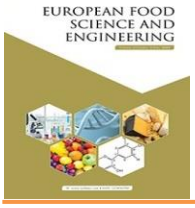

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A study on the investigation of some properties of cheeses supplied from Kastamonu local markets

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ABSTRACT

In this research, some physicochemical and microbiological analyses were performed on 10 Beyaz cheeses and 10 Lor cheeses obtained from the local markets in Kastamonu in February 2022, and it was determined whether the cheeses met the standards. Moisture, fat, fat in dry matter, protein, salt, salt in dry matter, pH, and titratable acidity values in Beyaz Cheese and Lor cheese samples were determined as 61.36-69.04%, 15.29-8.86%, 39.25-28.43%, 16.61-16.72%, 1.362-0.892%, 3.63-2.87%, 5.75-4.12, 0.150-0.172%, respectively. The average numbers of total aerobic mesophilic bacteria (TAMB), lactic acid bacteria growing on MRS agar, lactobacilli, lactic acid bacteria growing on M17 agar, lactococci, yeast-mold and coliform group bacteria in Beyaz Cheese and Lor cheese samples were determined as 7.89-7.25, 7.31-6.75, 6.93-6.84, 4.20-5.07, 5.70-0.78 log cfu/g, respectively. Based on the findings of the physicochemical analysis, it was found that the cheese samples made in the local markets of Kastamonu generally met the required standards. As a result of the microbiological analysis, coliform group bacteria were found in one of the Lor cheeses. However, coliform group bacteria were detected in all Beyaz cheese samples. These results showed that hygiene could not be ensured in the Beyaz cheese samples.

1. Introduction

Milk is a food of animal origin that is very important for human nutrition due to the macro and micronutrients it contains. Milk, which is needed at every stage of human life, has been proven by many studies to be beneficial to bone and dental health, especially during childhood and pregnancy. Moreover, studies showing its relationship with chronic diseases such as cancer, obesity, and hypertension have come to the fore and there has been an increase in studies in this direction (Black et al., 2002; Jain, 1998). Studies have shown that consuming 1 L of milk per day meets all the phosphorus and calcium needs of adults and almost all of the needs of children. Similarly, while it meets the entire need for vitamin B12 and vitamin B2, it meets half of the protein need (Onurlubaş & Çakırlar, 2016). As a result of changing living standards and the awareness of producers and consumers, the focus on food production and nutrition has increased. Thanks to this, researchers have shown interest in the production of foods that are both beneficial to human health and rich in nutrients (Seçkin & Baladura, 2011). Cheese, which is an example of these foods, is an important dairy product that, in addition to being nutritious, has many varieties that can meet the tastes and demands of society and whose production is rapidly increasing. It is stated that there are 4000 types of cheese in the world, which has an important place in people's diets (Fox, 1987). Cheese can be defined as a fermented milk product that has its own aroma, structure, and shape, depending on the distinctive processes of each region. Cheese technology applications have gained diversity as a result of the inclusion of traditional methods in production, as in many areas. Cheese types produced with traditional methods are preferred and offered for sale in many parts of Türkiye (Durlu Özkaya & Gün, 2007). According to the Turkish Food Codex Cheese Communiqué, the definition of cheese is “It is a dairy product obtained by coagulating the raw material using a suitable coagulant and separating the whey from the curd or coagulating the milk after separating the permeate”. The definition of Beyaz cheese is “brined cheese, which is produced by processing the curd obtained by coagulating the raw material using rennet, in accordance with the technique, can be defined as fresh or ripened according to the differences in the production stages, and has characteristic features specific to its type”. Lor cheese, on the other hand, is defined under the title of whey cheese as 'cheese that is consumed fresh and has characteristic features specific to its variety, obtained by denaturing and coagulating the serum proteins in the whey with the effect of heat treatment at certain acidities and then separating them from the serum' (Anonymous, 2015). Cheese, although it goes through some different processes depending on its type, basically consists of several processes. After the milk goes through certain pre-treatments, lactic acid bacteria suitable for the type of cheese to be made are used and rennet (proteolytic enzyme) is added after the pre-ripening process. Under the action of the enzyme, casein breaks down and becomes insoluble, allowing clot

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formation. These curds are then cut into small pieces with appropriate equipment for easier removal of whey. The whey is then removed from the curd. The resulting cheese is pressed by applying pressure using appropriate methods and takes its final shape (Erol, 2014). Cheese, based on the production amounts of milk and dairy products, ranks third after yoghurt and processed milk (Çelik & Uysal, 2009). Traditionally produced Beyaz cheese is the most preferred cheese type and accounts for 60% of our cheese production. These cheeses can be made from cow's milk, sheep's milk, and goat's milk, as well as combinations of these. A typical Beyaz cheese has a salty and acidic taste with a distinctive aroma. These cheeses can be porous or non-porous, semi-hard, or soft (Eren Vapur & Ozcan, 2012). Local cheeses constitute 11% of the cheeses produced in Türkiye. Apart from this data, there are also cheeses produced in rural farms and dairies, but the quantities of these cheeses produced cannot be known exactly because they cannot be recorded (Kamber, 2008).

Our study, it was aimed to determine the physicochemical and microbiological properties of the cheeses produced by the local people of Kastamonu province and sold in the local markets and their compliance with the standards.

2. Materials and methods

In the study 10 Beyaz Cheeses and 10 Lor Cheeses used were obtained from the local markets in Kastamonu in February 2022. All samples were stored at +4°C throughout the analyses. Cheese samples were analyzed for moisture by the oven-drying method at 102 °C (IDF, 1982), fat by the Gerber method (IDF, 1997), the salt content by the Mohr method (IDF, 1979), and total nitrogen by the micro-Kjeldahl method (IDF, 1993). For pH measurement, 10 g of sample was macerated in 10 mL of distilled water, and the pH of the resultant slurry was measured using a digital pH meter. Titratable acidity (% lactic acid) was measured as suggested by AOAC (1995). For microbiological analysis, 10 g of cheese sample was weighed into stomacher bags under aseptic conditions and 90 mL of physiological saline solution was added. It was homogenized for 2 min and the homogenate was used to prepare 1/10 serial dilutions.

Total aerobic mesophilic bacteria were enumerated on Plate Count Agar (Merck) at 30±1 °C for 48 h (Harrigan, 1998), presumptive lactobacilli on MRS agar (Merck) at 32±1 °C for 3–5 days under anaerobic conditions (Harrigan,1998), presumptive lactococci on M17 agar (Merck) at 30±1 °C for 24 or 48 h (Gilliland et al.,1984), yeasts and molds on Dichloran Rose Bengal Chloramphenicol (DRBC) Agar (Merck) at 25 °C for 5 day (Cankurt & Sağdıç, 2019), coliforms on Violet Red Bile Agar (Merck) at 35±1 °C for 24 h (Mehlman, 1984).

3. Results and Discussion

3.1. Physicochemical properties

Physicochemical analysis results of Beyaz cheese samples are given in Table 1. According to the Turkish Food Codex (TFC) Cheese Communiqué, the moisture content of fresh Beyaz cheese should not exceed 65% (Anonymous, 2015). When the determined moisture values were examined, it was determined that, except for the 3rd (66.10%) and 7th (69.55%) cheese samples, the other Beyaz cheeses did not exceed this limit. The average moisture value of Beyaz cheese samples was determined as 61.36% (Table 1). The results obtained were similar to the results of Harmankaya & Harmankaya (2020) (62.05%). The results obtained are higher than the results determined by Uraz & Şimşek (1998) (58.29%), Sağun et al. (2001) (59,45%), Toker (2001) (56.97%), Gökmen et al. (2013) (59.34%), Erol (2014) (53.06%), Eljagmani (2020) (56.10%), Çetinkaya (2021) (53.47%), and lower than Sancak & Sancak (1995) (63.39%) and Ayar et al. (2006) (64.20%). In the TFC, the amount of salt is stated as a percentage of dry matter, and it has been reported that this value should be at most 6.5% in Beyaz cheeses (Anonymous, 2015). Considering the calculated salt values, except for the 6th cheese sample (11.46%), the other cheese samples comply with the codex (Table 1). Salt used in cheese production has some purposes such as adding flavor to the cheese, increasing its shelf life, improving the texture and structure of the cheese, and adjusting and selecting the microflora of the cheese (Üçüncü, 2010). In addition, the amount of salt in cheese controls water activity, enzyme activity, and physical changes in cheese proteins (Gülter, 2011).

The average salt value of Beyaz cheese samples was determined as 1.362% (Table 1). The results obtained in the current study are higher than Eljagmani (2020) (0.328%), lower than the results of Sancak & Sancak (1995) (4.70%), Uraz & Şimşek (1998) (4.00%), Sağun et al. (2001) (3.42%), Toker (2001) (4.50%), Ayar et al. (2006) (3.42%), Erol (2014) (3.76%), Harmankaya & Harmankaya (2020) (2.73%), Çetinkaya (2021) (2.55%).

According to TFC, fat classification is stated as a percentage of dry matter. Cheeses with milk fat ≥45% are classified as full-fat, cheeses with 25%≤ milk fat <45% are classified as semi-skimmed, cheeses with 10%≤ milk fat <25% are classified as low-fat, and cheeses with milk fat <10% are classified as fat-free (Anonymous, 2015). When the fat values in the dry matter are calculated, the 2nd (46.84%), 3rd (50.15), 4th (46.23%), 8th (48.72%), and 10th (48.50%) cheeses are in the full-fat class, the 1st (40.15%), 5th (34.45%), 7th (27.42%), and 9th (28.21%) cheeses are in the semi-skimmed class, and the 6th (21.80%) cheese is in the low-fat class. The average fat value of Beyaz cheese samples was determined as 15.29% (Table 1). The results obtained are similar to the results of Sancak & Sancak (1995) (14.78%). The results obtained are lower than the results of Uraz & Şimşek (1998) (20.67%), Sağun et al. (2001) (18.60%), Toker (2001) (20.26%), Ayar et al. (2006) (17.16%), Erol (2014) (21.86%), Harmankaya & Harmankaya (2020) (21.25%), Çetinkaya (2021) (17.66%).

The functional properties of dairy products are largely due to the milk proteins that make up their composition and their properties. Proteins are one of the basic substances necessary for human growth and development (Özcan & Delikanlı, 2011). The protein amounts of Beyaz cheese samples were determined as the lowest at 11.93%, the highest at 20.03%, and the average at 16.61% (Table 1). The results obtained are higher than the results of Eljagmani (2020) (13.78%), similar to the results of Sancak & Sancak (1995) (15.22%), Uraz & Şimşek (1998) (14.59%), Toker (2001) (17.59%), Ayar et al. (2006) (14.26%), Erol (2014) (18.93%), Çetinkaya (2021) (17.66%).

Mesophilic or thermophilic cultures are used in cheese production. The main function of these cultures is to ensure the formation of lactic acid. It creates acid, which is important because it helps with coagulation, thus lowering the pH. The pH of Beyaz cheese samples was determined as the lowest at 4.30, the highest at 6.67 and the average at 5.75 (Table 1). The results obtained are lower than the results of Eljagmani (2020) (6.14), higher than the results of Sancak & Sancak (1995) (4.77), Uraz & Şimşek (1998) (4.26), Sağun et al. (2001) (4.84), Toker (2001) (5.01), Ayar et al. (2006) (4.30), Gökmen et al. (2013) (4.91), Erol (2014) (5.02), Harmankaya & Harmankaya (2020) (4.64), Çetinkaya (2021) (5.21). Differences in pH

values occur depending on the maturity of the cheese and the proteolysis activity of the flora used in its production. Additionally, low pH values may be caused by microbial growth.

Total sources of acidity in cheese are lactic acid, acetic acid, formic acid, and butyric acid, released as a result of the fermentation of lactose, free fatty acids released by lipolysis, and free amino acids formed as a result of proteolysis (Bulut Solak, 2013). The titratable acidity of Beyaz cheese samples was determined as the lowest at 0.108%, the highest at 0.212% and the average at 0.150% (Table 1). The results obtained are similar to the results of Eljagmani (2020) (0.346%), lower than the results of Sancak & Sancak (1995) (1.18%), Uraz & Şimşek (1998) (1.310%), Sağun et al. (2001) (1.06%), Toker (2001) (1.31%), Harmankaya & Harmankaya (2020) (1.25%), Çetinkaya (2021) (1.09%).

Physicochemical analysis results of Lor cheese samples are given in Table 2. According to the TFC Cheese Communiqué, the moisture content in whey cheeses should be at most 75% (Anonymous, 2015). When the determined moisture values are examined, all Lor cheeses comply with the notification. The average moisture value of Lor cheese samples was determined as 69.04% (Table 2). The results obtained are similar to the results of Ayar et al. (2006) (68.53%), higher than the results of Çardak (2012) (65.41%), lower than the results of Demirci et al. (1991) (74.01%), Sönmez (2019) (71.30%), Harmankaya & Harmankaya (2020) (71.47%).

According to the TFC Cheese Communiqué, the amount of salt in whey cheeses should be at most 6% of the dry matter (Anonymous, 2015). Considering the amount of salt in the dry matter, all Lor cheeses comply with the notification. The average salt value of Lor cheese samples was determined as 0.892% (Table 2). The results obtained are higher than the results of Sönmez (2019) (0.46%), lower than the results of Ayar et al. (2006) (1.77%), Çardak (2012) (1.69%), Harmankaya & Harmankaya (2020) (1.85%).

When the amount of fat in dry matter is examined, according to the TFC Cheese Communiqué the 1st (30.36%), 2nd (26.45%), 3rd (39.94%), 4th (38.35%), 6th (37.96) and 7th (34.68%) Lor cheeses are in the semi-skimmed class, while the 5th (18.97), 8th (22.14%), 9th (19.27%) and 10th (16.14%) Lor cheeses are in the low-fat class. The average fat value of Lor cheese samples was determined as 8.86% (Table 2). The results obtained are higher than the results of Demirci et al. (1991) (5.34%), Çardak (2012) (4.78%), lower than the results of Ayar et al. (2006) (13.16%), Sönmez (2019) (11.24%), Harmankaya & Harmankaya (2020) (9.46%).

The protein amounts of Lor cheese samples were determined as the lowest at 13.02%, the highest at 21.25%, and the average at 16.72% (Table 2). The results obtained are higher than the results of Ayar et al. (2006) (13.11%), Demirci et al. (1991) (13.50%), and Çardak (2012) (14.98%).

The pH values of Lor cheese samples ranged between 3.76 and 5.48, and the average was determined as 4.12 (Table 2). The results obtained are lower than the results of Ayar et al. (2006) (4.86), Çardak (2012) (4.85), Sönmez (2019) (5.90), Harmankaya & Harmankaya (2020) (4.46).

Titratable acidity values of Lor cheese samples were found to be between 0.104% and 0.247%, with an average of 0.172% (Table 2). The results obtained are lower than the results of Çardak (2012) (0.57%), Sönmez (2019) (0.46%), Harmankaya & Harmankaya (2020) (1.14%).

Table 1. Physicochemical analysis results of Beyaz cheese samples

Samples	DM (%)	Moisture (%)	Salt (%)	Salt in DM (%)	Fat (%)	Fat in DM (%)	Protein (%)	pH	Titratable acidity (%)
1	45.45	54.55	0.927	2.03	18.25	40.15	16.33	5.97	0.127
2	44.30	55.70	0.819	1.85	20.75	46.84	13.84	5.79	0.118
3	33.90	66.10	0.467	1.38	17.00	50.15	11.93	4.30	0.108
4	41.10	58.90	0.696	1.69	19.00	46.23	17.23	5.24	0.172
5	38.75	61.25	1.165	3.00	13.35	34.45	19.20	5.99	0.143
6	36.70	63.30	4.206	11.46	8.00	21.80	20.03	5.86	0.172
7	30.45	69.55	1.863	6.11	8.35	27.42	17.93	6.67	0.136
8	41.05	58.95	2.096	5.10	20.00	48.72	16.46	6.16	0.172
9	39.70	60.30	0.689	1.74	11.20	28.21	16.52	5.52	0.212
10	35.05	64.95	0.693	1.98	17.00	48.50	16.67	6.00	0.142
Lowest	30.45	54.55	0.467	1.38	8.00	21.80	11.93	4.30	0.108
Highest	45.45	69.55	4.206	11.46	20.75	48.72	20.03	6.67	0.212
Average	38.64	61.36	1.362	3.63	15.29	39.25	16.61	5.75	0.150

DM: Dry matter

Table 2. Physicochemical analysis results of Lor cheese samples

Samples	DM (%)	Moisture (%)	Salt (%)	Salt in DM (%)	Fat (%)	Fat in DM (%)	Protein (%)	pH	Titratable acidity (%)
1	33.60	66.40	0.919	2.73	10.20	30.36	21.25	3.92	0.173
2	30.25	69.75	0.465	1.54	8.00	26.45	15.31	3.98	0.185
3	31.55	68.45	0.679	2.15	12.60	39.94	17.42	3.97	0.208
4	33.90	66.10	1.855	5.47	13.00	38.35	21.05	5.48	0.178
5	29.25	70.75	0.446	1.52	5.55	18.97	17.74	3.96	0.171
6	27.40	72.60	0.685	2.50	10.40	37.96	13.02	3.95	0.175
7	34.60	65.40	1.150	3.32	12.00	34.68	15.82	3.76	0.247
8	27.10	72.90	0.919	3.39	6.00	22.14	15.25	4.06	0.141
9	27.25	72.75	1.127	4.13	5.25	19.27	14.04	4.08	0.138
10	34.70	65.30	0.676	1.95	5.60	16.14	16.33	4.06	0.104
Lowest	27.10	65.30	0.446	1.52	5.25	16.14	13.02	3.76	0.104
Highest	34.70	72.90	1.855	5.47	13.00	39.94	21.25	5.48	0.247
Average	30.96	69.04	0.892	2.87	8,86	28.43	16.72	4.12	0.172

DM: Dry matter

3.2. Microbiological properties

Significant parts of the microorganisms that can be found in foods are aerobic mesophilic bacteria. The majority of these bacteria can easily grow in slightly acidic environments and without requiring special nutrients. For this reason, determining the TAMB count, especially in dairy products, is considered an indicator in determining the microbiological quality of the product (Sönmez, 2019). Many factors affect the TAMB count in foods. Not pasteurizing the milk processed into cheese, not complying with hygienic rules, and presenting the cheese without ripening affect the microbiological quality of the cheese. In fact, it has been stated that the TAMB count in cheeses made from pasteurized milk is lower than in cheeses made from raw milk (Uğur, 2001). Microbiological analysis results of Beyaz cheese samples are given in Table 3. The lowest TAMB count detected in Beyaz cheese samples was 2.90 log cfu/g, the highest was 9.59 log cfu/g, and the average was 7.89 log cfu/g (Table 3). The results obtained are similar to the results of Sancak & Sancak (1995) (2.08×10^7 cfu/g), Sağun et al. (2001) (7.25 log cfu/g), Uğur (2001) (1.8×10^6-6×10^8 cfu/g), Erol (2014) (7.05 log cfu/g). The results obtained are higher than the results of Ceylan & Demirkaya (2007) (4.47 log cfu/g), Urhan (2012) (5.8×10^6 cfu/g), lower than the results of Harmankaya & Harmankaya (2020) (7.30×10^8 cfu/g), Koçak (2014) (9.43 log cfu/g).

Lactic acid bacteria are microorganisms used in the production and ripening of many dairy products such as fermented milk products and cheese, and can also be found in the normal microflora of cheeses. In terms of cheese technology, these microorganisms are not only technological importance; but also play a role in the formation of the desired characteristics of the products. The acidification, proteolytic activity, and lipolytic properties of these microorganisms, which can be used as starter or support cultures or can also be found in non-starter microflora, are effective in providing the desired properties in products (Gürsoy & Kınık, 2004; Ertürkmen & Öner, 2015). In Beyaz cheese samples, the average number of lactobacilli and lactococci was 7.31 log cfu/g and 6.93 log cfu/g, respectively (Table 3). The results obtained are higher than the results of Sağun et al. (2001) (5.59 log cfu/g), Ceylan & Demirkaya (2007) (4.52 log cfu/g), lower than the results of Yerlikaya (2018) (lactobacilli 4.2×10^4-7.9×10^8, lactococci 1.6×10^4-3.2×10^9).

Yeasts and molds that cause spoilage can cause a number of disorders such as the formation of bitter taste and bad odor in foods, and the formation of undesirable porous structures in some foods due to their gas-forming properties. Some types of mold can grow in contaminated food and cause poisoning that can result in death if the food is consumed, due to the toxic metabolites and mycotoxins they secrete. Some yeasts and molds are known to cause infection (Durlu Özkaya & Cömert, 2008). The lowest yeast-mold count detected in Beyaz cheese samples was <2 log cfu/g, the highest was 6.60 log cfu/g, and the average was 4.20 log cfu/g (Table 3). The results obtained are similar to the results of Uğur (2001) (3.7×10^3-3.9×10^6 cfu/g), Yerlikaya (2018) (<10^2-4.6×10^6 cfu/g), higher than the results of Ceylan & Demirkaya (2007) (3.23 log cfu/g), Çardak (2012) (2.2×10^2-8.1×10^4 cfu/g) Erol (2014) (3.27 log cfu/g), Gödek et al. (2021) (1.9 log cfu/g), lower than the results of Sancak & Sancak (1995) (1.92×10^5 cfu/g), Sağun et al. (2001) (5.24 log cfu/g), Urhan (2012) (5.4×10^2 cfu/g), Harmankaya & Harmankaya (2020) (2.85×10^6 cfu/g). Among the microorganisms that contaminate cheese from various sources, coliform bacteria are the most harmful group. These bacteria convert milk sugar into acid and gas, and the resulting gas collects in the interior of the cheese and causes pores to form (Kıvanç, 1990). Moreover, coliform bacteria also change the taste and aroma of cheese. Additionally, the presence of coliform group bacteria indicates that humans or warm-blooded animals (Urhan, 2012). The coliform group bacteria count detected in Beyaz cheese samples was found to be the lowest at 2.00 log cfu/g, the highest at 7.70 log cfu/g and the average at 5.70 log cfu/g (Table 3). The results obtained are similar to the results of Uğur (2001) (2×10^3-1.6×10^6 cfu/g), higher than the results of Sancak & Sancak (1995) (7.73×10^3 cfu/g), Sağun et al. (2001) (1.06 log cfu/g), Kaynar et al. (2005) (6.2×10^1-24×10^2), Ceylan & Demirkaya (2007) (<1-3.25 log cfu/g), Urhan (2012) (5.4×10^2), Harmankaya & Harmankaya (2020) (0.84×10^1 cfu/g).

Table 3. Microbiological analysis results of Beyaz cheese samples

Samples	TAMB	Lactic acid bacteria		Yeast-Mold	Coliform group
		MRS	M17		
1	6.48	4.90	5.36	5.63	6.32
2	9.01	8.76	8.83	5.60	6.30
3	8.92	9.16	9.17	3.32	6.57
4	8.99	9.17	9.14	3.81	7.57
5	9.59	8.46	6.08	5.70	5.22
6	9.59	9.06	6.57	6.18	6.74
7	7.00	7.16	7.57	<2	3.48
8	8.22	7.30	7.95	5.20	5.18
9	8.24	9.22	8.67	6.60	7.70
10	2.90	<2	<2	<2	2.00
Lowest	2.90	<2	<2	<2	2.00
Highest	9.59	9.22	9.17	6.60	7.70
Average	7.89	7.31	6.93	4.20	5.70

TAMB: Total aerobic mesophilic bacteria, MRS: Lactic acid bacteria growing on MRS agar, lactobacilli, M17: Lactic acid bacteria growing on M17 agar, lactococci. Results are given in log cfu/g

The high count of total microorganisms in Lor cheese can be considered as an indicator that hygienic rules are not followed during post-production and marketing. One of the most important reasons for this is that the Lor cheeses produced by traditional methods in public hands are not produced under hygienic conditions and the majority of them are stored under unsuitable conditions after production and sold openly (Demirci et al., 1991). The microbiological analysis results of Lor cheese samples are given in Table 4. The lowest TAMB count detected in Lor cheese samples was 5.48 log cfu/g, the highest was 9.78 log cfu/g, and the average was 7.25 log cfu/g (Table 4). The results obtained are similar to the results of

Sönmez (2019) (7.15 log cfu/g), higher than the results of Çardak (2012) (2.9×10^3-5.3×10^6 cfu/g), lower than the results of Demirci et al. (1991) (1.3×10^6-2.9×10^8), Koçak (2014) (9.80 log cfu/g), Harmankaya & Harmankaya (2020) (7.73×10^8 cfu/g). In Lor cheese samples, the average count of lactobacilli and lactococci was detected as 6.75 log cfu/g and 6.84 log cfu/g, respectively (Table 4). The lowest yeast-mold count detected in Lor cheese samples was <2 log cfu/g, the highest was 6.70 log cfu/g, and the average was 5.07 log cfu/g (Table 4). The results obtained are higher than the results of Sönmez (2019) (1.86 log cfu/g), Çardak (2012) (2.2×10^2-8.1×10^4 cfu/g), lower than the results of Harmankaya & Harmankaya (2020) (2.21×10^6 cfu/g). Lor cheese is obtained by boiling whey. Therefore, the number of microorganisms in the produced samples is expected to be lower. However, failure to comply with post-production hygienic conditions and poor storage conditions may lead to rapid deterioration of microbiological quality and chemical structure (Sönmez, 2019). Among the Lor cheese samples, coliform group bacteria were detected only in the 4th sample (Table 4). The results obtained are lower than the results of Demirci et al. (1991) (1.0×10^4-4.0×10^6), Sönmez (2019) (4.44 log cfu/g), Harmankaya & Harmankaya (2020) (1.66×10^1cfu/g).

Table 4. Microbiological analysis results of Lor cheese samples

Samples	TAMB	Lactic acid bacteria		Yeast-Mold	Coliform group
		MRS	M17		
1	6.30	5.41	5.78	<2	<2
2	7.08	6.87	7.70	5.48	<2
3	9.78	9.10	10.20	5.15	<2
4	9.20	7.78	9.15	6.60	7.78
5	7.26	7.28	4.30	4.95	<2
6	5.48	5.48	4.60	4.00	<2
7	8.14	8.64	8.04	6.30	<2
8	5.82	5.48	5.48	6.70	<2
9	6.30	6.70	6.66	6.30	<2
10	7.18	4.79	6.52	5.30	<2
Lowest	5.48	4.79	4.30	<2	<2
Highest	9.78	9.10	10.20	6.70	7.78
Average	7.25	6.75	6.84	5.07	0.78

TAMB: Total aerobic mesophilic bacteria, MRS: Lactic acid bacteria growing on MRS agar, lactobacilli, M17: Lactic acid bacteria growing on M17 agar, lactococci. Results are given in log cfu/g.

4. Conclusions

Considering the physicochemical analysis results of the cheese samples produced in Kastamonu and offered for consumption in the market, it was observed that they generally comply with the standards. As a result of microbiological analysis, only one Lor cheese sample contained coliform bacteria. However, coliform bacteria were detected in all Beyaz cheese samples. This situation showed that hygiene was not ensured in the Beyaz cheese samples. Some of the microorganisms found in cheese are saprophytic and produce metabolites that cause bad taste and aroma by using organic nutritional resources such as protein, fat, and carbohydrates found in cheese. As a result, deterioration such as bitterness, rancidity, and rancidity occur in cheeses. This could lead to significant economic loss. In addition, some of the microorganisms present are pathogenic and can cause serious diseases and food poisoning in people who consume such products. For this reason, hygiene rules should be observed from cheese making to consumption and producers should be made aware of this issue.

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Declaration of Competing Interest

There are no conflicts of interest from any of the authors concerning the conceptualization, research design, and publication of this work.

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