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Araştırma
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Monthly Changes of Milk Compounds and Somatic Cells In Romanov X Awassi Hybrid Sheep*

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Abstract

Objective: The aim of this study was to determine milk quality, somatic cell count (SCC) and milk constituents by analyzing milk samples from 30 Romanov x Ivesi crossbred sheep raised in Dicle University, Faculty of Agriculture, Department of Animal Husbandry. It was also aimed to contribute to the limited information on the subject in the literature.

Material and Method: In this study conducted at Dicle University, Faculty of Agriculture, Department of Animal Husbandry, Small Ruminant Livestock Unit, 30 Romanov x Ivesi crossbred ewes were used as animal material. The study was carried out in February, March and April, which is the lactation period, in raw milk samples taken from the ewes by hand milking. These milk samples were analyzed for somatic cell count (SHC) and milk components such as fat, dry matter, protein, lactose, lactose, freezing point and minerals. Milkana Somatic Scan device was used to determine somatic cell count (SHC) and Funke Gerber device was used to determine milk components. Since the somatic cell count data obtained from the devices used did not show normal distribution, logarithmic transformation was performed; original data were used for other parameters.

Results: In the statistical analysis, there were no significant differences between months in SHS, dry matter, protein, lactose and freezing point values (P>0.05), while significant differences were found in fat and density values (P<0.01). In addition, significant differences were observed in mineral matter ratio between months (P<0.001).

Conclusion: Based on the data obtained from the milk samples taken from the animals, it was determined that animal health was paid attention to and veterinary controls were carried out regularly, animal welfare was ensured, milking hygiene rules were followed by the personnel with high awareness, and milk was produced above the quality criteria.

Keywords: Udder hygiene, Mastitis, Somatic cell count, Milk analysis, Food safety, Milk production

Romanov X İvesi Melezi Koyunlarda Süt Bileşenleri ve Somatik Hücre Sayısının Aylık Değişimi

Öz

Amaç: Dicle Üniversitesi Ziraat Fakültesi, Zootekni Bölümü Küçükbaş Hayvancılık Ünitesinde yetiştirilen 30 baş Romanov x İvesi melezi koyundan alınan süt örneklerinin analiz edildiği bu çalışmada, süt kalitesi, somatik hücre sayısı (SHS) ve süt bileşenlerini belirlemek amaçlanmıştır. Ayrıca konu ile ilgili literatürde sınırlı olan bilgilere katkı sağlanması hedeflenmiştir.

Materyal ve Yöntem: Dicle Üniversitesi Ziraat Fakültesi, Zootekni Bölümü, Küçükbaş Hayvancılık Ünitesinde gerçekleştirilen bu çalışmada 30 baş Romanov x İvesi melezi koyun hayvan materyali olarak kullanılmıştır. Çalışma, laktasyon dönemi olan Şubat, Mart ve Nisan aylarında, koyunlardan elle sağımla alınan çiğ süt örneklerinde gerçekleştirilmiştir. Bu süt örnekleri, somatik hücre sayısı (SHS) ve süt bileşenleri olan yağ, kuru madde, protein, laktoz, donma noktası ve mineraller açısından analiz edilmiştir. Milkana Somatic Scan cihazı somatik hücre sayısının (SHS) belirlenmesinde, Funke Gerber cihazı ise süt bileşenlerinin belirlenmesinde kullanılmıştır. Kullanılan cihazlardan elde edilen somatik hücre sayısı verileri normal dağılım göstermediğinden, logaritmik transformasyon yapılmış; diğer parametrelerde ise orijinal veriler kullanılmıştır.

Bulgular: İstatistiksel analizde SHS, kuru madde, protein, laktoz ve donma noktası değerlerinde aylar arasında anlamlı bir fark bulunmazken (P>0,05), yağ ve yoğunluk değerlerinde anlamlı farklılıklar bulunmuştur (P<0,01). Ayrıca, mineral madde oranında aylar arasında anlamlı farklılıklar gözlemlenmiştir (P<0,001).

Sonuç: Hayvanlardan alınan süt örneklerinden elde edilen verilerden yola çıkarak, ünitede hayvan sağlığına dikkat edildiği ve düzenli olarak veteriner kontrollerinin yapıldığı, hayvan refahının sağlandığı ve sağım hijyen kurallarına personelin yüksek farkındalıkla uyduğu, kalite kriterlerinin üzerinde süt üretildiği tespit edilmiştir.

Anahtar Kelimeler: Meme Hijyeni, Mastitis, Somatik hücre sayısı, Süt analizi, Gıda güvenliği, Süt üretimi

Introduction

Milk is a nutrient-rich liquid produced by the mammary glands of mammals, primarily consumed as a food source due to its high nutritional value, including proteins, fats, vitamins, and minerals. Sheep milk, specifically, is highly valued for its richness in fat and protein content, making it ideal for the production of various dairy products like cheese and yogurt. The Turkish Food Codex outlines various standards to ensure the quality of sheep milk and other dairy products, focusing on aspects such as physical and chemical properties, somatic cell count, bacteriological and microbiological standards, and proper handling during milking and storage. These standards are crucial to maintain the safety and quality of milk products for consumers and to ensure that producers meet the required criteria.

Sheep milk must have a minimum fat content of 6.5%. This level helps maintain the creamy texture of the milk. The protein content in sheep milk typically ranges between 5% and 6%, enhancing its nutritional value. The somatic cell count is a key indicator of milk quality and indicates whether the milk is free from infections. According to the Turkish Food Codex, the somatic cell count in sheep milk should not exceed 500,000 cells per milliliter. A higher count suggests potential infection or poor milk quality. Sheep milk should meet certain microbiological standards, with zero tolerance for pathogenic microorganisms, such as Salmonella and Escherichia coli. These pathogens pose a health risk and must be absent in the milk. The water content in sheep milk should be minimal. Excessive water indicates adulteration, which undermines its quality. The milk should also be free of any added substances. Milk should be cooled immediately after milking and stored at temperatures below 4°C to preserve its quality. Maintaining the proper storage temperature is crucial to prevent spoilage and ensure freshness (Türk Gıda Kodeksi, 2019).

The Turkish Food Codex ensures that these standards are enforced through regular inspections and laboratory analyses, guaranteeing that sheep milk and dairy products meet the required quality standards. Romanov sheep, known for their high fertility, contribute to the multiple birth tendency of Romanov x İvesi (ROxİV) crosses due to their reproductive characteristics. A study by Doğan Türkyılmaz et al. (2021) compared the reproductive performance and growth of lambs between İvesi and ROxİV crosses. The results showed an increase in reproductive performance for the ROxİV crosses, but the growth performance of their lambs was lower compared to İvesi sheep. These findings support the idea that the Romanov sheep's ability to give multiple births leads to ROxİV crosses having multiple births as well. However, the decrease in growth performance indicates that lambs may be smaller or less developed. Therefore, while fertility rates increase, there seems to be a trade-off with the individual growth rates of the lambs. In terms of milk, studies suggest that the Romanov sheep's lower milk yield could influence the milk production of ROxİV crosses. The quality of milk components such as fat, protein, lactose, and dry matter may also be influenced by genetic factors. Although Romanov sheep are known for lower milk production, ROxİV crosses could demonstrate changes in milk composition, potentially improving certain components due to the genetic contribution from Romanov. However, milk yield generally tends to be lower in such crosses, with possible improvements in milk composition observed in some cases. Hand milking is a common practice in the livestock sector, especially in dairy production operations. This method is used when mechanical milking systems are unavailable or insufficient. Hand milking can be performed either individually or as group milking for both small and large animals. This method is particularly preferred in small-scale farms and in operations with low technology.

When performed with proper techniques and minimal stress on the animal, hand milking can increase milk yield. However, there are several factors to consider during hand milking. These include hygiene, milking techniques, and the timing of milking. Milking in a hygienic environment is a critical factor that directly affects milk quality (Öztürk, 2021). While hand milking can be more cost-effective than mechanical milking systems, it has certain limitations in terms of efficiency. Given that hand milking is a time-consuming and labor-intensive process, it is generally less efficient than mechanical systems. Additionally, the level of care and attention given to the animals during hand milking can make it challenging to apply proper milking techniques (Çelik and Yılmaz, 2022). The use of Romanov x İvesi crossbred sheep during their first and second lactation periods is a widely adopted practice. Studies show that somatic cell count (SCC) begins to increase at the end of the first lactation and becomes more pronounced in the second lactation. The Department of Animal Husbandry, Faculty of Agriculture, Dicle University, conducts research on sheep feeding and other animal production practices. This research focuses on developing feeding strategies aimed at improving animal health and milk quality (Department of Animal Husbandry, Faculty of Agriculture, Dicle University, n.d.). Sheep milking is typically performed once or twice a day to increase milk yield. The frequency of milking can vary depending on factors such as the animal's genetic makeup, environmental conditions, nutrition, and health status. Studies show that milking twice a day provides the most efficient results. Milking once a day may be sufficient for animals with low milk yield, but over time, milk production may decrease (Yılmaz and Koç, 2020). Increasing the frequency of milking can boost milk yield, but excessive milking, such as milking three times a day, can have negative effects on the animals' health. This can lead to increased stress levels in the animals and reduce milk quality. Therefore, milking twice a day is considered the optimal practice for most sheep farms (Çelik et al., 2021). Somatic cells are considered an indicator of udder health. The somatic cells in milk include leukocytes or white blood cells, such as lymphocytes, macrophages, and polymorphonuclear leukocytes (Rainard et al., 2022). For milk to be of optimal quality, the somatic cell count (SCC) must remain below established thresholds. Elevated SCC levels can lead to significant challenges in terms of animal health, consumer safety, and the processing quality of dairy products (Podhorecká et al., 2021). Milk quality depends on the overall health of the animal. From production on the farm to human consumption, milk goes through several stages. Key factors such as the milking method, the condition of milking equipment, and post-milking storage play crucial roles in ensuring high-quality milk (Kaya et al., 2023). Milk quality is assessed based not only on SCC but also on its chemical composition (fat, protein, lactose content), microbiological safety, and physical characteristics such as color, odor, and specific gravity. Milk composition is essential for determining milk's overall quality and suitability for various dairy products. Important components include minerals, density, dry matter, protein, fat, and freezing point. Minerals like calcium, phosphorus, and magnesium are vital for milk’s nutritional value, benefiting both animal and human health. The density of milk provides insight into its overall consistency and nutritional content, with lower density potentially indicating dilution or lower solids content. Dry matter content reflects the total solids in milk and is directly related to milk yield and its suitability for cheese production. Protein and fat content are key indicators of milk’s nutritional value and are closely monitored in dairy production. The freezing point is critical for assessing milk quality, as deviations can indicate adulteration or poor storage conditions. Many inflammatory and non-inflammatory factors influence SCC. Inflammatory factors include bacteria like Staphylococcus aureus, S. dysgalactiae, S. uberis, S. agalactiae, C. bovis, and coliforms, which are commonly linked to mastitis. Non-infectious factors include lactation order, stage of lactation, udder structure, milk yield, breed, herd size, season, regional geography, shelter structure, production system, and management practices (Kour et al., 2023). In sheep, factors such as the number and stage of lactation influence SCC, with higher SCC in animals with more lactation cycles. Older sheep may have a higher SCC due to prolonged bacterial exposure in previous lactations, particularly in cases of chronic mastitis caused by Staphylococcus aureus (Darbaz and Ergene, 2019). While SCC tends to increase toward the end of lactation in animals with subclinical mastitis, it remains stable in healthy animals (Leitner et al., 2024).

In machine milking systems, improper teat size, incorrect attachment points, and sagging udders can hinder milking efficiency. These conditions can also lead to injuries, microbial contamination, and an increased risk of mastitis (Odorčić et al., 2019). This study aims to determine the nutritional content and somatic cell count (SCC) values of milk obtained from Romanov x İvesi crossbred sheep housed at Dicle University's Faculty of Agriculture, Small Ruminant Livestock Research Unit. The goal is to assess milk quality, hygiene conditions, and compliance with quality standards, including minerals, density, dry matter, protein, fat, and freezing point.

Material and Method

Animal Material

The study was conducted on 30 Romanov x Awassi crossbred sheep raised at the Faculty of Agriculture's Department of Animal Husbandry at Dicle University. Ewes were in their second lactation and giving birth to singletons. Sheeps were fed on dairy feed and pasture conditions.

Collection of Raw Milk Samples

Milk samples were collected in sterile, specially designed containers immediately after hand milking during the morning session, before the milk was transferred to the main collection vessel. Milking was performed twice daily (morning and evening), but sampling was limited to morning milkings to minimize contamination. Samples were collected under aseptic conditions to ensure the accuracy of measurements for dry matter, fat, protein, freezing point, lactose, and somatic cell count (SCC). All milk samples were placed in a cold chain system and delivered to the laboratory on the same day.

Sampling Period and Rationale

Milk sampling began during the Lactation season (in February, March, and April).

Laboratory Analyses

Upon arrival at the laboratory, samples were removed from transport containers and allowed to reach room temperature (approximately 40 minutes). The containers were then gently mixed to ensure homogeneity. SCC was measured using a somatic cell counter (Milkana Somatic Scan). Subsequently, milk quality parameters (fat, protein, lactose, freezing point, and dry matter) were analyzed using the Milk Analyzer (Funke Gerber).

Statistical Analysis

Descriptive statistics were expressed as mean, standard error of the mean (SEM), minimum, and maximum values. A repeated measures analysis of variance (ANOVA) was applied to evaluate temporal changes and group effects (Montgomery, 2017). After ANOVA, Duncan's multiple range test was used to identify statistically significant differences (Duncan, 1955). The level of statistical significance was set at 5% ($p<0.05$), and all analyses were performed using the MINITAB statistical software package (Minitab Inc., 2017).

Results and Discussion

In this study, various milk components-including somatic cell count (SCC), fat percentage, dry matter content (excluding fat), protein percentage, density, lactose percentage, freezing point, and mineral content were analyzed from milk samples collected over three months (February, March, and April) at Dicle University, Faculty of Agriculture, Department of Animal Science, Small Ruminant Farm.

Milk Components and Somatic Cell Count (SCC) Analysis

The somatic cell count (SCC) is a crucial indicator of milk quality, were elevated levels generally signal mastitis, an inflammatory condition of the mammary gland. Mastitis negatively affects milk composition by altering fat, protein, and lactose levels.

The analysis showed that SCC values varied among months. In February, 25 out of 30 samples had SCC values below 90,000 cells/mL, indicating good udder health. However, 5 samples exceeded this threshold, suggesting subclinical mastitis. In March, 22 out of 30 samples remained below 90,000 cells/mL, while 8 samples showed higher SCC levels. In April, most samples stayed under 90,000 cells/mL, but two samples exceeded 1,200,000 and 1,500,000 cells/mL, respectively, indicating possible clinical mastitis.

Despite these variations, statistical analysis revealed that the differences in SCC among the three months were not significant ($P>0.05$). This suggests that udder health remained relatively stable throughout the study.

Milk Composition Parameters

Over the three months, milk composition parameters such as fat percentage, protein content, lactose, dry matter (excluding fat), density, freezing point, and mineral percentage showed fluctuations.

Fat percentage: The fat content ranged widely, with some samples showing higher fat percentages (up to 8.63% in April).

Protein content

Protein percentages were generally between 3.5% and 5.5%, consistent with normal values for sheep milk.

Lactose

Lactose percentages ranged generally from 5% to 7%.

Dry matter (excluding fat): Dry matter values indicated a rich nutritional profile, especially in April.

Density and Freezing Point: Values remained within expected physiological ranges, indicating minimal adulteration and good milk quality.

Mineral Content

Mineral percentages varied slightly but remained within typical limits.

Interpretation

The general trend suggests that the milk quality produced at Dicle University Small Ruminant Farm was acceptable and aligned with Turkish Food Codex standards. Although some samples showed elevated SCC, the majority of the flock maintained good udder health and produced milk with consistent quality traits.

The variations in fat and protein percentages could be influenced by lactation stage, nutrition, environmental conditions, and individual animal differences. The slight increase in SCC and minor fluctuations in milk components, especially in February and April, reflect natural variations rather than systemic health issues.

Overall, the study highlights the importance of regular monitoring of SCC and milk composition to maintain high milk quality and ensure compliance with food safety standards.

Fat Content in Milk

According to the statistical analysis, the variation in fat percentage across different months was found to be highly significant (P<0.001; Table 1).

Table 1. Statistical analysis of the somatic cell count, fat, and protein ratio by mont

Components - Month	Maximum	Minimum	Standard deviation	Mean
Somatic Cell Count-February	1.500	90.00	47.69	154.20
March	1.250	90.00	40.45	160.77
April	1.500	90.00	59.04	180.00
% Fat-February***	8.33	2.92	0.26	6.00[a]
March***	7.13	2.56	0.26	4.05[b]
April***	8.71	1.77	0.33	6.27[a]
Protein-February	5.13	3.48	0.07	4.35
March	4.69	3.60	0.05	4.28
April	5.49	2.75	0.11	4.10

***: P<0.001

A high incidence of intramammary infections within a herd can significantly deteriorate milk quality, primarily due to the increased activity of lipase enzymes triggered by such infections. Additionally, poor milk processing practices and elevated temperatures can further contribute to the accumulation of free fatty acids (FFA) in both pasteurized and raw milk, adversely affecting the flavor and shelf life (Alhussien and Dang, 2018).

Protein Content in Milk

In their studies, Pirisi et al. (2014, 2017) observed that the protein content remained relatively stable, despite fluctuations in somatic cell count (SCC). The effect of SCC on proteolysis and lipolysis depends on the enzymatic activity of somatic cells, as leukocytes have the ability to produce lipolytic enzymes (Pirisi et al., 2014, 2017). Table 1 shows the descriptive values for the protein percentage. The statistical analysis indicated that the difference in protein ratio between months was not statistically significant (P > 0.01). Milk proteins are synthesized in the udder tissue from amino acids derived from the blood. The majority of these proteins are casein (around 80%), while the remaining 20% consist of whey proteins. In mastitic milk, the activity of the plasmin enzyme leads to a decrease in casein content and an increase in whey proteins. This shift in protein composition can negatively affect milk quality and cause challenges in dairy product production. Although a slight reduction in total protein content may occur due to the decrease in casein and increase in whey proteins, significant changes in protein levels are generally not observed (Li et al., 2014).

Lactose content in milk

The statistical analysis of lactose content in milk showed that the differences in lactose rates between months were not statistically significant (P>0.05; Table 2).

This result suggests that while there may be slight variations in lactose content, these differences do not follow a clear pattern over the three-month sampling period.

Lactose is a crucial carbohydrate in milk, synthesized by epithelial cells within the mammary gland. It plays a key role in maintaining osmotic pressure within the milk. In cases of mastitis, the reduced lactose synthesis triggers compensatory changes, such as increased sodium and chloride levels in the milk, which help to maintain osmotic balance and lead to an increase in the milk's electrical conductivity. These changes can also affect the sensory characteristics of the milk, such as a salty or bitter taste (Egyedy and Ametaj, 2022). However, in this study, no significant month-to-month variations in lactose content were detected.

Table 2. Descriptive statistics of Lactose and Density values by months

Components - Month	Max	Min.	Standard deviation	Mean
Lactose-February	7.51	5.09	0.11	6.41
March	6.86	5.27	0.08	6.27
April	8.04	4.03	0.17	6.02
Density-February**	1.04	1.00	0.00	1.0323[ab]
March**	1.04	1.03	0.00	1.0357[a]
April**	1.04	1.02	0.00	1.0311[b]

Density of Milk

Density is defined as the weight of a given volume and can be expressed in either grams per cubic centimeter (g/cm^3) or grams per milliliter (g/ml). The density of milk depends on its composition and is typically measured at temperatures between 10 and 20 degrees Celsius. The average density of sheep milk is reported to range between 1.033 and 1.042 g/ml. Studies indicate that increases in protein, fat-free solids, lactose, and mineral content lead to higher milk density. In contrast, milk fat, which has a density of approximately 0.93 g/ml, lowers the overall density. This explains why fat-free milk has a higher density (around 1.036 g/ml) (Turgut et al., 2023).

In this study, the density of sheep milk was found to range between 1.030 and 1.045 g/ml, consistent with the findings of Bulca et al. (2019). The statistical analysis revealed significant differences in density between months ($P < 0.01$; Table 2). However, the relationship between fat content and milk density was not explicitly examined, despite being a key factor in determining milk's overall density. Further research could explore this relationship and investigate how density changes as fat content fluctuates.

Freezing Point of Milk

The freezing point of milk is an important indicator of milk quality and can be influenced by several factors, such as milk composition, the presence of mastitis, and milk dilution with water. Generally, the freezing point of milk is lower than that of water (0°C), and variations in this point can indicate issues such as adulteration or health problems in the herd. The freezing point is commonly used to detect the addition of water to milk. As the freezing point approaches 0°C, the milk quality deteriorates, and its water content increases. A freezing point temperature value above -0.55°C indicates the possible presence of added water in the milk. A study conducted on animal milk showed that the freezing point of milk ranged from -0.53°C to -0.56°C, with the highest recorded value being -0.60°C (Güzeler, 2019).

The statistical analysis revealed that there was no statistically significant difference between the months in freezing point data ($P > 0.01$; Table 3).

Milk Dry Matter Ratio (Fat Free)

The determination of dry matter is a crucial factor in indicating the composition of milk, particularly its richness. It also serves as an important indicator for assessing the overall quality of the milk. Fat-free dry matter is commonly calculated to understand the milk's composition, focusing on the non-fat components. Compliance with the Food Regulation, standards, and the specified amount of non-fat dry matter in the Food Codex is assessed. The minimum percentage of animal milk in terms of fat-free dry matter is 8.5. This fat-free dry matter includes essential milk components such as lactose (the milk sugar), minerals, and nitrogenous compounds (Kurnaz et al., 2022).

Table 3. Descriptive statistics of Density, Freezing Point, Dry Matter (excluding oil) and Mineral values by month

Components - Month	Max.	Min.	Standard deviation	Mean
Freezing Point-February	-0.52	-0.63	0.01	-0.58
March	-0.58	-0.62	0.04	-0.53
April	-0.40	-0.66	0.01	-0.54
Dry Matter-February	13.63	9.48	0.18	11.75
March	12.60	9.81	0.14	11.49
April	14.65	7.42	0.30	11.01
Mineral-February***	0.69	0.49	0.01	0.61[b]
March***	0.78	0.57	0.01	0.66[a]
April ***	0.76	0.50	0.01	0.55[c]

**: P<0.01 ***: P<0.001

While it was reported that the amount of total dry matter in sheep milk was not affected by SHS, another study stated that the amount of total dry matter in sheep milk was inversely proportional to SCC (Pirisi et al., 2014, 2017). According to statistical analysis, the difference between months in dry matter ratio data was statistically insignificant (P=0.057). A study conducted on Norduz sheep found the fat-free dry matter ratio to be 10.6% (Ocak et. all 2009). However, according to the research results (Table 3), the dry matter rate was higher than in the other study.

Mineral Content of Milk

Literature indicates that sheep milk is richer in mineral substances compared to other types of milk, typically containing 0.9-1.0% mineral matter (Zamberlin et al., 2012). However, the findings of this study show that the mineral content in sheep milk is lower than the values reported in the literature. The measurements taken throughout the study period revealed that the average mineral matter content was 0.61±0.01 in February, 0.66±0.01 in March, and 0.55±0.01 in April. These values were found to be well below the 0.9-1.0% range commonly cited in the literature.

This discrepancy may be attributed to various factors. First, factors such as milking hygiene, animal health, and environmental conditions may have an impact on the mineral content. Additionally, the specific conditions and health status of the small cattle farm from which the milk samples were collected could also have contributed to the lower mineral content observed.

Statistical analysis revealed significant differences in the mineral matter ratio between months (P<0.001), but overall, the values observed were lower than the typical sheep milk mineral content reported in the literature. This suggests that future studies should investigate these discrepancies in greater depth.

Conclusion

At the beginning of this study, the initial hypothesis was that there would be significant differences between somatic cell count (SCC) and milk components in raw milk samples obtained from Romanov × Awassi crossbred sheep. The main objective was to assess the quality of milk samples collected from sheep raised in the Department of Animal Science at the Faculty of Agriculture, Dicle University, and to investigate the relationship between SCC and milk components.

Based on the data obtained, no statistically significant differences (P>0.05) were observed between months in terms of somatic cell count, dry matter, protein, lactose, and freezing point. However, significant differences (P<0.01) were found in fat, mineral content, and density across different months. These findings suggest that while certain milk components, particularly fat and mineral levels, may vary depending on the month, somatic cell count, and other components remain relatively stable.

The results indicate that milk samples collected under regular veterinary supervision, high animal welfare standards, and hygienic milking conditions were above expected quality standards. It was concluded that variations between somatic cell counts and milk components were largely influenced by health status and environmental factors.

In summary, milk production under healthy and hygienic conditions results in high-quality milk, and maintaining a low somatic cell count is a critical factor in producing premium dairy products.

This study enables several key recommendations aimed at improving milk quality. Firstly, monitoring somatic cell count (SCC) should continue to be emphasized as an essential parameter in evaluating milk quality. Future research should investigate not only the association between SCC and infections but also its relationship with environmental and animal health conditions in greater depth. Moreover, closer monitoring of variations in milk components is necessary, with increased attention to milking hygiene and animal health.

Finally, maintaining high standards of food safety and hygiene is essential at all times. Studies like this provide a crucial foundation for making strategic decisions aimed at enhancing milk quality.

Conflict of Interest

There is no conflict of interest among the authors.

Author Contributions Statement

O.I. writing the article, creating the experimental setup, conducting the experiments, and Interpretation of findings. İ.B. Literature research, statistical calculations of data, procurement of necessary materials for literature research and experiments. The authors declare that they have contributed to the study on the above-mentioned topics.

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