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Physio-Chemical and Microbial Quality of Kurdish Soft Cheese from Sulaymaniyah Market

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Abstract

This study looked into the quality of Kurdish soft cheese sold in local markets across Sulaymaniyah City, Iraq. Between February and May 2024, fifteen cheese samples were collected and thoroughly analyzed. The results showed quite a bit of variation among the samples. On the microbiological side, TVC ranged from 4.0×10^3 to 1.2×10^7 CFU/g. Coliforms were found in more than 85% of the samples, with counts between 2.4×10^2 and 5.2×10^2 CFU/g, and yeast and mold counts went as high as 6.7×10^3 CFU/g. pH values were between 6.19 and 6.73, while acidity ranged from 0.95% to 2.29% as lactic acid. The hardness of the cheese varied widely, from 162.5 g up to 452.5 g. Moisture content ranged from 46.3% to 64.9%, protein from 19.5% to 26.8%, fat from 13.2% to 23.5%, and salt from 1.6% to 3.7%.
Overall, these findings highlight significant inconsistencies in the quality of Kurdish soft cheese sold in Sulaymaniyah. They also point to shortcomings in hygiene practices during production and handling. This underscores the need for better quality control and stricter manufacturing standards to protect consumer health.

I. INTRODUCTION

Cheese is one of the oldest and most widely consumed dairy products worldwide, with a rich history that dates back thousands of years. Among the many varieties, white soft cheese holds a special place, particularly in Middle Eastern, Mediterranean, and South Asian diets. Known for its mild flavor, soft texture, and high moisture content, this cheese type is typically consumed fresh, often within days or weeks of production. Its widespread popularity is attributed not only to its palatability but also to its nutritional richness, as it serves as a substantial source of proteins, essential amino acids, fatty acids, vitamins (A, B2, B12), and minerals such as calcium, phosphorus, and zinc, which are vital for human health across all age groups (McGee, 2004; Mayo et al., 2021).
White soft cheese is generally manufactured using either raw or pasteurized milk, depending on local customs, regulations, and technological access (Rashtchi et al., 2021). In many rural and semi-urban areas, traditional practices involving raw milk continue to dominate due to ease of processing and the perception that raw milk enhances flavor and texture. However, this practice introduces significant microbiological risks, as raw milk can harbor diverse populations of aerobic mesophilic bacteria, coliforms, and pathogenic microorganisms (Hayaloglu & Kirbag, 2007). Even when pasteurized milk is used, lapses in hygienic handling, equipment sanitation, or storage conditions can lead to post-pasteurization contamination, compromising the safety and shelf-life of the cheese.
Maintaining hygienic practices throughout processing is crucial since raw milk can harbor high levels of aerobic mesophilic bacteria and other contaminants (Hayaloglu & Kirbag, 2007). Regular microbiological tests are therefore vital to ensure both product quality and compliance with safety standards (Verga, 2007).

Among the potential bacterial hazards are Staphylococcus aureus, which can be spread through human handling or infected animals (Sahu et al., 2014; Aung et al., 2017), along with enteric pathogens such as Shiga toxin-producing *E. coli* (STEC) and *Salmonella spp*. (Baylis, 2009; Kousta et al., 2010). While beneficial lactic acid bacteria play a role in cheese quality, soft cheeses can also support the growth of spoilage organisms and pathogens like *Listeria monocytogenes* and *Brucella spp.* (Carlotta et al., 2020).
Moreover, soft cheeses provide favorable environments for the growth of psychrotrophic pathogens like Listeria

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monocytogenes, which can proliferate at refrigeration temperatures and pose significant risks, particularly to pregnant women, the elderly, and immunocompromised individuals (Carlotta et al., 2020). In Iraq, soft cheese is primarily made from cow's milk, sometimes mixed with milk from sheep, goats, or buffalo. According to the FAO, global cheese consumption has grown by around 5% in recent years, with market revenues projected to reach $124 billion by 2022 (FAO, 2021).

The aim of this study was to evaluate the physio-chemical and microbiological quality of Kurdish soft cheese sold in Sulaymaniyah markets to check if they meet Iraqi standards and to identify any public health risks.

II. Materials and Methods

Sample Collection

Fifteen local made cheese samples, each weighing about 150 grams, were randomly collected from local markets and retail shops across Sulaymaniyah city between February and May 2024. Samples were transported in coolers to maintain quality before testing.

Microbiological Analysis

Sample Preparation:

Eleven grams from each sample were blended with 99 mL of sterile 0.1% normal saline. Serial dilutions were prepared up to 10^{-6} (Heikal et al., 2014).

Standard Plate Count (SPC):

The SPC was determined using the pour plate technique with plate count agar. Plates were incubated at 37 °C for 24-48 hours(Laird et al., 2004; Haddad and Yamani, 2017).

Coliforms:

Counts were done using MacConkey agar, incubated at 37 °C/24 hours (Haddad and Yamani, 2017).

Yeasts and Molds:

Samples were spread on Potato Dextrose Agar and incubated at 25°C for 2-5 days (Haddad and Yamani, 2017).

Physio-Chemical Analysis

pH:

Prepared by blending 10 g cheese in 50 mL distilled water, then measured with a calibrated pH meter (Gutiérrez Coronado et al., 2025).

Texture analysis:

Texture Profile Analysis (TPA) was conducted to determine the hardness of the cheese samples using a CT3 4500 texture analyzer (Brookfield Engineering Lab). The procedure followed the method described by Ruvalcaba-Gómez et al. (2020). A 25 mm probe, 5 kg load, 10 mm penetration, 5 g trigger force, and 3 mm/s speed were applied.

Moisture:

About 3 g cheese was dried at 105°C for 12 hours (AOAC, 2016).

Protein:

Determined by Kjeldahl method, with nitrogen converted to protein by a factor (Aska et al., 2023).

Fat:

Analyzed by Gerber method according to AOAC (2016).

Salt:

Measured following Hooi et al. (2004).

Titratable Acidity:

10 g cheese was mixed with warm distilled water (to 105 mL), filtered, and titrated against 0.1 M NaOH using phenolphthalein (Elsamani et al., 2014).

Statistical analysis

Data were analyzed using the analysis of variance procedures. All statistical analyses were performed using the XLstat software (version version 16.8). Significant differences were determined using LSD test ($p<0.05$).

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III. Results

Fifteen soft cheese samples from Sulaymaniyah were evaluated. The analysis covered microbial load, pH, TPA, moisture, protein, fat, salt, and acidity.

The data in table 1 summarize the bacterial load of Kurdish white soft cheese. In this study, the standard plate count (SPC) in the samples of soft cheese was detected to be the interval of 4.0×10^3 to 1.2×10^7 CFU/g. The coliform bacteria count was detected all samples except two of them (sample No. 1 and No. 10) and it was between 240 and 520 (CFU/g). Also, the yeast and mold count was detected in all samples except No. 1 and 10 (TFTC), and it was in the range of 2.9 x 10^2 to 6.7×10^3 CFU/g.

Table 1: Microbial Tests of White Soft Cheese Samples

Sample No.	TVC (CFU/g)	Coliforms (CFU/g)	Yeast & Mold (CFU/g)
1	4.0×10^3	ND	TFTC
2	4.2×10^6	460	5.3 x10^2
3	6.5×10^6	375	6.7×10^3
4	8.2×10^6	350	6.1×10^3
5	7.3×10^6	380	5.8×10^3
6	3.4×10^6	240	3.5 x10^2
7	1.2×10^7	340	5.4×10^3
8	4.1×10^6	480	2.9 x 10^2
9	4.5×10^6	520	3.0 x10^2
10	5.1 x 10^3	ND	TFTC
11	5.3×10^6	460	3.1 x10^2
12	1.1×10^7	330	5.0×10^3
13	1.8×10^7	360	5.7×10^3
14	7.9×10^6	320	5.1×10^3
15	4.2×10^6	500	2.7 x10^2
LSD (0.05)	**3.92×10^6**	**87**	**1.65×10^3**

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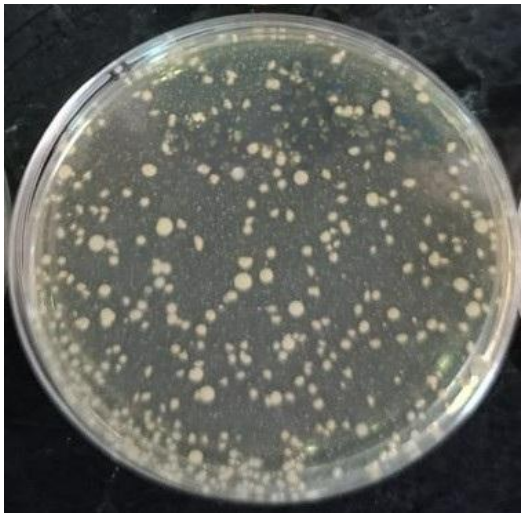

Figure 1: Total plate count on nutrient agar

Figure 2: Coliform on MacConkey agar

Figure 3: Yeast and Mold on PDA

The table 3 shows chemical properties of cheese of fifteen samples. Moisture percentage was between 46.3 and 64.9 % and fat percentage was between 13.2 and 23.5 %. In other hand, the protein percentage and salt percentage ranged between 19.5 and 26.8 % , 1.6 and 3.7 % respectively as shown in table 3

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Table 2: Iraqi Standard Chemical Composition of White Soft Cheese*

Moisture (%)	Protein (%)	Fat (%)	Salt (%)	pH
≥ 50%	13.51% - 21.01%	16% ± 1	2% ± 0.2	6.4 ± 0.2

*** Iraqi standard for chemical composition in white soft cheese No. (1/693:1988)**

Table 3: Chemical Composition of White Soft Cheese Samples

Sample No.	Moisture (%)	Protein (%)	Fat (%)	Salt (%)
1	57.5	21.0	17.0	2.2
2	47.8	24.7	20.4	2.9
3	61.2	23.1	13.2	1.6
4	60.9	21.4	13.8	2.4
5	61.1	21.8	13.7	2.5
6	47.2	24.9	20.8	3.1
7	63.2	19.5	13.6	2.8
8	48.2	26.8	17.3	3.7
9	46.3	24.4	23.5	3.0
10	57.6	21.3	16.8	2.3
11	49.5	22.3	22.6	2.8
12	62.8	20.9	13.3	1.7
13	64.9	19.1	13.4	1.5
14	59.8	22.3	14.6	1.9
15	48.4	25.6	19.9	2.9
LSD (0.05)	**5.43**	**1.77**	**2.87**	**0.49**

. In table 4 shows pH and acidity percent (present as a lactic acid), pH ranged between 6.19 and 6.73 , while acidity ranged between 0.95 and 2.29 %.

Table 4: pH and Acidity of White Soft Cheese Samples

Sample No.	pH value	Acidity (%)
1	6.41	0.95
2	6.67	1.86
3	6.37	1.18
4	6.28	1.25
5	6.31	1.23
6	6.73	1.94
7	6.19	1.43
8	6.70	2.11
9	6.73	2.29

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10	6.35	0.91
11	6.70	2.08
12	6.21	1.54
13	6.60	1.9
14	6.30	1.32
15	6.65	2.06
LSD (0.05)	**0.16**	**0.36**

One of important tests done for samples TPA, as a hardness in table 5. The hardness of samples ranged between 159.5 and 452.5 (g).

Table 5: TPA of White Soft Cheese Samples

Sample No.	Hardness (g)
1	193.5
2	403.5
3	163.5
4	177.5
5	172.0
6	452.5
7	162.5
8	229.0
9	250.5
10	206.0
11	235.0
12	165.0
13	159.5
14	174.0
15	225.0
LSD (0.05)	**69.10**

IV. Discussion

These results reveal notable differences in cheese quality, which are likely associated with variations in production methods and hygiene standards (El-Ghousein & Al-Khaldi, 2017). Fluctuations in moisture content suggest differing risks of spoilage. The elevated standard plate counts observed in the cheese samples indicate generally poor hygienic conditions during production and storage (Haddad and Yamani, 2017; Hussein and Isa, 2023).

The microbiological findings, particularly the detection of coliforms, highlight deficiencies in sanitation and handling practices (Robinson and Tamime, 2006). The presence of coliforms typically signifies direct or indirect fecal contamination of milk, or contamination occurring during processing, handling, and distribution. This raises concerns

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about the possible presence of pathogenic bacteria, viruses, or protozoa of fecal origin (Santos and Babo Martins, 2019). Additionally, fungal spoilage in dairy products produces a range of metabolic by-products, leading to undesirable odors, flavors, and visible alterations in color or texture. These changes can adversely affect food safety, quality, nutritional value, and consumer acceptance (Ledenbach and Marshall, 2009).Yeast and mold counts in cheese serve as important indicators of sanitation, and certain species pose significant public health risks due to their ability to produce mycotoxins (Aranda et al, 2025).

The physio-chemical analysis of the fifteen cheese samples revealed considerable variability in moisture, protein, fat, and salt content, reflecting differences in manufacturing practices and possible inconsistencies in raw milk composition or processing conditions. Moisture level variations, indicating a broad variation that can influence texture, shelf life, and susceptibility to spoilage. Samples 3, 4, 5, 12, and 13 exhibited the highest moisture percentages (>60%), typical of fresh or soft cheeses, which are more prone to microbial growth due to higher water activity (Fox et al., 2017).

In contrast, samples 6, 8, 9, and 15 had notably lower moisture levels (~46–48%), suggesting either a firmer cheese type or extended draining/pressing times.

Differences in protein contents can be linked to the protein concentration of the original milk and to the degree of whey removal during cheese-making (Guinee & O'Kennedy, 2007). Higher protein levels are generally desirable, contributing to nutritional value and influencing textural properties such as firmness and chewiness. Samples with lower fat content (e.g., 3, 4, 5, 7, 12 and 13) may present a firmer, less creamy texture, while higher-fat samples are expected to have richer sensory attributes. The fat-to-protein ratio is an important quality parameter affecting flavor, mouthfeel, and consumer acceptance (McSweeney & Fox, 2004).

Salt plays multiple roles in cheese, including moisture regulation, flavor development, and inhibition of undesirable microorganisms (Guinee, 2004). However, excessive salt can impact consumer health perceptions and acceptance. Moreover, the elevated moisture in several samples may predispose them to faster spoilage and microbial contamination, highlighting the importance of integrating robust hygiene and preservation practices. Given consumer trends favoring both high protein and moderate fat content, balancing these components while maintaining safety and sensory quality is critical.

Generally, an inverse relationship was observed: samples with higher acidity tended to have lower pH values, consistent with the typical buffering behavior of cheese (Fox et al., 2017). Samples 8 and 9 exhibited the highest acidity (2.11% and 2.29%) along with relatively high pH values (~6.70–6.73), which may indicate differences in buffering capacity due to higher protein or mineral content (Guinee & Fox, 2004), and/or due to deamination from protein and conversion to ammonia post processing, leading to an increase in pH (Mei et al., 2015). Meanwhile, sample 7 showed the lowest pH (6.19) with moderate acidity (1.43%), suggesting possible differences in acid development or microbial activity.

Samples 6 and 2 exhibited the highest hardness values (452.5 g and 403.5 g) respectively, likely associated with their lower moisture contents, which result in a firmer structure due to reduced water-mediated protein matrix plasticity (Gunasekaran & Ak, 2003). In contrast, samples 3, 7, 12, and 13 showed the lowest hardness (approximately 159.5–165 g), consistent with their higher moisture levels, leading to a softer and more deformable texture (Fox et al., 2017).

These differences may also arise from variations in fat content, salt concentration, and manufacturing conditions such as pressing and curd cutting. Lower-fat cheeses generally develop a firmer body due to tighter protein networks, whereas higher salt promotes protein aggregation, further affecting texture (Guinee, 2004).

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V. Conclusion

Given these considerations, continuous monitoring of the microbiological and physicochemical quality of white soft cheese is essential, not only to protect consumer health but also to support the dairy sector's contribution to food security and economic growth. This study thus aims to evaluate the quality attributes of white soft cheese available in local markets, with a focus on identifying potential microbial hazards and assessing compliance with national and international standards.

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