Araştırma Makalesi / Research Article

Investigation of Some Microbiological and Chemical Properties of Different Cheeses

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Abstract
In this study, some microbiological and chemical analyses were performed on samples of kashar, chechil, lor and white cheeses produced in the region of Kars. The samples were microbiologically evaluated in means of total aerob mesophilic bacteria, coliform group bacteria, *Escherichia coli, Enterobacteriaceae, Staphylococci-Micrococci,* yeast-mold, *Salmonella* spp. and *Listeria monocytogenes.* The pH values of cheese samples were determined by pH-meter, acidity and salt content by titration method, fat content by Gerber method and moisture content by gravimetric method. The chemical analyses were completed and investigated for compliance with Turkish standards. Of the examined kashar cheese samples, 28% in terms of salt content and 40% in terms of moisture content did not meet Turkish standards. Of the chechil cheese samples, 60% in terms of salt content and 40% in terms of moisture content did not meet Turkish standards. Of the lor cheese samples, 4% contained *L. monocytogenes,* while 20% in terms of salt content and 28% in terms of moisture content did not meet Turkish standards. Of the white cheese samples, 8% contained *L. monocytogenes*, while 48% in terms of salt content and 28% in terms of moisture content did not meet Turkish standards It was determined that some of the cheese samples examined in accordance with the obtained results may pose a risk in microbiological terms and do not comply with the relevant standards in terms of chemistry.

Keywords: Kashar, chechil, lor, white cheese, microbiological, chemical.

Farklı Peynir Çeşitlerinin Bazı Mikrobiyolojik ve Kimyasal Özelliklerinin Araştırılması

Öz
Bu araştırmada Kars yöresinde üretimi yapılan kaşar, çeçil, lor ve beyaz peynir örneklerinin mikrobiyolojik ve kimyasal özellikleri incelendi. Örnekler mikrobiyolojik olarak toplam aerob mezofilik bakteri, koliform grubu bakteri, *E. coli, Enterobacteriaceae, Stafilokok-Mikrokok,* maya-küf, *Salmonella* spp. ve *L. monocytogenes* yönünden değerlendirildi. Peynir örneklerinin pH değerleri pH-metreyle, asitlik ve tuz miktarları titrasyon yöntemiyle, yağ miktarı Gerber metoduyla ve rutubet miktarı gravimetrik yöntemle tespit edilerek örneklerin kimyasal özellikler açısından standartlara uygun olup olmadıkları belirlendi. Sonuç olarak incelenen kaşar peyniri örneklerinden %28'inin tuz ve %40'ının rutubet; çeçil peyniri örneklerinden %60'ının tuz ve %40'ının rutubet; lor örneklerinden %4'ünün *L. monocytogenes*, %20'sinin tuz ve %28'inin rutubet; beyaz peynir örneklerinden %8'inin *L. monocytogenes*, %48'inin tuz ve %28'inin rutubet yönünden Türk Standartlarında belirtilen kriterlere uygun olmadığı belirlendi. Elde edilen sonuçlar doğrultusunda incelenen peynir örneklerinin bazılarının mikrobiyolojik açıdan risk oluşturabileceği ve kimyasal yönden de ilgili standartlara uymadığı belirlendi.

Anahtar kelimeler: Kaşar, çeçil, lor, beyaz peynir, mikrobiyolojik, kimyasal.

1. Introduction

Cheese is an important food that contains essential amino acids that cannot be synthesized by our body and is rich in protein, mineral and vitamin content. Cheese, which is indispensable for breakfast tables,

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has a very important place in human nutrition because of its superior composition. More than 1000 different types of cheese are produced worldwide while produced by the impact of different cultures in Turkey there are 150 varieties of cheese from more [1].

Cheese, which has hundreds of varieties and holds a very important place in human nutrition, also has important chemical and microbiological qualities. The microorganisms found in cheese cause changes in the structure of the cheese, negatively affecting its quality, and can lead to food poisoning as a result. Many bacteria that can threaten public health can be found in the natural flora of milk. At the same time, the processes applied during heat treatment and production should be controlled as much as possible because they also affect the overall quality of milk [2]. Inadequate pasteurization of milk used in cheese production and bacterial contamination of holding conditions during maturation negatively affect the development and quality of cheese microflora [3, 4]. In studies of the microbiological quality of cheeses, it has been expressed that many microorganisms that negatively affect the quality of cheese and species that threaten human health have been isolated in cheese samples. Foremostamong those mentioned include *E. coli*, coliform group bacteria, *Salmonella* species, *L. monocytogenes*, *Staphylococcus aureus*, yeast and mold [5]. In one of these studies, coliform group bacteria, *E. coli, S. aureus* and fecal *Streptococci* were found in tulumcheese samples in different packages procured from the Istanbul market [6].

In a study, *Enterobacteriaceae*, coliform and *S. aureus* were found in herbycheese samples collected from various sales points in Van city center [7]. In another study, it was stated that 90.5% of 42 kashar cheese samples failed to comply with the TSE (Turkish Standards Institute) standards due to pathogenic bacterial load [8]. In a study in which microbiological and chemical properties of Divle cheese, a type of cheese from the Konya, Karaman and Ereğli region, were investigated, it was reported that consumption of Divletulum cheeses posed potentially serious risks to public health because of containing varying levels of microorganisms and also many pathogens and non-pathogenic microorganisms [9]. In a study which investigated the microbiological quality of civil cheeses obtained from Erzurum region, according to the microbiological analysis results, it was concluded that civil cheese may cause a potential risk for public health [10].

Cheese production has held an important place in the Kars economy since the 1870s. Around 16 dairy farms were first established by Swiss, Armenian, Greek, Russian and Georgian cheese producers in the region of Kars and nearby districts [11]. More than 10 different types of cheese, mainly kashar and gruyere-type, are produced in this region [1]. Although the history of cheese-making is very old, most of today's production is provided by small family farms and dairies in the region. As the raw material of cheese is milk, investigating the microbiological characteristics of the product at every stage from production to consumption is very important. This study aimed to investigate the microbiological and chemical quality of different cheese varieties obtained from the Kars market and to find solutions to possible risks or shortcomings of the Kars cheese industry, which holds a very important place in the region in cultural and economic terms.

2. Material and Methods

Cheese samples: In order to examine the microbiological and chemical quality of the cheese offered in the market, 100 cheese samples, including 25 of kashar cheese, 25 of chechil cheese, 25 of lor and 25 of white cheese were supplied from sales points at the centre of Kars. Without interfering with the vendors' routine sales procedures and packaging, each 500-g cheese sample was then placed in heat-insulated containers and kept cold. Samples were brought to the laboratory within 30-60 minutes after they were taken from the market and analyzed for microbiological and chemical properties.

2.1. Microbiological Analyses

The cheese samples, weighing 500 g, were taken from the packaging material using sterile forceps and a spatula, transferred into sterile bags and then broken up and mashed by applying pressure and pounding the bag. For each cheese sample, 10 g were weighted and diluted aseptically in 90 mL of citrate buffer and homogenised in a sterile bag using a stomacher for 2 min. The complete decimal serial dilutions till 10^{-6} of the samples were prepared and inoculated using pour and spread techniques under the following incubation conditions. The details of the methods used for microbiological analyses are shown in Table

1.All colonies produced on Plate Count Agar (PCA) were aerobic mesophilic bacteria [12, 13]; dark red colonies 0.5 mm in diameter or larger cultured on Violet Red Bile Lactose Agar (VL) were coliform bacteria [14]; blue-green colonies grown on Tryptone Bile X-Glucuronide medium (TBX) were *E. coli* [15, 16]; all red colored and oxidase (-) colonies 1-2 mm in diameter cultured on Violet Red Bile Glucose Agar (VG) were *Enterobacteriaceae* [13, 17]; black colonies formed on Baird Parker Agar (BPA) were evaluated as *Staphylococci-Micrococci* [13]; all colonies cultured on Potato Dextrose Agar (PDA) were yeast-mold [14]. To analyze the presence of *Salmonella* spp., and *L. monocytogenes* 25 g samples were pre-enriched and incubated at 37°C for 24h, 30°C for 24h, respectively. 225 mL Buffered Pepton Water (Oxoid CM509, UK) and 225 mL Buffered Listeria Enrichment Broth (Oxoid CM897, UK) respectively were used for selective enrichment. Samples homogenized for 2 minutes. For the inoculation, incubation and identification were applied according to the methods specified in TSE standards [18, 19]. Selected typical 5 suspected colonies for *Salmonella* spp. (Oxoid DR1108, UK) and *L. monocytogenes* (Oxoid MB1128A, UK) were confirmed with serological and biochemical test kits.

The appropriate amount of the homogenized cheese samples were taken and made ready for chemical analyses.

2.2. Chemical Analyses

The pH values of the samples were measured using a pH-meter and determined according to the method of Bianco et al. [20]. The acidity and salt contents of the samples were determined by titration method, the fat content was analyzed using the Gerber method and the moisture content was determined by the gravimetric method [21].

Table1. Media used in microbiological analysis and incubation conditions of bacteria

Group of bacteria	Medium	Incubation temperature	Incubation time	Incubation atmosphere
Total aerob mesophilic bacteria	Plate Count Agar (PCA) (Oxoid CM0325)	30 °C	48 hour	Aerobic
Coliform	Violet Red Bile Lactose Agar (VL) (Oxoid CM0107)	37 °C	48 hour	Facultative Aerobic
Escherichia coli	TBX Medium (Oxoid CM0945)	44.5	24 hour	Aerobic
Enterobacteriaceae	Violet Red Bile Glucose Agar (VG) (Oxoid CM0485)	35 °C	48 hour	Facultative Aerobic
Staphylococci-Micrococci	Baird Parker Agar (BP) (Oxoid CM0275)	37 °C	24 hour	Aerobic
Yeast-Mold	Potado Dextrose Agar (PDA) (BAM Media M127)	25 °C	4-5 day	Aerobic
***Salmonella* spp.**	Brillant Green Phenol Red Agar (Modified) (Oxoid CM0329) Xylose-Lysine-Desoxycholate Agar (XLD) (Labm LAB 032)	37 °C	24 hour	Aerobic
Listeria monocytogenes	Listeria Selective Agar Base (Oxoid CM0856)	30 °C	24 hour	Aerobic

2.3. Statistical analyses

The data obtained as a result of the research were subjected to variance analysis via the SPSS PASW Statistics 18 package program and the results were given as mean ± standard deviation.

3. Results and Discussion

As a result, of the kashar cheese samples, 7 (28%) in terms of salt content and 10 (40%) in terms of moisture content did not meet Turkish standards. Of the chechil cheese samples, 15 (60%) in terms of salt content and 10 (40%) in terms of moisture content did not meet Turkish standards. Of the lor samples, 1 (4%) contained *L. monocytogenes*, while 5 (20%) in terms of salt content and 7 (28%) in terms of moisture content did not meet Turkish standards. Of the examined white cheese samples, 2 (8%) contained *L. monocytogenes*, while 12 (48%) in terms of salt content and 7 (28%) in terms of moisture content did not meet Turkish standards. The microbiological analysis results of all cheeses are given in Tables 2 and 3. Chemical analysis findings of the kashar, chechil, lor and white cheeses evaluated according to the Turkish Food Codex Cheese Communiqué [21] are given in Tables 4 and 5.

When the microbiological data of the samples collected from the market were analyzed, it was found that the microbial load varied from sample to the sample.

The average TAMB count in the kashar cheese samples was $1.2x10^8$ cfu/g. This result was higher than that reported by Kamber [22] (7.03 $\log_{10}$ cfu/g) and Öksüztepe et al. [26] ($1.1x10^7$ cfu/g). Although there is no limitation for TAMB in the Turkish cheese standard, these pathogenic bacteria values are at a level that could threaten public health. This may be due to a lack of hygiene during the production or sales phase. In this study, the average coliform group bacteria count in kashar cheese was found to be $0.66x10^1$ cfu/g. These results were lower than those of Gülmez et al. [27] ($1.16x10^2$ cfu/g) and Kamber [22] (3.91 $\log_{10}$ cfu/g). In none of the kashar samples, *E. coli* was not found, and this microorganism poses a risk for food safety as well as endangering the formation of cheeses [3]. The *Enterobacteriaceae* count ($3.5x10^1$ cfu/g) was also found to be lower than that reported by Kamber (22) (4.30 $\log_{10}$ cfu/g). The average *Staphylococci-Micrococci* count was $8.30x10^1$ cfu/g, which was lower than that found by Öksüztepe et al. [26] ($1.4x10^2$ cfu/g). The yeast-mold count ($3.82x10^1$ cfu/g) was similar to the results of Kamber [22], with 6.04 $\log_{10}$ cfu/g, but lower than those of Gülmez et al. [27] ($3.8x10^8$ cfu/g). Neither *L. monocytogenes* nor *Salmonella* spp. were present in any of the kashar cheese samples.

The average TAMB count found in the samples of chechil cheese was $1.2x10^8$ cfu/g. This result was higher than the results of Kamber [22] (7.253 $\log_{10}$ cfu/g) and of Yangılar and Kızılkaya [23] (7.97 $\log_{10}$ cfu/g), while lower than that of Gülmez and Güven [24] ($1.1x10^9$ cfu/g). This situation may have been caused by many factors, such as the differences in pasteurization processes applied to the milk or ripening times of the cheese. Kamber [22], in his study, found the number of coliform bacteria in chechil cheese to be on average 4.35 $\log_{10}$ cfu/g, while the number determined by Gülmez and Güven [24] was $2.8x10^5$ cfu/g. In the present study, in contrast, the coliform bacteria count was found to be quite low ($1.9x10^1$ cfu/g). The presence of coliform bacteria in foods indicates inadequate or incorrect heat treatment applications or poor hygiene conditions [3]. The average *E. coli* count was found to be $0.14x10^1$ cfu/g in two samples. The presence of this bacterium may indicate a fecal source of contamination as well as the presence of pathogenic microorganisms in the environment [25]. The *Enterobacteriaceae* count was recorded as $1.9x10^2$ cfu/g, whereas the study by Kamber [22] found a higher number of *Enterobacteriaceae* (3.47 $\log_{10}$ cfu/g). The average *Staphylococci-Micrococci* count was found to be $1.65x10^2$ cfu/g. The yeast-mold count was determined as $4.31x10^6$, similar to the result of Kamber [22] (6.454 $\log_{10}$ cfu/g), wherein it was lower than the result of Gülmez and Güven [24] ($6.8x10^8$ cfu/g). *L. monocytogenes* and *Salmonella* spp. were not detected in any of the samples of chechil cheese.

In the lor samples, the TAMB count was determined as $7.73x10^8$ cfu/g. This result showed a similarity to that reported by Sert and Kıvanç (34) ($1.9x10^8$ cfu/g), while it was lower than the results of Kızanlık-Koçak and Göksoy [29] (9.80 $\log_{10}$ cfu/g). The average coliform bacteria count was $1.66x10^1$ cfu/g, which was lower than the results of Sert and Kıvanç [34] ($1.1x10^3$ cfu/g). The *E. coli* count was $0.28x10^1$ cfu/g, lower than the result of Sert and Kıvanç [34] ($4.37x10^2$ cfu/g). The *Enterobacteriaceae* count was $5.9x10^1$ cfu/g and the *Staphylococci-Micrococci* count was $9.59x10^1$ cfu/g. The yeast-mold

count was determined as $2.21x10^6$ cfu/g, similar to the results of Sert and Kıvanç [34] ($1.9x10^8$ cfu/g). *L. monocytogenes* ($0.04x10^1$ cfu/g) was detected in one lor sample, whereas none of the samples exhibited the presence of *Salmonella* spp. *L. monocytogenes* is a pathogenic bacterium which, according to Turkish standards, should not be found in cheese as it can cause serious health problems such as meningitis, septicemia, and abortion [3].

The average TAMB count in the white cheese samples was found to be $7.3x10^8$ cfu/g, whereas the number found by Sağun et al. [28] was lower (7.25 $\log_{10}$ cfu/g), and that found by Kızanlık-Koçak and Göksoy [29] was higher (9.43 $\log_{10}$ cfu/g). The coliform bacteria count found ($0.84x10^1$ cfu/g) was similar to that reported by Sağun et al. [28] (1.06 $\log_{10}$ cfu/g). In this study, *E. coli* was not detected in any of the white cheese samples, although in another study on raw milk and white cheese samples in the Kars Province, *E. coli* was isolated in all the samples of white cheese [30]. In the tested samples *Enterobacteriaceae* count was $9.28x10^1$ cfu/g. Similarly, the *Staphylococci-Micrococci* count ($1.18x10^1$ cfu/g) was also close to that reported by Sağun et al. [28]. In the tested samples yeast-mold count was $2.85x10^6$ cfu/g. *L. monocytogenes* must not be found in food samples. In a study, samples of white cheese and chechil cheese offered for sale in Kars Province were examined for *Campylobacter*, *Salmonella* and *Listeria* species and *L. monocytogenes* was found in 5% of the fresh cheese samples. In another study, *L. monocytogenes* in 3% of the white cheese samples [31] while in the present study, *L. monocytogenes* was detected in 8% of the white cheese samples that might also cause the public health risks. This is an indication that the milk had not been sufficiently pasteurized [3]. In order to control *Salmonella* contamination and infection, it is necessary to regularly analyze the presence of *Salmonella* in food. Similar to the results obtained in the present study, no *Salmonella* was detected in the cheese samples in another study performed for evaluating the microbiological quality of cheese samples sold in Ankara [32]. However, *Salmonella* species were found in 2% of cheese samples in another study conducted with white cheese obtained from distinct markets in central Afyonkarahisar Province [33].

In a study that examined samples of Kars kashar cheese, it was reported that 92% and 38% of the samples failed to meet the standards in terms of moisture content and dry matter salt content, respectively [24]. Similarly in this study, 40% of the kashar cheese samples in terms of moisture and 28% in terms of salt did not meet Turkish standards. This may be due to the manufacturer's failure to use a standard method. In this study, the fat content of the chechil cheese was between 14.3% and 22.6%. This result is higher than that found by Yangılar and Kızılkaya [23] (7.43%-12.55%). In this study, the fat content in lor cheese was found between 7.21% and 13.3%. As in this study, fat rates were found different in other studies [35, 36, 37]. This difference may be due to the difference in the amount of fat used in milk production in cheese. In this study, 80% of the white cheese samples were found to be semi-skimmed and 20% low-fat. This result is similar to the results of Gülmez et. al. [27].

Table 2. Results of microbiological analysis of kashar and chechil cheeses (cfu/g)

Cheese Type	Number of samples	Analysis	TS Standard 28155	Distribution of bacteria	Number of samples	Minimum	Maximum	Average±SD	Non-standard samples (%)
Kashar Cheese	25	TAMB	-	$<10^8$	19	$1.4x10^7$	$6.8x10^8$	$1.02x10^8 \pm 2.92$	-
				$\geq 10^8$	6				
		Coliform	-	$<10^1$	23	$<10^1$	$3.6x10^1$	$0.66x10^1 \pm 0.23$	-
				$\geq 10^1$	2				
		Escherichia coli	10^2	$<10^1$	25	$<10^1$	$<10^1$	$<10^1$	-
				$\geq 10^1$	0				
		Enterobacteriaceae	-	$<10^2$	23	$<10^2$	$1.7x10^2$	$3.5x10^1 \pm 0.90$	-
				$\geq 10^2$	2				
		Staphylococci-Micrococci	-	$<10^2$	8	$1.1x10^1$	$3.4x10^2$	$8.30x10^1 \pm 1.55$	-
				$\geq 10^2$	17				
		Yeast-Mold	-	$< 10^6$	9	$4.4x10^5$	$1.6x10^7$	$3.82x10^6 \pm 7.87$	-
				$\geq 10^6$	16				
		Salmonella spp.	-	-	-	-	-	-	-
		Listeria monocytogenes	-	-	-	-	-	-	-
Chechil Cheese	25	TAMB	-	$<10^8$	14	$1.5x10^7$	$1.8x10^9$	$1.6x10^8 \pm 7.08$	-
				$\geq 10^8$	11				
		Coliform	-	$<10^1$	24	$<10^1$	$1.6x10^2$	$1.9x10^1 \pm 0.71$	-
				$\geq 10^1$	1				
		Escherichia coli	10^2	$<10^1$	23	$<10^1$	$2.4x10^1$	$2.3x10^1 \pm 0.10$	-
				$\geq 10^1$	2				
		Enterobacteriaceae	-	$<10^2$	11	$<10^2$	$6.8x10^2$	$1.9x10^2 \pm 4.21$	-
				$\geq 10^2$	14				
		Staphylococci-Micrococci	-	$<10^2$	11	$1.8x10^1$	$7.4x10^2$	$1.65x10^2 \pm 3.45$	-
				$\geq 10^2$	14				
		Yeast-Mold	-	$<10^6$	6	$2.2x10^5$	$2.8x10^7$	$4.31x10^6 \pm 1.18$	-
				$\geq 10^6$	19				
		Salmonella spp.	-	-	-	-	-	-	-
		Listeria monocytogenes	-	-	-	-	-	-	-

Table 3. Results of microbiological analysis of lor and white cheeses (log cfu/g)

Cheese Type	Number of samples	Analysis	TS Standard 28155	Distribution of bacteria	Number of samples	Minimum	Maximum	Average±SD	Non-standard samples (%)
Lor	**25**	TAMB	-	$<10^8$	0	$1.2x10^8$	$3.4x10^9$	$7.73x10^8±1.59$	-
				$\geq10^8$	25				
		Coliform	-	$<10^1$	20	$<10^1$	$6.8x10^1$	$1.66x10^1±0.49$	-
				$\geq10^1$	5				
		Escherichia coli	10^2	$<10^1$	23	$<10^1$	$3.2x10^1$	$0.28x10^1±0.16$	-
				$\geq10^1$	2				
		Enterobacteriaceae	-	$<10^2$	22	$<10^2$	$3.2x10^2$	$5.9x10^1±1.58$	-
				$\geq10^2$	3				
		Staphylococci-Micrococci	-	$<10^2$	17	$1.1x10^1$	$4.8x10^8$	$9.59x10^1±2.17$	-
				$\geq10^2$	8				
		Yeast-Mold	-	$<10^6$	13	$1.2x10^5$	$1.1x10^7$	$2.21x10^6±5.08$	-
				$\geq10^6$	12				
		Salmonella spp.	-	-	-	-	-	-	-
				-	-				
		Listeria monocytogenes	-	$<10^1$	24	-	$1.4 x10^1$	$0.04x10^1±0.04$	1(4)
				$\geq10^1$	1				
White Cheese	**25**	TAMB	-	$<10^8$	0	$1.4x10^8$	$6.2x10^9$	$7.3x10^8±2.37$	-
				$\geq10^8$	25				
		Coliform	-	$<10^1$	21	$<10^1$	$8.6x10^1$	$0.84x10^1±0.60$	-
				$\geq10^1$	4				
		Escherichia coli	10^2	$<10^1$	25	$<10^1$	$<10^1$	$<10^1$	-
				$\geq10^1$	0				
		Enterobacteriaceae	-	$<10^2$	16	$<10^2$	$2.8x10^2$	$9.28x10^1±1.81$	-
				$\geq10^2$	9				
		Staphylococci-Micrococci	-	$<10^2$	19	$1.2x10^1$	$6.1x10^2$	$1.18x10^1±3.19$	-
				$\geq10^6$	6				
		Yeast-Mold	-	$<10^6$	15	$1.4x10^5$	$1.4x10^7$	$2.85x10^6±7.38$	-
				$\geq10^2$	10				
		Salmonella spp.	-	-	-	-	-	-	-
				-	-				
		Listeria monocytogenes	-	$<10^1$	23	-	$2.6x10^1$	$0.20x10^1±0.13$	2(8)
				$\geq10^1$	2				

Table 4. Results of chemical analysis of kashar and chechil cheeses (log cfu/g)

Cheese Type	Number of samples	Analysis	TS Standard 28155	Distribution	Number of samples	Minimum	Maximum	Average±SD	Non-standard samples (%)
Kashar Cheese	**25**	pH	-	<4.0 4.0-5.0 >5.0	*	*	*	*	*
		Acidity (lactic acid%)	-	<2.0 2.0-3.0 >3.0	7 17 1	1.44	3.02	2.29±0.07	-
		Fat(%)	Full fat Semi-skimmed Low fat Fatless	≥45 25-44 10-24 <10	8 17 0 0	35.2	54.4	42.84±0.92	-
		Salt(%)	2.5- 3.5	<2.5 2.5-3.5 >3.5	0 18 7	2.9	5	3.58±0.12	7 (28)
		Moisture(%)	≤45	≤45 >45	15 10	31.2	49.1	42.59±1.00	10 (40)
Chechil Cheese	**25**	pH	-	<4.0 4.0-5.0 >5.0	0 0 25	5.11	5.72	5.35±0.03	-
		Acidity (lactic acid%)	-	<2.0 2.0-3.0 >3.0	25 0 0	0.46	1.86	1.03±0.06	-
		Fat(%)	Full fat Semi-skimmed Low fat Fatless	≥45 25-44 10-24 <10	0 0 25 0	14.3	22	18.48±0.47	-
		Salt(%)	≤3.0	≤3.0 >3.0	10 15	1.1	4.5	2.84±0.19	15 (60)
		Moisture(%)	≤45	≤45 >45	15 10	36.2	52.6	45.51±0.90	10 (40)

*: No results or measurement failed

Table 5. Results of chemical analysis of lor and white cheeses (log cfu/g)

Cheese Type	Number of samples	Analysis	TS Standard 28155	Distribution	Number of samples	Minimum	Maximum	Average±SD	Non-standard samples (%)
Lor	**25**	pH	-	<4.0	0	4.12	4.98	4.46±0.05	-
				4.0-5.0	25				
				>5.0	0				
		Acidity (lactic acid%)	-	<2.0	25	0.71	1.51	1.14±0.53	-
				2.0-3.0	0				
				>3.0	0				
		Fat(%)	Full fat	≥45	0	7.2	13.3	9.46±0.36	-
			Semi-skimmed	25-44	0				
			Low fat	10-24	10				
			Fatless	<10	15				
		Salt(%)	≤2.0	≤2.0	20	1.2	2.2	1.85±0.04	5 (20)
				>2.0	5				
		Moisture(%)	≤75	≤75	18	62.2	86.6	71.47±1.25	7 (28)
				>75	7				
White Cheeses	**25**	pH	-	<4.0	0	4.42	4.86	4.64±0.02	-
				4.0-5.0	25				
				>5.0	0				
		Acidity (lactic acid%)	-	<2.0	25	1.02	1.6	1.25±0.30	-
				2.0-3.0	0				
				>3.0	0				
		Fat(%)	Full fat	≥45	0	11.5	29.2	21.25±0.86	-
			Semi-skimmed	25- 44	5				
			Low Fat	10-24	20				
			Fatless	<10	0				
		Salt(%)	≤2.5	≤2.5	13	2	3.6	2.73±0.11	12 (48)
				>2.5	12				
		Moisture(%)	65	≤65	18	54.2	69.4	62.05±0.92	7 (28)
				>65	7				

4. Conclusion and Suggestions

As a result, according to the results obtained, many of the cheese samples might pose a microbiological risk and moreover, were shown to be chemically and microbiologically sub-standard. This situation shows the deficiencies in the quality of cheeses and poses a potential threat to public health. In this situation, hygiene rules must be followed throughout all stages of cheese production, from the processing stage to the marketing stage, by using pasteurized and standardized milk, using a starter culture and using suitable processing and packaging methods. Cheese production can also be improved by raising the awareness of the small family businesses that play a major role in the market share. Thus, it will be possible to obtain a more standard, hygienic and high-quality product. As in all food sectors, support must be provided for more discerning and controlled production and marketing opportunities in terms of milk and dairy products. The aim of this study was to provide a reference to encourage more detailed microbiological and chemical studies in order to offer healthful and safe cheese to the public. Kars cheeses, predominantly kashar, hold a very important place in the Kars market as well as throughout the whole of Turkey. For this, the production of Kars cheeses in hygienic conditions and in accordance with the standards is important for the protection of public health.

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Author' Contributions

The author gave final approval of the current version and any revised version to be submitted to the journal.

Statement of Conflicts of Interest

No potential conflict of interest was reported by the authors.

Statement of Research and Publication Ethics

The authors declare that this study complies with Research and Publication Ethics.

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