

Camel milk composition

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Abstract. This study analyzed the physicochemical properties, amino acid profile, fatty acid composition, and sensory characteristics of camel, cow, and mixed (camel:cow) milk samples. The physicochemical analysis showed that the average values of the main components (such as protein, lactose, fat, and total solids) were not significantly different from those in cow milk. There were no significant differences ($p > 0.05$) in the milk samples' fatty acid and amino acid profiles. The predominant fatty acids in all three types included C_{16:0}, C_{18:0}, C_{18:1n9c}, and C_{14:0}. The milk samples have different concentrations of specific polyunsaturated fatty acids (PUFAs), such as C_{18:3n3c} and C_{18:3n6c}. For camel milk samples, glutamic acid (10.71%) was identified as the most prevalent amino acid, followed by proline (10.71%) and leucine (8.51%). The sensory assessment revealed a specific taste profile; however, camel milk is recognized for its distinctive appearance, which is characterized by a homogeneous liquid with foam on top. It has a white color and a slightly salty flavor. These findings provide a scientific and practical basis for developing and implementing innovative technologies in dairy production.

1 Introduction

Climate change is a global challenge impacting human and natural ecosystems across environmental, social, and economic dimensions [1]. In the context of global warming, camel breeding is emerging as a significant sustainable livestock species because of its multifunctional role and unique ability to adapt to continuously changing environmental conditions. The composition of milk from dairy animals has been extensively studied, focusing on cow's milk, which accounts for 85.0% of global milk consumption, and, to a lesser extent, on goat, sheep, and buffalo milk. Although there is considerable nutritional interest in milk from other animals like yaks, mares, camels, and others, research on the composition and technological properties of these kinds of milk remains relatively limited [4]. Given these characteristics, further research into camel milk is advisable, especially regarding its unique composition and possible medicinal uses [5]. Several studies have demonstrated that camel milk possesses various therapeutic properties, including antidiabetic and hypoallergenic effects [6,7]. Other components, including hydrogen peroxide, lactoferrin, lactoperoxidase, immunoglobulins, and vitamin C, have enhanced camel milk's efficacy in treating gastric and intestinal disorders [8]. Camel milk lactoperoxidase has been demonstrated to exhibit inhibitory activities against both gram-positive and gram-negative bacteria [9]. Additionally, camel milk has been linked to therapeutic benefits for preventing and treating malaria, jaundice, gastrointestinal disorders, pneumonia, tuberculosis, and heart disease [10].

Its high content of unsaturated fatty acids enhances the overall quality of the diet. Meanwhile, the low level of β -casein and the absence of β -lactoglobulin contribute to the hypoallergenic properties of camel milk [11,12].

This study aims to determine the composition and nutritional value of camel milk, promote the growth of the camel milk industry, and contribute to research on its effectiveness and properties.

2 Materials and methods

2.1 Source, preparation, and analysis of milk samples

The full-cream camel milk powder was procured from the Al Ain Dairy Plant in Al Ain City, Emirate of Abu Dhabi, United Arab Emirates. The camel milk powder was reconstituted. Before the dissolution process, distilled water was heated to 55 to 60°C. To prepare the requisite quantity of dried powder, a portion of water was initially added and mixed thoroughly until a thick, homogeneous slurry was formed. Subsequently, the remaining water was added. To ensure complete dissolution of the solid particles, the resulting mixture is subjected to intensive stirring for 8-10 min, which is maintained at 20-25 °C for 20-30 min.

In the present study, the dry matter content of camel milk was employed as the criterion for assessment. The investigated camel milk's dry matter content was about 13.0% during the determination. Subsequently, the moisture content of the camel milk was determined to

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be 2.5%. To achieve the initial dry matter content of the camel milk, the amount of distillate water required for recovery was calculated using the following equation (1).

$$DM_{CM.P.} = 100 - MC_{CM.P.} = 100 - 2.5 = 97.5 \quad (1)$$

$$RW = MC_{CM.P.} / DM_{CM} = 97.5 / 12.7 = 7.6 \quad (2)$$

Where:

$DM_{CM.P.}$ - dry matter of the camel milk powder;

$MC_{CM.P.}$ - moisture content of the camel milk powder;

DM_{CM} - dry matter of the reconstituted camel milk.

Accordingly, in equation (1), desiccated camel milk was reconstituted by distilled water in a 1:7.6 ratio based on the standard amount of dry matter in camel milk. The ratio was calculated, bearing in mind that the dry matter content of camel milk is equal to 12.7%.

The present study employed three distinct milk samples, each with a volume of five liters: camel milk, cow milk, and a mixture of them (the fresh cow milk and reconstituted camel milk forming a 1:1 mixture in weight).

The composition of the milk samples, including the proportions of solid non-fat (SNF), milk fat, proteins, carbohydrates, and solids, as well as the density and freezing point (FP), was determined using a Lactoscan SFP Options Milk Analyzer (Milkotronic Ltd., Bulgaria).

The water content was calculated according to the BS 1109-80 [13] and represented as a percentage of dry matter (DM).

Titrate acidity was determined by the method set forth by Thorner [14], and pH was quantified utilizing a pH meter (model MS 2000, Mycosist, Plovdiv, Bulgaria) with a glass electrode (Sensorex, Garden Grove, USA) calibrated at 20°C within the range 7.01–4.01.

The presence of residual antibiotics in the milk samples was determined using BetaStar® S Combo rapid tests (Chr. Hansen, Denmark).

The sensorial evaluation of the milk samples was conducted using the standards outlined in BS 11:1987 [15].

Determination of amino acids and fatty acids. Fifty mg of the lyophilized sample (in five replicates) was mixed with 4 mL of 6N HCl and incubated at 110°C for 24 hours. The solution was then filtered through a 0.2 µm filter, and 100 µL was transferred to a GC vial and mixed with 30 µL of ribitol (0.2 mg/mL in water). The mixture was dried in a vacuum concentrator at 60°C for 2 hours. The extraction procedure for the lipids and the derivatization protocols for the amino and fatty acid fractions obtained were conducted following the method outlined by Dincheva et al., 2025 [16].

Statistical analysis. Statistical analysis, conducted through computer processing of the results, was performed using Microsoft Excel 2010 (ANOVA). Multiple comparisons were made using the LSD method. The results are presented as mean values ±SD (n=3) and are deemed statistically significant when $p < 0.05$.

3 Results and discussion

The physicochemical composition of the milk used in the study is presented in Table 1. The results indicate that the composition of the main nutrients (dry matter, water content, lactose, fats, and proteins) in camel milk is comparable to that of cow milk. The dry matter and water content in the three samples studied show minimal variation, ranging from 12.2% to 12.5% and 87.3% to 87.8%, respectively. According to Fuquay et al. (2011) [17], the average water content of camel milk is approximately 87.0% to 89.0%, which is comparable to that of cow milk. However, several factors influence the water content of camel milk, including the availability of potable water, ambient temperature, and agroecological conditions [17]. The fat content of milk significantly affects the dry matter content, with values slightly lower than those of cow milk. Similar to other nutrients in camel milk, the fat content varies widely, ranging from 1.8% to 4.3%, influenced by various factors such as environmental conditions, feed availability, and stage of lactation, season, and housing management [5]. The protein and fat content of the three milk types under observation exhibited comparable ($p < 0.05$) values, with a parallel trend also evident in the density indicator. In the study by Konuspayeva et al., 2009 [18], the protein content of camel milk was found to be 3.03 %, which was higher than that of cow milk but exhibited a similar range. Camel milk protein comprises 61.8%–88.5% casein, with the remainder comprising whey proteins [4]. This contrasts with cow milk, which contains only 0.47% whey proteins [19]. Camel milk contains lower fats, proteins, and carbohydrate levels than cow milk [20,21]. The total solids (TS) content ranged between 7.7% and 12.1%, with an average value of 11.97%, comparable to goat milk but lower than cow and buffalo milk [22]. The increased values observed in the composition of camel milk in the present study can be attributed to the utilization of reconstituted full-fat dry milk in the analytical process.

The composition of camel milk contained a higher proportion of solids (1.0%), which indicates the richness of macro and micronutrients. Several authors [11,23,24] have suggested that camel milk contains a high concentration of vit. C (24–52 mg/kg), folic acid, niacin (B3), vit. B12 and pantothenic acid. Additionally, it has been observed that other vitamins, including A, E, B, and micronutrients such as copper (Cu), have been present in significant quantities [11]. The concentrations of sodium (Na), potassium (K), iron (Fe), and manganese (Mn) were higher. In comparison, the concentration of calcium (Ca), phosphorus (P), and magnesium (Mg) were lower than that observed in cow milk [24]. In camel milk, lactose content was higher - 5.1% compared to the other samples. According to Al-Juboori et al., 2013 [25], the lactose content of camel milk was found to vary from 3.3% to 5.4%, depending on the season, feeding resources, etc. In extreme or harsh climates, the taste of camel milk was observed to change from sweet to spicy and salty due to a reduction in water and lactose content and an increased concentration of minerals [27].

Table 1. Physicochemical and organoleptic characteristics of milk.

| Properties | Milk samples | | |
|----------------------------|---|--------------------------------------|---------------------------------------|
| | Camel | Cow | Mix |
| Physicochemical | | | |
| Dry matter, % | 12.7±0.12 ^a | 12.2±0.10 ^b | 12.5±0.12 ^c |
| Water content, % | 87.3±0.11 ^a | 87.8±0.09 ^a | 87.5±0.13 ^a |
| SNF, % | 9.4±0.01 ^a | 8.7±0.05 ^b | 9.1±0.01 ^c |
| Fats, % | 3.3±0.01 ^a | 3.5±0.05 ^a | 3.4±0.05 ^a |
| Proteins, % | 3.3±0.01 ^a | 3.3±0.02 ^a | 3.3±0.01 ^a |
| Carbohydrates, % | 5.1±0.04 ^a | 4.7±0.04 ^a | 4.9±0.03 ^c |
| Solids, % | 1.0±0.02 ^a | 0.7±0.01 ^b | 0.9±0.03 ^a |
| Density, g/cm ³ | 1.029±0.00 ^a | 1.028±0.01 ^a | 1.029±0.00 ^a |
| FP, °C | - 0.542±0,002 ^a | - 0,554±0,001 ^b | - 0.550±0,001 ^c |
| Titrate acidity, °T | 17.0±1.0 ^a | 15.0±1.0 ^a | 16.0±1.0 ^a |
| pH | 6.45±0.03 ^a | 6.71±0.06 ^b | 6.66±0.05 ^b |
| Antibiotics | Negative | Negative | Negative |
| Organoleptic | | | |
| Appearance | Homogeneous liquid with foam on the surface | Homogeneous liquid | Homogeneous liquid |
| Flavor | Specific with a slightly salty taste | Specific with a slightly sweet taste | Specific with a sweet and salty taste |
| Odor | Specific and pleasant | Specific and pleasant | Specific and pleasant |
| Color | White | White with a slight creamy tint | White with a slight creamy tint |
| Consistency | Homogeneous liquid | Homogeneous liquid | Homogeneous liquid |

*a-c means with different letters within a row are significantly different ($p < 0.05$).

The low titratable acidity values (17.0, 15.0 and 16.0 °T), respectively for camel, cow and mixed milk) testify to their freshness and good microbiological quality. The higher content of solids and proteins also provides an explanation for the higher values of titratable acidity and lower values of active acidity 6.45 and 6.66 observed in camel and mixed milk in comparison to cow milk – pH 6.71. The acidity of fresh camel milk is typically within the range of 0.13% to 0.17% lactic acid [22]. Furthermore, the pH of fresh camel milk exhibits variability, typically oscillating between 6.2 and 6.5. This range is slightly more acidic than cow milk's [28]. A lower freezing point than cow milk distinguished camel milk. Our findings by those of Arain et al., 2024 [29], who determined the freezing point to be between – 0.53°C and –0.57°C, attributable to its reduced fat content and increased solids concentration. The conducted antibiotic test demonstrated the absence of inhibitory substances in the milk, a crucial prerequisite for its utilization in the production of dairy products.

Following an organoleptic analysis of the milk samples (Table 1), it was determined that cow milk exhibits a typical white color with a slight creamy tint, a moderately sweet taste, a pleasant milky odor, and a uniform consistency. A comparable organoleptic assessment was conducted on a sample mixture that exhibited characteristics similar to cow milk. However, the taste profile differed, displaying a combination of salty and sweet notes. Camel milk has a distinctive appearance, with a foam layer on the surface. It has a subtle salty taste, a unique and typical milk aroma, and

a white color. The white color is attributed to the presence of casein protein and finely dispersed small milk fat globules - 2.99 µm, in addition to the absence of carotene in milk [30].

Fat is a significant constituent of milk, comprising a mixture of triglycerides, phospholipids, cholesterol, and other esters, and it is a source of fat-soluble vitamins [31]. Fatty acids (FAs) are indispensable for the optimal functioning of the body's systems, including blood circulation, respiration, immunity, and brain function [32,33].

The composition of fatty acids (FAs) in the milk samples is presented in Table 2. The results show that the concentration of short-chain saturated fatty acids is significantly lower than that of medium-chain and long-chain fatty acids. In contrast, low-molecular-weight fatty acids, including butyric, caproic, caprylic, capric acids, and medium-molecular-weight lauric acid, are found in higher concentrations in cow and mixed milk. The predominant saturated fatty acids (SFAs) in the three samples were palmitic, stearic, and myristic. The concentrations of palmitic and stearic acids are higher in camel and mixed milk, whereas the levels of myristic acid are greater in cow milk. Previous studies have also found that the most representative fatty acids include C_{16:0}, C_{18:0}, C_{18:1n9c}, and C_{14:0} in Sudan [34], Kazakhstan [35], and Turkish camel milk [36]. Among the various types of unsaturated fatty acids, monounsaturated acids are the most abundant in milk samples. These findings are consistent with those previously reported by other researchers [34,37]. Camel milk displayed the highest a

Table 2. Fatty acids composition of milk samples.

| Fatty acids C:D | Classification | Milk sample, % of total fat | | |
|------------------------------------|----------------|-----------------------------|-------------------------|-------------------------|
| | | Camel | Cow | Mix |
| Saturated fatty acids | | | | |
| C _{4:1} | Butyric | 0.90±0.04 ^a | 9.35±0.02 ^b | 6.79±0.04 ^c |
| C _{6:0} | Caproic | 0.28±0.03 ^a | 4.01±0.03 ^b | 3.25±0.02 ^c |
| C _{8:0} | Caprylic | 0.22±0.01 ^a | 0.78±0.03 ^b | 0.32±0.03 ^c |
| C _{10:0} | Capric | 0.31±0.07 ^a | 2.24±0.05 ^b | 1.27±0.06 ^c |
| C _{12:0} | Lauric | 0.49±0.09 ^a | 3.60±0.07 ^b | 2.43±0.07 ^c |
| C _{14:0} | Myristic | 10.24±0.51 ^a | 12.20±0.53 ^b | 9.01±0.53 ^c |
| C _{16:0} | Palmitic | 29.16±1.13 ^a | 23.25±1.14 ^b | 27.78±1.13 ^a |
| C _{18:0} | Stearic | 12.13±0.46 ^a | 10.12±0.46 ^b | 9.62±0.48 ^c |
| Monounsaturated fatty acids | | | | |
| C _{14:1} | Myristoleic | 1.68±0.50 ^a | 0.12±0.42 ^b | 1.20±0.48 ^c |
| C _{16:1} | Palmitoleic | 3.09±1.30 ^a | 0.93±0.28 ^b | 2.52±0.30 ^c |
| C _{18:1n9c} | Oleic | 34.23±0.80 ^a | 30.04±0.79 ^b | 28.20±0.87 ^c |
| Polyunsaturated fatty acids | | | | |
| C _{18:3n3c} | α-Linoleic | 4.58±0.56 ^a | 2.08±0.61 ^b | 5.03±0.60 ^a |
| C _{18:3n6c} | γ-Linoleic | 0.50±0.01 ^a | 0.80±0.02 ^b | 0.64±0.01 ^c |
| Polyunsaturated fatty acids | | | | |
| C _{18:3n3c} | Linolenic | 2.19±0.02 ^a | 0.48±0.03 ^b | 1.93±0.03 ^c |

*a-c means with different letters within a row are significantly different ($p < 0.05$).

concentration of monounsaturated fatty acids (MUFAs), with the most prevalent being C_{14:1} (1.68%), C_{16:1} (3.09%), and C_{18:1n9c} (34.23%). MUFAs have been shown to enhance glucose absorption, contributing to fortifying the immune system, reducing cholesterol levels in the blood, and lowering the risk of atherosclerosis [33]. It was observed that the oleic acid content was slightly higher in camel milk (34.23%) and cow milk (30.04%) compared.

According to contemporary nutraceutical regulations, fats with a high content of PUFAs are regarded as biologically valuable due to their capacity to reinforce the structure of cell membranes and enhance cellular activity in all organs and body systems [38]. PUFAs account for 3.36% of the total FAs in cow milk (Table 2), which was lower than in camel (7.27%) and mixed (7.60%) milk. Similar findings have been reported elsewhere [39], which conclude that PUFAs account for 2.7–8.46% of the total FAs in camel milk (Table 2), which is higher than cow milk (1.89%) but still less than human milk (10–20%). The essential FAs, namely α-linolenic acid (C_{18:3-ω-3}) and γ-linoleic acid (C_{18:2-ω-6}), constitute a significant proportion of the human daily intake of PUFAs. These FAs cannot be synthesized in humans. The proportion of ω-3 and ω-6 fatty acids in camel, cow, and mixed milk was 4.58% and 0.50%, 2.08% and 0.80%, and 5.03%, and 0.64%, respectively. These findings are also consistent with the results, which have been reported by Mohamed and Mustafa, 2013 [34].

The proportions of SFAs, MUFAs, and PUFAs were 53.64%, 39.00%, and 7.29% for camel milk; 65.55%, 31.09%, and 3.36% for cow milk, and 60.47%, 31.92%, and 7.60% for mixed milk, respectively. The content of MUFAs was 39.01% of the total FAs, while that of cow and mixed milk was approximately 31.0%, respectively. Regarding cis-monoenoic fatty acids, the camel milk fat sample also exhibited a high concentration of palmitoleic

acid (3.09%) and oleic acid (34.23%). Furthermore, camel milk fat constitutes an excellent source of essential fatty acids, which can fulfill the daily nutritional requirements of countries with traditional diets. According to contemporary nutraceutical regulations, fats with a high content of PUFAs are considered biologically valuable due to their ability to strengthen the structure of cell membranes and enhance cellular function across all organs and body systems [38]. PUFAs make up 3.36% of the total FAs in cow's milk (Table 2), which is lower than in camel (7.27%) and mixed (7.60%) milk. Similar findings have been reported elsewhere [39], concluding that PUFAs account for 2.7–8.46% of the total FAs in camel milk (Table 2), which is higher than cow's milk (1.89%) but still less than human milk (10–20%). The essential FAs, specifically α-linolenic acid (C_{18:3-ω-3}) and γ-linoleic acid (C_{18:2-ω-6}), represent a significant share of the human daily intake of PUFAs. The human body cannot synthesize these FAs. The proportions of ω-3 and ω-6 fatty acids in camel, cow, and mixed milk were 4.58% and 0.50%, 2.08% and 0.80%, and 5.03% and 0.64%, respectively. These findings also align with those reported by Mohamed and Mustafa in 2013 [34]. The proportions of SFAs, MUFAs, and PUFAs were 53.64%, 39.00%, and 7.29% for camel milk; 65.55%, 31.09%, and 3.36% for cow's milk; and 60.47%, 31.92%, and 7.60% for mixed milk, respectively.

The content of MUFAs in camel milk constituted 39.01% of the total FAs, while cow's and mixed milk comprised approximately 31.0, respectively. Regarding cis-monoenoic fatty acids, the camel milk fat sample demonstrated a high concentration of palmitoleic acid (3.09%) and oleic acid (34.23%). Moreover, camel milk fat serves as an excellent source of essential fatty acids, which can satisfy the daily nutritional needs of countries with traditional diets that are high in carbohydrates [40].

The milk proteins, including casein and whey proteins, comprise a favorable balance of amino acids. Twenty different amino acids are known to contain essential and non-essential amino acids in varying concentrations [40]. Table 3 presents the concentrations of amino acids in the milk samples.

The findings of our study suggest that the highest concentrations of amino acids are present in milk samples in the following order: glutamic acid, lysine, proline, and leucine. Additionally, the milk samples exhibited a notable proline content, ranging from 6.74 to 10.72 %.

Table 3. Amino acids composition of milk samples.

| Amino acids | Milk samples, % of total protein (TP) | | |
|---------------|---------------------------------------|-------------------------|-------------------------|
| | Camel | Cow | Mix |
| Alanine | 2.19±0.04 ^a | 1.53±0.07 ^b | 1.89±0.05 ^c |
| Valine | 6.32±0.05 ^a | 4.68±0.05 ^b | 5.56±0.06 ^c |
| Leucine | 8.51±0.10 ^a | 9.86±0.13 ^b | 7.49±0.11 ^c |
| Isoleucine | 4.94±0.08 ^a | 5.64±0.07 ^b | 4.35±0.08 ^c |
| Glycine | 1.45±0.02 ^a | 2.36±0.03 ^b | 1.27±0.03 ^c |
| Proline | 10.71±0.10 ^a | 6.74±0.09 ^b | 9.42±0.12 ^c |
| Serine | 4.74±0.07 ^a | 5.47±0.07 ^b | 4.17±0.07 ^c |
| Threonine | 4.55±0.06 ^a | 3.37±0.05 ^b | 4.00±0.05 ^c |
| Methionine | 2.81±0.05 ^a | 1.36±0.03 ^b | 2.47±0.01 ^c |
| Aspartic acid | 6.30±0.07 ^a | 8.22±0.05 ^b | 5.55±0.08 ^c |
| Glutamic acid | 17.52±0.15 ^a | 15.14±0.17 ^b | 16.74±0.14 ^c |
| Phenylalanine | 4.23±0.08 ^a | 5.38±0.05 ^b | 3.72±0.07 ^c |
| Tyrosine | 6.11±0.03 ^a | 6.69±0.01 ^b | 5.38±0.01 ^c |
| Arginine | 4.80±0.07 ^a | 5.50±0.06 ^b | 6.22±0.06 ^c |
| Histidine | 2.84±0.04 ^a | 3.53±0.02 ^b | 2.50±0.06 ^c |
| Lysine | 8.42±0.08 ^a | 10.04±0.07 ^b | 9.41±0.07 ^c |
| Cystine | 1.36±0.02 ^a | 1.71±0.02 ^b | 1.20±0.03 ^c |
| Tryptophan | 2.20±0.02 ^a | 2.78±0.03 ^b | 2.94±0.03 ^c |

*a-c means with different letters within a row are significantly different ($p < 0.05$).

The data presented in Table 3 demonstrates that leucine and lysine are the most prevalent amino acids. The highest concentration of leucine was observed in cow milk (9.86%), followed by camel (8.51%) and mixed (7.49%) milk. The current study reveals minor differences in the tryptophan content of proteins derived from all milk samples. Nevertheless, the cow milk sample exhibited a higher concentration of essential amino acids, namely isoleucine (5.64%) and phenylalanine (5.38%), compared to the other milk samples. Conversely, a notable increase in the concentration of methionine, threonine, and valine was observed in camel milk (2.81, 4.55 and 6.32 %) and mixed milk (2.74, 4.00 and 5.56 %) in comparison to cow milk (1.36, 3.37 and 4.68), respectively. The non-essential amino acid glutamic acid was present in the highest concentration in the milk samples. Nevertheless, compared to cow milk, the highest concentration of glutamic acid was observed in camel (17.52%) and mixed milk (16.74%). The results of our study indicate a higher amino acid content than that reported for Saudi Arabian camels [40]. Additionally, the milk samples exhibited a notable proline content, ranging from 6.74 to 10.72%. Prior investigations into the amino acid profile of goat milk [42] and camel milk [32] similarly have identified leucine and glutamic acid as the predominant amino acids in whole casein. At the same time, methionine and glycine were present in trace amounts.

Moreover, cysteine was identified in casein and whey proteins, with slight variations observed in all milk samples. The concentration of asparagine and serine was

higher in cow milk proteins compared to the other samples. The histidine and arginine levels in milk samples range from 2.50-3.53 and 4.80 - 6.22, respectively. These data are similar to those observed in Bactrian camel milk, which ranged from 2.64 to 2.75 g/100 g and 3.99 to 4.35 g/100 g, respectively [25]. The biological properties of camel milk proteins include high digestibility and a balanced amino acid composition. Furthermore, our findings indicate notable discrepancies in the amino acid profiles of the camel milk samples. These differences are probably attributable to the utilization of full-fat dry camel milk. Furthermore, alterations in amino acid composition may be attributed to the denaturation of heat-labile milk proteins during the drying process. Milk processing can result in amino acid denaturation, aggregation, and chemical alteration [42]. Prolonged heating causes modifications in the charge and degree of hydration of protein molecules and the release of active centers capable of interacting on their surface. The reduction of specific amino acids may be attributed to heat degradation or combination with other components [43]. As is known, animal proteins play a crucial role in rational nutrition. Camel milk proteins are biologically valuable in digestibility and balanced amino acid composition.

4 Conclusion

The physicochemical composition and characteristics of the milk samples' fatty acid and amino acid profiles

exhibit significant differences in this study. The specific composition and its inherent functionality make camel milk an interesting raw material, providing a foundation for scientific and applied research in Bulgaria's dairy production field. Following an in-depth analysis of the results, the scientific team will focus on optimizing parameters for the developing and implementing new technologies to develop the camel milk market further.

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