INTRODUCTION

Milk and milk products are healthy and nutritional foodstuffs consumed by people around the world. Predominantly, ruminant milk (e.g., cow, goat, camel) is utilized to produce milk products, such as yogurt, cheese, cream, and butter. Nowadays, yogurt is economically important and studied by the large number of published articles (Aryana & Olson, 2017). Yogurt possesses a variety of health-related benefits including angiotensin-converting enzyme inhibitory activity (Akalin, Unal, & Dinkci, 2018), gut health (Pei, Martin, DiMarco, & Bolling, 2017), and probiotics (Kok & Hutkins, 2018). In addition, yogurt fortified with different...
components, such as vitamin D, vegetable fiber, whey protein isolates, and grape-seed oil, exhibits nutritional, microbiological, and functional properties (Mercan, Sert, Karakavuk, & Akin, 2018; Mostafai et al., 2019; Yildiz & Ozcan, 2019; Yildiz-Akgöl, 2018). Compared with yogurt, Chigee, a spontaneously fermented milk product made from mare milk, is popular among the people of Mongolia, Kazakhstan, Kirgizstan, and some regions of Russia and Bulgaria (Danova, Petrov, Pavlov, & Petrova, 2005). Mare milk is a milk secreted by female horses, known as mares, to feed their foals during lactation. Additionally, mare milk, which is not a ruminant milk, is similar to breast milk in nutritional composition (Park, 2009) and can relieve recurrent inflammation (Ellinger, Linscheid, Jahnecke, Goerlich, & Enbergs, 2002). Besides, modified mare milk is a safe substitute for cow milk in infants with allergy (Muraro, Giampietro, & Galli, 2002).

Chigee is extensively consumed by the Mongols of the Xilin Gol region of China. More importantly, it is used as a traditional Mongolian medicine to cure intestinal dyspepsia, hypertension, and dyslipidemia (Rong et al., 2015; Yao et al., 2017). The traditional Mongolian medicine in Xilin Gol established the Chigee therapeutics of anti-hypertension and anti-hyperlipidemia. Xilin Gol grassland in China is a natural grazing country and is named “capital of horses” in China. The horse population in Xilin Gol was more than one hundred and fifty thousand in 2019, and mare milk and milk products from this region are notable for their high quality in China. Previous studies conducted nutritional evaluation and microbiological analysis of mare milk from Africa, Mongolia, and Europe (Bornaz et al., 2010; Markiewicz-Kęszycka et al., 2013; Minjigdorj, Baldorj, & Austba, 2012). Recent studies have investigated the microbiome of Chigee from Xilin Gol by metagenomic analysis (Gesudu et al., 2016; Guo et al., 2019; Yao et al., 2017). However, Chigee has not been studied well in the fields of traditional production technology, nutrition, and microbiology. In this study, we investigated the artisanal production technology and analyzed nutritional and microbiological properties of mare milk and Chigee based on large-scale sampling. The findings of this research can be exploited by administrative institutions and industries for the establishment of product standard and commercial production of Chigee, respectively.

2 | MATERIALS AND METHODS

2.1 | Collection of samples

Seventy-one mare milk and 117 Chigee samples were collected from Mongolian nomads in Inner Mongolia during horse lactation (June to September). Each sample originated from a herd of mares fed by a nomadic family. Most of the samples (172 out of 188) were obtained from the nine administrative divisions of Xilin Gol; nine samples were obtained from Hulun Buir and seven from Chifeng (Figure 1). A total of 14, 26, 30, and 85 samples were collected from Lan Banner, Abag Banner, West Ujimqin Banner, and Xilinhot, respectively, and 1, 2, 2, 3, and 9 samples were collected from East

![Figure 1](image-url)
2.2 | Measurement of lactose content, acidity, alcohol content, and pH of mare milk and Chigee

The lactose (China National Food Safety Standard, 2010) content, acidity (China National Food Safety Standard, 2016a), and alcohol (China National Food Safety Standard, 2016b) content were measured according to the protocols in these relevant Chinese national food safety standards. The lactose content was determined by the titration method using Feline's solution (Sinopharm) and methylene blue (Sinopharm). The acidity was determined by the titration method using sodium hydroxide (0.1 mol/L) and phenolphthalein indicator (Sinopharm). The pH of mare milk and Chigee were determined by a pH meter (Mettler Toledo).

2.3 | Measurement of protein, fat, ash, and minerals contents of mare milk and Chigee

The protein content was determined using the Kjeldahl method (China National Food Safety Standard, 2016c). The fat content was measured using the Soxhlet extraction method (China National Food Safety Standard, 2016d). The ash content was estimated after incineration in an electric muffle furnace (Taisite) at 550°C for 4 hr. The concentrations of calcium, potassium, sodium, magnesium, zinc, iron, copper, and manganese in mare milk and Chigee were determined by atomic absorption spectrophotometry (Thermo Scientific). The concentration of phosphorus was determined by visible spectrophotometry (PerkinElmer).

2.4 | Microbiological analysis of Chigee

Lactic acid bacteria (LAB) (China National Food Safety Standard, 2016e) was incubated using Man Rogosa Sharpe (MRS) for 72 hr at 36°C according to National Food Safety Standards in China, and the enumeration of LAB was done by counting colonies. The enumeration of yeast (China National Food Safety Standard, 2016f) was calculated using Rose Bengal Agar with chloramphenicol for 5 days at 28°C. The enumeration of coliforms was determined using Violet Red Bile Agar (VRBA) and Brilliant Green Lactose Bile (BGLB) for 48 hr at 36°C (China National Food Safety Standard, 2016g). Salmonella spp. (China National Food Safety Standard, 2016h) and Staphylococcus aureus (China National Food Safety Standard, 2016i) were detected according to the protocols in these relevant China National Food Safety Standards.

2.5 | Statistical analysis

The physicochemical data of fresh mare milk and Chigee were using independence-samples t test to determine significant difference. The level of significance was $p < .01$. The data were analyzed using SPSS version 13.0.

3 | RESULTS AND DISCUSSION

3.1 | Production technology of naturally fermented Chigee

Chigee is produced by spontaneous fermentation of mare milk. This artisanal production technology was investigated in the nomadic yurts by field survey. Although the different nomadic family had distinctive features in the artisanal technology, the core technology contained the common critical control points. A flow chart model illustrating the production technology of Chigee in Xilin Gol is given in Figure 2. Homemade palm-sized cloth bag (Hurunge in the Mongolian language) with microbiota from last year’s Chigee served as the fermentation starter culture. Mongolian nomads stored homemade starter culture with microbiota from last year to ferment mare milk during horse lactation (June to September). Fresh mare milk was naturally cooled and filtered by gauze. Filtered and cooled mare milk was mixed with starter culture in a porcelain barrel and allowed to spontaneously ferment at ambient temperature (approximately 20°C). Chigee was produced after incubation at ambient temperature (approximately 20°C) for 1–2 days, beaten, and stirred with a wooden stick (100–1,000 times per hour; a maximum of ten thousand per day) to remove carbon dioxide, ensure homogeneity, speed up the process, and eliminate the propagation of other detrimental microbes (e.g., coliforms). Normally, nomads decide the end of fermentation for consumption or sale based on personal favorite and market demand (strong, moderate, and light Chigee), Chigee was bottled in huge quantities (>50% volume) and stored at 4°C to extend shelf life. Chigee with good quality is homogenous, no layers in it, and has fermentative fragrance with sparkling feeling derived from carbon dioxide.

Strong Chigee underwent relatively longer spontaneous fermentation with higher acidity and more alcohol as well as carbon dioxide. A small volume of Chigee (5%–20%) from this was retained to serve as a starter culture for the next-day production. This cycle of Chigee fermentation continued throughout the entire horse lactation period. Homemade starter culture was prepared for next-year fermentation according to the following steps. Some boiled millets and small fruits were added to the palm-sized cloth bag, tied with a rope, immersed in the Chigee liquid for several days, and stored at 4°C after drying. The role of millets and small fruits in the preparation of the starter culture was a medium for adsorbing Chigee for adhering microbiota. The millet was unmalted and boiled for enhancing the adsorbing ability of millet. The artisanal production technology was investigated and documented in this study, which
3.2 Nutritional compositions of mare milk and Chigee

The change in lactose content after spontaneous fermentation of mare milk is given in Figure 3. Lactose content of fresh mare milk was 6.95 ± 0.45% (range: 5.99%–8.09%; n = 60). After spontaneous fermentation, the lactose content of Chigee was 2.82 ± 1.65% (0%–5.99%; n = 98). The lactose content in mare milk decreased after spontaneous fermentation. Statistical analysis showed extremely significant difference (p < .01) in lactose content between mare milk and Chigee.

We compared mare milk with cow, sheep, goat, and human milk; lactose content in mare milk was the highest (Potočnik, Gantner, Kuterovac, & Cividini, 2011). High lactose content of mare milk (5.99%–8.09%) compared with cow (4.4%–4.9%), sheep (4.1%–5.9%), goat (4.2%–5%), and human (6.3%–7%) milk suggests that more carbon sources could be utilized by LAB and yeasts to produce fermented milk products (e.g., Chigee). We speculated that mare milk with abundant lactose is good for processing into fermented products. Consistent with a previous study (Uniacke-Lowe, Huppertz, & Fox, 2010), we recorded the lactose content of mare milk similar to that of human milk and more than that of ruminant milk. Additionally, the lactose content of Mongolia mare milk (5.99%–8.09%) is more than that of Andalusian horse (5.41%–6.58%), Standardbred horse (6.08%–7.44%), and Arabian horse (5.57%–6.13%) milk (Park, 2009). In addition, we observed that lactose content was above 7% in the 50% mare milk samples of Xilin Gol. We guessed that lactose, a carbon source, may serve as a prebiotic for microorganisms to yield high-quality Chigee. We recorded 2.82% lactose in Chigee, which is more than that reported for Chigee (2.2%) and kefir (2%) (Zhang & Cheng, 1997). The test did not detect lactose in 14 out of 98 samples of Chigee. Due to the yield of Chigee from artisanal fermentation of mare milk from Mongolian nomads in Inner Mongolia, the core production technology is consistent, but different nomadic family has distinctive features during handmade process. Thus, the slightly differences in artisanal production technology, surrounding temperature and humidity, sanitary condition, and autochthonic microbes result in the differentiation of physicochemical indexes, such as lactose, acidity, and alcohol content.
The richness of lactic acid in Chigee was evaluated by acidity using the titration method. In this study, the acidity of mare milk was $5.7 \pm 3.14^\circ T$ ($2.13^\circ - 20.2^\circ T; n = 63$; Figure 4a). After spontaneous fermentation, the acidity of Chigee reached $136.72 \pm 57.88^\circ T$ ($58.7^\circ - 340^\circ T; n = 124$; Figure 4a). Statistical analysis showed extremely significant difference in acidity ($p < .01$) between mare milk and Chigee. We observed significant increase in acidity after spontaneous fermentation of mare milk.

Besides, pH value can be applied to evaluate the degree of fermentation of mare milk. The pH of mare milk was $6.89 \pm 0.2$ ($6.35^\circ - 7.17^\circ T; n = 23$; Figure 4b). After spontaneous fermentation, the pH of Chigee was $3.65 \pm 0.26$ ($3.29^\circ - 4.47^\circ ; n = 126$; Figure 4b). Statistical analysis showed extremely significant difference in pH ($p < .01$) between mare milk and Chigee. Chigee is usually classified into three types (strong, moderate, and light) based on pH (Park, 2009). Strong Chigee is a highly acidified product (pH 3.3–3.6), and we obtained 41.3% of strong Chigee from Xilin Gol samples (52 out of 126). Moderate Chigee is a moderately acidified product (pH 3.6–4.5), and we obtained 58.7% of moderate Chigee from Xilin Gol samples (74 out of 126). Chigee in Xilin Gol is known for its fragrance and taste with moderate acidification (Danova et al., 2005). We did not obtain any light Chigee (pH 4.5–5.0) during this process.

Chigee has a unique, slightly sour flavor with a bite from the mild alcoholic content. Fresh mare milk has no alcohol. Nevertheless, the alcohol content of Chigee was $1.22 \pm 0.7\%$ (0.09%–2.8%, $n = 102$; Figure 4c). The alcohol content significantly increased after spontaneous fermentation of mare milk due to the function of indigenous yeasts. We speculated that the exact flavor varied between different producers due to the difference in alcohol content and lactic acid richness, and the Chigee in Xilin Gol contained more alcohol than kefir made from cow milk (0.8%) (Zhang & Cheng, 1997).

As shown in Figure 5, the protein content (%) of mare milk was $1.93 \pm 0.27$ (mean ± SD; $n = 68$) and of Chigee was $1.93 \pm 0.28$ ($n = 107$). The fat content (%) of mare milk was $1.11 \pm 0.57$ ($n = 68$) and of Chigee was $1.12 \pm 0.42$ ($n = 86$). The ash content (%) of mare milk was $0.4 \pm 0.06$ ($n = 16$) and of Chigee was $0.41 \pm 0.05$ ($n = 16$). Statistical analysis showed no significant difference between mare milk and Chigee in protein, fat, and ash contents ($p > .05$). The above results demonstrated that the traditional fermentation of Chigee did not change the contents of protein, fat, and ash, and consumed lactose by assimilation.

The protein content of mare milk (1.93%) was less than cow (3.4%), sheep (5.6%), goat (3.5%), buffalo (4.7%), camel (3.4%), yak (4.2%), and higher than human milk (0.9%) (Uniacke-Lowe et al., 2010). The fat content (1.11%) of mare milk was less than that of cow (3.7%), sheep (6.8%), goat (3.8%), buffalo (4.7%), camel (3.8%), yak (5.6%), and human (3.8%) milk (Uniacke-Lowe et al., 2010). The protein and fat contents of Mongolia horse in Xilin Gol are more than Haflinger and Lusitano (Mariani et al., 2001; Santos & Silvestre, 2008), and less than Arabian and Russian heavy mare (Pieszka & Kulisa, 2003; Stoyanova, Abramova, & Ladoto, 1988).

The ash content in mare milk (0.4%) compared with cow (0.7%), sheep (1%), goat (0.8%), buffalo (0.8%), and human (0.2%) milk (Uniacke-Lowe et al., 2010) suggests that the mineral content

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**FIGURE 4** Acidity of mare milk ($5.7 \pm 3.14^\circ T$) and Chigee ($136.72 \pm 57.88^\circ T$) (a), pH of mare milk ($6.89 \pm 0.2$) and Chigee ($3.65 \pm 0.26$) (b). Alcohol content of mare milk and Chigee ($1.22 \pm 0.7\%$) (c)

**FIGURE 5** Protein, fat, and ash contents of mare milk and Chigee. There was no significant difference between mare milk and Chigee in protein, fat, and ash contents ($p > .05$)
could be less than that of cow, sheep, goat, and buffalo milk and more than that of human milk. There was no difference between mare milk \((n = 26)\) and Chigee \((n = 47)\) in macroelements and microelements. The concentrations of macroelements in mare milk and Chigee were less than that of other ruminants and more than that of human, and the concentrations of microelements were the lowest in mare milk (Table 1). In addition, the microelement concentrations of mare milk and Chigee were less than that of commercial strawberry-flavored yogurts and fermented whey beverages (Souza et al., 2019). The results in this study were corresponding to the previous research for the quantity of elements in other mare milk (Park, 2009).

3.3 | Microbiological analysis of Chigee produced from mare milk by spontaneous fermentation in Xilin Gol

Chigee is made from mare milk by spontaneous fermentation of lactose to lactic acid and alcohol, and microbiota plays an essential role in spontaneous fermentation of Chigee. The total number of LAB in the Chigee \((n = 51)\) varied from 5.32 to 8.56 log cfu/ml \((\text{mean} \pm \text{SD}: 7.6 \pm 0.68 \text{ log cfu/ml})\). The total number of yeasts in the Chigee \((n = 65)\) varied from 2.41 to 6.98 log cfu/ml \((\text{mean} \pm \text{SD}: 5.56 \pm 1.02 \text{ log cfu/ml})\). Our investigation confirmed high microbiological quality of Chigee from Xilin Gol. The pathogens such as *Salmonella* spp. and *Staphylococcus aureus* were not detected in all the samples. However, coliforms were detected in few Chigee samples \((n = 61)\). The coliform count varied from 0.3 to 7 log cfu/ml \((\text{mean} \pm \text{SD}: 3.37 \pm 2.06 \text{ log cfu/ml})\).

As showed in Figure 6a, the acidity of Chigee rose with increase in LAB within a certain range of LAB count. The correlation between LAB count and acidity suggested that LAB played a major role in the production of lactic acid by fermenting lactose. Chigee was made by fermentation with a mixed microflora, which contained various LAB and yeasts (Gesudu et al., 2016; Guo et al., 2019; Yao et al., 2017). However, the quantity of yeasts in Chigee was not related to the alcohol content (Figure 6b). We speculated that some of yeasts with aerobic respiration could not produce alcohol, and some of LAB could possess alcohol dehydrogenase to oxidize ethanol to acetic acid. In addition, approximately, 41% of the Chigee samples \((25 \text{ samples})\) identified to contain coliforms were able to ferment lactose. Coliforms carried out fermentation that resulted in deterioration of milk products (Todaro et al., 2017). Nevertheless, we did not detect coliforms in the Chigee with high acidity \((\geq 178^\circ \text{T})\) (Figure 6c). We speculated that high acidity may inhibit coliform growth, and LAB and yeasts determined the acidity and alcohol content of Chigee, which restrained the propagation of pathogens, such as coliforms, *Salmonella* spp., and *Staphylococcus aureus*.

Due to the spontaneous fermentation of Chigee by Mongolian nomads in Inner Mongolia, the diversity of homemade starter culture, operational habit of individual, humiture, and hygienic environment of yurts can determine the quality of Chigee such as acidity, alcoholic content, LAB, and yeasts. So, we think that the huge differences in the nutritional and microbiological compositions truly reflect the production technology and natural quality of homemade Chigee of Xilin Gol in the variation.

4 | CONCLUSIONS

Xilin Gol is a major cradle of Mongolian culture, and Chigee and horses are significant components of this magnificent culture. Chigee is a highly nutritious and health-promoting traditional dairy food. Nevertheless, the production of Chigee is restricted to the spontaneous fermentation of scarce mare milk in the Mongolian yurt. More importantly, the production technology of Chigee is still not investigated thoroughly and standardized for mass production. In this study, we collected mare milk \((n = 71)\) and Chigee \((n = 117)\) samples from the herdmen’s horses and yurts in Xilin Gol and investigated the traditional technology of Chigee production. The nutritional analysis of mare milk and Chigee suggested that

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**TABLE 1** Macroelements and microelements of mare milk and Chigee

| Species       | Calcium (mg/kg) | Phosphorus (mg/kg) | Potassium (mg/kg) | Sodium (mg/kg) | Magnesium (mg/kg) | Zinc (mg/kg) | Iron (mg/kg) | Copper (mg/kg) | Manganese (mg/kg) |
|---------------|-----------------|--------------------|-------------------|----------------|-------------------|--------------|--------------|---------------|------------------|
| Mare milk     | 775 ± 91        | 603 ± 94           | 516 ± 130         | 119 ± 23       | 57 ± 7            | 1.86 ± 0.45  | 0.25 ± 0.15  | 0.11 ± 0.02    | 0.018 ± 0.012    |
| Chigee        | 730 ± 123       | 593 ± 80           | 477 ± 122         | 124 ± 32       | 56 ± 6            | 1.81 ± 0.38  | 0.26 ± 0.16  | 0.11 ± 0.05    | 0.019 ± 0.013    |
| Cow           | 1,220           | 1,190              | 1,520             | 580            | 120               | 5.3          | 0.8          | 0.6           | 0.2              |
| Buffalo       | 1,839           | 887                | 1,016             | 448            | 190               | 1.46–7.28    | 0.42–1.52    | 0.07–0.21      | 0.38–0.66        |
| Goat          | 1,340           | 1,210              | 1,810             | 410            | 160               | 5.6          | 0.7          | 0.5           | 0.32             |
| Sheep         | 1,980           | 1,300              | 1,200             | 500            | 180               | 7.5          | 0.76         | 0.07          | 0.007            |
| Human         | 330             | 430                | 550               | 150            | 40                | 3.8          | 2            | 0.6           | 0.07             |
| Mare milk     | 500–1,300       | 200–1,200          | 300–800           | 167–200        | 40–110            | 0.9–6.4      | 0.22–1.46    | 0.2–1          | 0.01–0.05        |

Note: a,b,c,d,e,f,g Adapted from Park (2009).

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Adapted from Salimei and Fantuz (2012), value represents the range of content.
lactose significantly decreased and acidity and alcohol content significantly increased after spontaneous fermentation of mare milk. Nevertheless, there was no change in protein, fat, ash, and mineral contents during the fermentation process. The microbiological analysis revealed the abundance of LAB and yeasts and the absence of *Salmonella* spp. and *Staphylococcus aureus* in Chigee. In addition, the acidity of Chigee rose with the increase in LAB count inhibited the growth of coliforms. The study investigated thoroughly the artisanal production technology of Chigee and its nutritional and microbiological profiles that could contribute to establish the food standard of Chigee in China and to standardize the fermentation technique for the industrial production of Chigee.

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**CONFLICT OF INTEREST**

All authors declare no conflict of interest.

**ETHICAL STATEMENTS**

This study does not involve any human or animal testing.

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**REFERENCES**

Akalin, A. S., Unal, G., & Dinkci, N. (2018). Angiotensin-converting enzyme inhibitory and starter culture activities in probiotic yoghurt: Effect of sodium–calcium caseinate and whey protein concentrate. *International Journal of Dairy Technology, 71*(S1), 185–194. https://doi.org/10.1111/1471-0307.12427

Aryana, K. J., & Olson, D. W. (2017). A 100-Year Review: Yogurt and other cultured dairy products. *Journal of Dairy Science, 100*(12), 9987–10013. https://doi.org/10.3168/jds.2017-12981

Bornaz, S., Guizani, N., Sammari, J., Allouch, W., Sahli, A., & Attia, H. (2010). Physicochemical properties of fermented Arabian mares’ milk. *International Dairy Journal, 20*, 500–505. https://doi.org/10.1016/j.idairyj.2010.02.001

China National Food Safety Standard (2010). GB 5413.5-2010. *Determination of lactose and sucrose in foods for infants and young children*. Ministry of Health of the People’s Republic of China, China: National food safety standard.

China National Food Safety Standard (2016a). GB 5009.239-2016. *Determination of acidity in foods*. Ministry of Health of the People’s Republic of China, China: National food safety standard.

China National Food Safety Standard (2016b). GB 5009.225-2016. *Determination of alcohol in liquors*. Ministry of Health of the People’s Republic of China, China: National food safety standard.

China National Food Safety Standard (2016c). GB 5009.5-2016. *Detection of food microorganisms - lactic acid bacteria*. Ministry of Health of the People’s Republic of China, China: National food safety standard.

China National Food Safety Standard (2016d). GB 5009.15-2016. *Detection of food microorganisms - yeast and mold*. Ministry of Health of the People’s Republic of China, China: National food safety standard.

China National Food Safety Standard (2016g). GB4789.3-2016. *Detection of food microorganisms - coliform*. Ministry of Health of the People’s Republic of China, China: National food safety standard.

China National Food Safety Standard (2016h). GB4789.4-2016. *Detection of food microorganisms - Salmonella spp*. Ministry of Health of the People’s Republic of China, China: National food safety standard.

China National Food Safety Standard (2016i). GB4789.10-2016. *Detection of food microorganisms - Staphylococcus aureus*. Ministry of Health of the People’s Republic of China, China: National food safety standard.

**FIGURE 6** Microbial characteristics of Chigee. Correlation between LAB count and the acidity of Chigee (a), yeast count and the alcohol content of Chigee (b), and coliforms count and the acidity of Chigee (c).
Danova, S., Petrov, K. K., Pavlov, P., & Petrova, P. (2005). Isolation and characterization of Lactobacillus strains involved in koumiss fermentation. International Journal of Dairy Technology, 58(2), 100–105. https://doi.org/10.1080/1471-0307.2005.00194.x

Ellinger, S., Linscheid, K. P., Jahnecke, S., Goerlich, R., & Enbergs, H. (2002). The effect of mare’s milk consumption on functional elements of phagocytosis of human neutrophil granulocytes from healthy volunteers. Food and Agricultural Immunology, 14(3), 191–200. https://doi.org/10.1080/09540100201450006

Gesudu, Q., Zheng, Y., Xi, X., Hou, Q. C., Xu, H., Huang, W., & Liu, W. (2016). Investigating bacterial population structure and dynamics in traditional koumiss from Inner Mongolia using single molecule real-time sequencing. Journal of Dairy Science, 99(10), 7852–7863. https://doi.org/10.3168/jds.2016-11167

Guo, L., Yang, Y., Guo, J., Li, J., Sun, J., & Qian, J. P. (2019). Study of bacterial and fungal community structures in traditional koumiss from Inner Mongolia. Journal of Dairy Science, 102(3), 1972–1984. https://doi.org/10.3168/jds.2018-15155

Kok, C. R., & Hutkins, R. (2018). Yogurt and other fermented foods as sources of health-promoting bacteria. Nutrition Reviews, 76(Suppl 1), 4–15. https://doi.org/10.1093/nutrit/muy056

Mariani, P., Summer, A., Martuzzi, F., Formaggioni, P., Sabbioni, A., & Catalano, A. L. (2001). Physicochemical properties, gross composition, energy value and nitrogen fractions of Halflinger nursing mare milk throughout 6 lactation months. Animal Research, 50, 415–425. https://doi.org/10.1016/S1471-0307(01)00140-7

Markiewicz-Keşzycka, M., Wójtowski, J., Kuczynska, B., Puppel, K., Czyżak-Runowska, G., Bagnicka, E., & Krzyżewski, J. (2013). Chemical composition and whey protein fraction of late lactation mares’ milk. International Dairy Journal, 31(2), 62–64. https://doi.org/10.1016/j.idairyj.2013.02.006

Mercan, E., Sert, D., Karakavuk, E., & Akin, N. (2018). Effect of different levels of grapeseed (Vitis vinifera) oil addition on physicochemical, microbiological and sensory properties of set-type yoghurt. International Journal of Dairy Technology, 71(S1), 34–43. https://doi.org/10.1111/1471-0307.12415

Minjigdor, N., Baldorj, O., & Austba, D. (2012). Chemical composition of Mongolian mare milk. Acta Agriculturae Scandincavia, Section A – Animal Science, 62, 66–72. https://doi.org/10.1080/09064702.2012.720999

Mostafal, R., Nachvaci, S. M., Mohammadi, R., Rocha, R. S., da Silva, M. C., Esmerino, E. A., & Mortazavian, A. M. (2019). Effects of vitamin D-fortified yogurt in comparison to oral vitamin D supplement on hyperlipidemia in pre-diabetic patients: A randomized clinical trial. Journal of Functional Foods, 52, 116–120. https://doi.org/10.1016/j.jff.2018.10.040

Muraro, M. A., Giampietro, P. G., & Galli, E. (2002). Soy formulas and nonbovine milk. Annals of Allergy, Asthma & Immunology, 89(Suppl 1), 97–101. https://doi.org/10.1016/S1081-1206(10)62132-1

Park, Y. W. (2009). Bioactive components in milk and dairy products. Ames, IA: Wiley-Blackwell.

Pei, R., Martin, D. A., D’Marco, D. M., & Bolling, B. W. (2017). Evidence for the effects of yogurt on gut health and obesity. Critical Reviews in Food Science and Nutrition, 57(8), 1569–1583. https://doi.org/10.1080/10408398.2014.883356

Pieszka, M., & Kulisa, M. (2003). The influence of some factors on solids content in mare’s milk. Roczniki Naukowe Zootechniki, 17, 513–516.

Potočnik, K., Gantner, V., Kuterovac, K., & Cividini, A. (2011). Mare’s milk: Composition and protein fraction in comparison with different milk species. Mljekarstvo, 61(2), 107–113.

Rong, J., Zheng, H., Liu, M., Hu, X., Wang, T., Zhang, X., … Wang, L. (2015). Probiotic and anti-inflammatory attributes of an isolate Lactobacillus helveticus NS8 from Mongolian fermented koumiss. BMC Microbiology, 15, 196. https://doi.org/10.1186/s12866-015-0525-2

Salimi, E., & Fantuz, F. (2012). Equid milk for human consumption. International Dairy Journal, 24, 130–142. https://doi.org/10.1016/j.idairyj.2011.11.008

Santos, A. S., & Silvestre, A. M. (2008). A study of Lusitano mare lactation curve with Wood’s model. Journal of Dairy Science, 91(2), 760–766. https://doi.org/10.3168/jds.2007-0057

Souza, T. S. P., Luna, A. S., Barros, D. B., Pimentel, T. C., Pereira, E. P. R., Guimaraes, J., … Cruz, A. G. (2019). Yogurt and whey beverages available in Brazilian market: Mineral and trace contents, daily intake and statistical differentiation. Food Research International, 119, 709–714. https://doi.org/10.1016/j.foodres.2018.10.050

Stoyanova, L. G., Abramova, L. A., & Ladoto, K. S. (1988). Freeze-dried mares’ milk and its potential use in infant and dietetic food products. Voprosy Pitaniia, 2, 64–67.

Todaro, M., Palmeri, M., Settanni, L., Scatassa, M. L., Mazza, F., Bonanno, A., & Di Grigoli, A. (2017). Effect of refrigerated storage on microbial, chemical and sensory characteristics of a ewes’ raw milk stretched cheese. Food Packaging and Shelf Life, 11, 67–73. https://doi.org/10.1016/j.foodp.2017.01.005

Uśmiełowie, T., Huppertz, T., & Fox, P. F. (2010). Equine milk proteins: Chemistry, structure and nutritional significance. International Dairy Journal, 20(9), 609–629. https://doi.org/10.1016/j.idairyj.2010.02.007

Yao, G., Yu, J., Hou, Q., Hui, W., Liu, W., Kwok, L. Y., … Zhang, W. (2017). A perspective study of koumiss microbiome by metagenomics analysis based on single-cell amplification technique. Front Microbiology, 8, 165. https://doi.org/10.3389/fmicb.2017.00165

Yildiz, E., & Ozcan, T. (2019). Functional and textural properties of vegetable-fibre enriched yoghurt. International Journal of Dairy Technology, 72(2), 199–207. https://doi.org/10.1111/1471-0307.12566

Yildiz-Ağkuş, F. (2018). Enhancement of torba yoghurt with whey protein isolates. International Journal of Dairy Technology, 71(4), 898–905. https://doi.org/10.1111/1471-0307.12525

Zhang, L. B., & Cheng, T. (1997). The nutritional characteristics and protein isolates. China Dairy Industry, 25(3), 36–38.