variation in fat content amongst cheeses that are sold (37). According to these research, the dry matter ratios of the cheeses that were for sale varied significantly. We think it would be fair to set a minimum and maximum fat level of 20% and 25% for herby cheeses. We found that Siirt Herby Tulum Cheese made using cow's milk can have fat values that are standardized between 20 and 25 percent in this experimental study (Fig. 6).

The maximum permitted salt concentration in the dry matter of tulum cheese according to the Cheese Communiqué (20) is 5%. It is acknowledged that Tulum cheese should have a maximum salinity of 2.25%. According to the Herby Cheese Standard (47), the maximum salt content is 7.5%, whereas the Van Herby Cheese Geographic Indication document states the maximum salt content is 6.9%. They discovered that the dry matter of the cheeses had a minimum of 1.1% salt content, with a maximum of 4.5% and an average of 2.9%, after analyzing samples of herby cheese that were purchased from Siirt city center sales points (37).

Coagulase-positive staphylococci are the indicator microbe group that must be found in tulum cheese in numerical numbers, with a maximum level of 103 cfu/g permitted, according to the Turkish Food Codex Microbiological Criteria Communiqué (19). According to reports, three of the five samples that were collected for examination should include no more than 102 cfu/g of Coagulase-positive staphylococci, and the other two samples should contain no more than 103 cfu/g. In raw milk, coagulase-positive staphylococcus levels of 3.9 log cfu/g were found. In thermized milk cheese, contamination was found at 3.8 log cfu/g and 5.1 log cfu/g. Coagulase-positive staphylococci were found to be more prevalent throughout the cheese production phase. Pasteurized milk cheeses had a 1.6 log cfu/g contamination level, and their hygienic quality was found to be adequate. On the 60th d in thermized cheese samples and the 90th d in raw milk cheese samples, it did, however, drop to a level that would be deemed hygienic. Other types of cheese were found to drop below the countable level only on the sixty-first d (Fig. 7). Gülmez et al. (17)

from sales locations in Siirt's city center, Gülmez et al. (37) discovered that the cheeses had a minimum of 3.2 log cfu/g, a maximum of 7.3 log cfu/g, and an average of 5 log cfu/g of Coagulase-positive staphylococci. These numbers are all above the level for contamination. High amounts of

contamination were found in samples obtained from sales locations in a few other earlier investigations (21–23,31,35,36).

The Turkish Food Codex Microbiological Criteria Communiqué (19) states that the criterion does not include counting coliform bacteria in cheese. Nevertheless, in order to assess the degree of hygiene and provide specific commentary on the impact of pasteurization and thermization on hygiene, analysis of coliforms was also carried out in this investigation. In raw milk, levels of the coliforms were found to be 6.3 log cfu/g. In raw milk cheese, the degree of contamination was found to be 5.7 log cfu/g and in thermized milk cheese, 5.0 log cfu/g, respectively, exceeding acceptable limits. With the exception of the pasteurized milk cheeses, large levels of contamination (>3 log cfu/g) were found in the other two cheeses on the first d of ripening; however, contamination over this level was only seen in the raw milk cheese at d thirty (Fig. 7). In a prior experimental work with sheep milk, Gülmez et al. (17) found that on the 120th d of ripening in raw milk cheese and on the 90th d of ripening in thermized milk cheese, it dropped below 3 log cfu/g. It has been stated that pasteurization is required to guarantee hygiene. The coliform level in the 20 herby cheese samples that Gülmez et al. (37), analyzed from sales points in the Siirt city center, was found to be at least 1 log cfu/g, at most 9 log cfu/g, and on average 4.6 log cfu/g. These numbers are all above the level for contamination. High levels of contamination, greater than 3 log cfu/g, were seen in samples obtained from sales locations in a few other earlier studies (21-23,31,35, 36).

Because of this, it appears that pasteurized milk must be used in production rather than raw or termized milk, as the existing state of raw milk hygiene is insufficient. Siirt Herby Cheese appears to be able to be made with cow's milk. Cheeses that are low-fat, semi-fat, and full-fat can be made by standardizing the milk that is used. comprehensive analyses of the HACCP system, the industrial production model, the prerequisites, the minimum conditions, a thorough product description, the workflow diagram, the facility layout and operation process, the critical control points, the critical limits, the barrier technology, and the Siirt Herby Cheese recall procedures. It's still not finished. Being one of the initial investigations on tulum cheese with Siirt herb, this study is anticipated to be a valuable resource for future research. We think it would be advantageous to carry out additional research on the topic and create procedures that abide by legal requirements and technical advancements.

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Conflict of Interest

The authors declare no conflict of interest.

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