Therapeutics Effects and Health Benefits of the Caucasus Koumiss: A review

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ABSTRACT

Koumiss (koumyss, kumiss, kumys, kumyz, kimiz or coomy) has been popular in Kyrgyzstan, Kazakhstan, Mongolia, and the Turkic, Mongolian, and Caucasian peoples of Russia: Altay, Bashkortostan, Buryatia, Dagestan, Kabardino-Balkaria, Kalmykia, Karachaevo-Cherkessia, Tatarstan, Tyva, Chuvashia, and Saha (Yakutia). Many countries in numerous Central Asian countries provide Koumiss therapeutic services, which are primarily provided by small and medium-sized accommodation firms that are particularly active in rural areas of those countries.

Koumiss is classified as a functional food due to its nutritional and medicinal properties. Many health benefits of koumiss include high probiotic content; antibacterial and antifungal characteristics; regulation of immunity; maintenance of a healthy gastric-intestinal system; regulation of cholesterol and sugar levels; regulation of blood pressure; and induction of some important vitamins. The objective of this review is to provide a comprehensive summary of the health benefits of koumiss.

Keywords: mare milk, beneficial,health, koumiss,

1. INTRODUCTION

Koumiss has long been regarded as a valuable food item and a beverage with powerful therapeutic effects. The mare appeared more than 5000 years after the domestication of horses by nomadic tribes. Archaeological expeditions carried out in Mongolia and Central Asia revealed leather remains with mare's milk remnants. However, they kept the secret of the Koumiss for a long time, and strangers who accidentally learned the technology of preparation of the drink were blinded. Koumiss is a traditional drink and folk medicine in Bashkiria, Kazakhstan, Mongolia, Uzbekistan, Kyrgyzstan, Tatarstan, Kalmykia, and Yakutia. In Europe and North America, a koumiss-like product is prepared from full or skimmed cow's milk [1, 2]. According to the Central Asian Turks, Koumiss is a drink that increases the courage of the brave, inspires the poets, uproots hopelessness and bad thoughts, and gives vigor and joy to the body. The Kyrgyz expressed the importance of Koumiss in terms of health by saying that "whoever drinks Koumiss will not even have cold sores." It is reported that it was accepted as "the drink of the gods" by the Turks and served to the gods [3, 4, 5].

Franciscan friar Plano Carpini pointed to mare's milk – koumiss in nutritional Mongols in the XIII century. William de Rubruck also gave a detailed description of koumiss, which he called "cosmos". Marco Polo called koumiss "milk-wine". In France, koumiss is called "milk-champagne" because of the gas that makes it brilliant. The end of the seventeenth century saw a resurgence of interest in Koumiss throughout Western Europe. Mare's milk, as a product of opening Western travelers, was frequently used by Russian doctors to treat

tuberculosis and diarrheal disorders in the second half of the nineteenth century. Koumiss' medicinal use in Europe and France began in the 1870s [6].

Foreign researchers' origin of the word "koumiss" is interpreted as follows: The etymology of the word koumiss seems to date back to the word "Cumans," militant nomadic people who inhabited the area between Tibet and Bukhara, on the banks of the Kuma River. The people the Mongols conquered inherited many of the traditions and customs, including the use of koumiss. The spelling and pronunciation of the word varies:«chumis, chemius, koumys, koumis, koumiss, kumis, krumis» [6].

2. NUTRITIONAL PROPERTIES

In terms of nutritional components, koumiss is incredibly diverse and contains a wide range of fatty and protein-containing nutrients as well as vitamins, amino acids, carbohydrates, and trace mineral elements [7]. Traditionally, it was regarded as a functional food, not only because it contained a high concentration of nutrients, but also because of its medical characteristics. When used in postoperative treatment, it is regarded to be useful [8]. Koumiss is sour, bubbly, mildly alcoholic. The microflora of the region includes lactic acid bacteria (*Lactobacillus bulgaricus and Lactobacillus acidophilus), lactose-fermenting yeast (K. Marxianus var. Marxianus* and *Candida koumiss*), non-lactose-fermenting yeast (*Saccharomyces cartilaginous*), and non-carbohydrate-fermenting yeast (*Mycoderma spp*.) The most essential microorganisms in koumiss are the lactic acid bacteria, which convert lactose to lactic acid, and the yeast, which convert sugar to carbon dioxide, and ethyl alcohol, which are both produced by the bacteria. This beverage usually contains about 0.2-2.5% alcohol, 0.5–1.5% lactic acid, 3.5-4.3% lactose, and 0.6-1.3% fat (Table 1). Due to the reduced fat content, mare milk has a lower calorie value (480 kcal kg/l) than human or cow milk [9,10,11,12,13]. Carbon dioxide formed from fermentation gives the product a foamy structure similar to soda or champagne [14,15]. It is also high in vitamins C, A, E, D, B_1, B_2, B_{12}, as well as trace minerals and antibiotics [10, 16].

Table 1. Nutritional properties f Koumiss

Content	Amount (%)
Protein	1.7-1.9
Fat	0.6-1.3
Lactose	3.5-4.3
Total Solids	10.6-11.3
Ash	0.4-0.5
Carbon dioxide	0.5-0.9
Ethanol	0.6-2.5

3. PRODUCTION OF KOUMISS

Traditionally, koumiss was created by inoculating fresh non-pasteurized mares' milk in tanks constructed of smoked horsehide ("saba" or "turdusk"). *Lactobacillus delbrueckii subsp.bulgaricus, Lactobacillus casei, Lactococcus lactis subsp. lactis, Kluyveromyces fragilis,* and *Saccharomyces unisporus* contributed to the fermentation, which lasted 3–8 hours [2].

Industrial koumiss production uses pure yeast and lactic acid bacteria cultures. Milk is heated to 90°C-92°C for 5 minutes and then chilled to 26°C-28°C to make koumiss. After that, the starter is added and left to ferment. It is then chilled to 20°C and stirred for 1-2 hours after fermentation. The product is bottled and allowed to ripen for 1-3 days at 6°C-8°C [2, 4].

4. KOUMISS TREATMENT PRACTICES AROUND THE WORLD

Today, Koumiss therapeutic center services are available in a number of countries throughout Central Asia through small and medium-sized accommodation firms that are particularly active in rural areas. In this regard, one of the primary travel objectives for tourists seeking koumiss treatment is to seek medical care in order to find a solution to their varied discomforts. As a result, it is not inaccurate to categorize koumiss treatment as a phenomenon that falls under the ambit of medical tourism, as previously stated [17].

In Kyrgyzstan, Kazakhstan, China, Mongolia, Tatarstan, and Russia, the "Koumiss therapy method" and "Koumiss therapy center" were established to aid in treating hepatitis, chronic ulcers, and tuberculosis. The koumiss treatment centers in these countries have been observed to boost their activity, notably during the spring months. Visiting patients with liver and stomach disorders stay in hotels near tiny horse farms on the tablelands. They receive koumiss treatment for one week by drinking horse milk four times a day. However, Koumiss therapy is not as common today as it was 100-150 years ago [17, 18, 19]

In Kyrgyzstan, Koumiss treatment or Koumiss therapy begins in the second part of May and lasts two to four months. Kyrgyzstan has about 17 koumiss treatment clinics. Koumiss therapy is predominantly found in the Chuy area, which also contains Bishkek. The cost of these services is dependent on the level of service provided. Daily prices in a typical facility range from 1500 to 2000 Som (about 21 to 29 dollars), with fees as high as 19000 Som (approximately 280 dollars). The costs shown are per person and include three meals per day (breakfast, lunch, and dinner), as well as five servings of koumiss per day. For koumiss therapy to be effective, a treatment period of 7-10 days is recommended [20, 21].

In Kazakhstan, another Central Asian country, the first koumiss treatment hospital was established in Bogdanovka village in Samara state in 1854. The use of koumiss for treatment was discovered in the Kazak steppes, dating back 5,500 years. Nomads have been developing koumiss technology for generations, but it has been kept secret. During the antique period, Kazakhs were known to employ koumiss to treat tuberculosis. Bashkortostan, Chernebinks Region, Southern Ural, Volga Region, and Salsk Steppe have all seen an increase in Koumiss treatment clinics. A good example is the Yumatova sanatorium in Bashkortostan. This koumiss institution, which first opened in 1934, has managed to stay in business until now [22].

In Inner Mongolia of China and other countries, such as Bashkortostan, Kazakhstan, Krygzstan, Uzbekistan, and Ukraine, there are nursing homes or medical centers treating patients with koumiss [23]. There were centers effectively using koumis therapy to treat lung ailments, notably tuberculosis, and to strengthen the body in the middle of the 19th century in Russia, primarily in the regions of Samara and Orenburg, as well as Moscow and Saint Petersburg [8].

In Europe, there are also Koumiss therapy center examples. During World War II, the German B. Zollman was kidnapped by the Russians and contracted tuberculosis at the Karlag work camp in Russia. When Zollmann was close to dying of tuberculosis after being liberated, a Kazakh shepherd took him to a village and treated him with koumiss. In Germany, Zollmann developed a farm with 400 mares and began producing koumiss. Furthermore, another German soldier, R. Storch, who the Russians captured during World War II, reported that he witnessed sanatoriums in Russia where koumiss was used to cure ailments including tuberculosis and pneumonia. Storch bought a mare and constructed a koumiss sanatorium when he returned to Germany [22].

5. HEALTH BENEFITS OF KOUMISS

As a functional food ingredient, Koumiss has sparked increased interest at the industrial level due to its favorable effects in treating a variety of health conditions [15,24].

The koumiss cure's origins can be traced back to the late eighteenth century when Russian and Western European physicians were interested in koumiss as a tuberculosis treatment. Koumiss treatments were used on Anton Chekhov and Count Leo Tolstoy. Chekhov was pessimistic about the prospect. It was in 1901 that a medical specialist advised Chekhov that his disease was so severe that he had no choice but to undergo the steppe koumiss cure or die [25].

The report published by the Scotchman Griwin 1784, who was in charge of the Russian army, was the first scientific understanding of the chemical structure of Koumiss. However, before this account, W. Rubrikas, a Frenchman who journeyed to the region where Tatar Turks lived in 1253, provided information on how Koumiss was manufactured, its flavor, intoxicating properties, and health consequences. Before this, when discussing the Scythians, Heredotos asserted that they acquired spirit from mare's milk. However, following Heredotos, no Western source mentions Koumiss until the 12th century. Thus, Koumiss was first recorded in Russian chronicles after the 12th century [17, 26].

Koumiss has been utilized to treat anemia, emaciation, and tuberculosis sickness for over a century. During the 1800s, Koumiss became known worldwide as a wonder drug, and koumiss treatment sanatoriums were constructed in Russia [26].

To make Koumiss, you use raw mare milk fermented with yeasts and bacteria. It has been shown to be effective in the treatment of a variety of ailments, including cardiovascular disease, digestive disease, tuberculosis, diabetes, and diarrhea. [27, 28].

5.1 TREATING TUBERCULOSIS

As a functional food ingredient, Koumisss has sparked increased interest at the industrial level due to its favorable effects in treating a variety of health conditions [15,24].

During the Union of Soviet Socialist Republics, sanatoriums were known to adopt treatments in which a few liters of koumiss were drunk daily to treat tuberculosis sickness. After their investigation, which looked into the therapeutic effects of Koumiss on nausea and vomiting, Tegin and Gonulalan [15] concluded that Koumiss can be used effectively to treat nausea and vomiting.

In the former Soviet Union, Koumiss is used as a therapeutic drink, mostly to treat tuberculosis. N. Zeland, a military doctor, described its anti-tuberculosis action in 1861 [4].

Postnikkov opened the first hospital (sanatorium) to provide treatment with Koumiss in Samara in 1858. Berlin [31] reported that 1000 patients were cured with Koumiss in nearly 50 sanatoriums in the former USSR in 1962, and 3500 mares were fed in sanatoriums for this purpose.

Mongolian doctors initially utilized Koumiss to treat tuberculosis and incorporated it into their clinical methods. Every summer and autumn at the Ximeng Mongolian Medical Research Institute, Koumiss is effectively used to heal tuberculosis. Treatment with Koumiss in clinical practice for tuberculosis patients has resulted in a 60-91% recovery rate, which has been

confirmed by laboratory techniques such as X-rays and tuberculosis testing. The absence of symptoms is an indication of successful treatment [32].

5.2. TREATING CARDIOVASCULAR DISEASES

Koumiss is used to treat cardiovascular illnesses in Europe, mainly in France, Italy, Hungary, the Netherlands, Russia, and Mongolia [33].

Akhmetova and Enikeeva [34] investigated the use of Koumiss in the treatment of individuals with cardiovascular blockage. Individuals who consumed Koumiss had their cholesterol levels drop by 10%, whereas those who did not drink it decreased by 6.9%. Furthermore, because Koumiss is high in anti-arteriosclerosis amino acids, including lysine, tyrosine, tryptophan, and glutamic acid, it is a substance used to treat cardiovascular problems [4, 35, 36, 37].

High blood pressure is linked to the development of cardiovascular and renal end-stage illnesses. According to Zha et al. [38] regular use of Koumiss lowers blood cholesterol levels and regulates the growth of blood lipids. In addition, Chen et al. [39] discovered four new angiotensin I-converting enzyme-inhibitory peptides (PI, PK, PM, and PP) in Koumiss. PI was part of β-casein in mare's milk. The three peptides PK, PM, and PP did not correspond with any known milk protein. The findings imply that koumiss contains a high concentration of ACE inhibitory peptides, and that the ACE inhibitors in koumiss are either pro-drug or a mix of pro-drug and true inhibitor types. These findings may provide proof of koumiss's health benefits, particularly in terms of cardiovascular health.

5.3.TREATMENT OF DIGESTIVE SYSTEM DISEASE

Koumiss was used to treat 130 patients with stomach ulcers and 28 duodenal ulcers in the Yumatova Sanatorium between 1966 and 1974. As a result of the studies, it was determined that the patients who used Koumiss in their treatment recovered faster [40].

Consumption of Koumiss increases the secretion of gastric juices and accelerates stomach and intestinal movements. For this reason, individuals who drink Koumiss increase their appetite, increase the level of benefit from nutrients, and have a desire to urinate more [41].

On the walls of the stomach and intestine, the bacteria in Koumiss create a biological barrier. As a result, the microecological environment stops hazardous bacteria from growing. In addition, microorganisms produce an antibiotic substance that can clean and kill bacteria that have been degraded [42].

5.4.TREATMENT CHRONIC ATROPHIC GASTRITIS

Chronic atrophic gastritis (CAG), chronic inflammation of the stomach mucosa, is distinguished by the replacement of gastric glandular cells by intestine-type epithelia, pyloric-type glands, and fibrous structures. CAG is a common but hazardous gastrointestinal condition that can lead to major problems such as stomach bleeding, anemia, peptic ulcers, and even peptic cancer [43].

The study Li et al. involved 10 female patients aged 41-55 to explore the therapeutic efficacy of koumiss on CAG. Each patient consumed three daily servings of koumiss during the 60-day therapy period (each of 250 ml). They first confirmed that koumiss treatment was

successful in reducing the patients' symptoms and maybe improving CAG based on the patients' symptoms ratings. The next study looked at the koumiss microbiome, as well as changes in the fecal microbiota and several blood markers in CAG patients before and after koumiss treatment [42].

Since 2013, the Inner Mongolia XilinGol League Mongolian Hospital has conducted long-term clinical trials, administering koumiss to CAG patients on a voluntary basis. The hospital has observed a significant reduction in CAG levels as a result of the treatment. According to the results of a small-scale pilot clinical investigation involving 11 hyperlipidemic patients, drinking fresh mares' milk did not have similar therapeutic effects [42, 44].

The research of Dhewa et al. [45] indicates that koumiss therapy is beneficial to people with hyperlipidemia. These positive benefits were linked not only to the composition, microbiota, and metabolites of koumiss, but also to the role that koumiss played in rebuilding the gut microbiota of the patients.

5.5.TREATMENT OF NEUROLOGICAL DISEASES

Koumiss contains a number of important and uncommon chemicals (B1, B2, and C vitamins) that are required for the proper functioning of the neurological system. Aside from that, Koumiss has been shown to increase the circulation and blood supply functions in the brain. As a result, it can be used to treat a wide range of neurological and intestinal conditions [46].

5.6.TREATMENT OF DIABETES

Type 2 diabetes is a metabolic disorder characterized by hyperglycemia, or high blood glucose levels, that is caused by insulin secretion, insulin action, or a combination of the two. The continuous hyperglycemia of type 2 diabetes causes long-term damage, oxidative dysfunction, and organ failure, particularly in the eyes, kidneys, nerves, heart, and blood vessels. Hyperglycemia has also been connected to high blood pressure [47]. Koumiss regulates sugar metabolism by lowering blood sugar levels and increasing insülin secretion [12].

5.7.TREATMENT OF CHLOASMA

Koumiss is used not only internally but also externally. They can cure boils, acne, and festering wounds. Koumiss also improves the overall condition of problem skin and even has a rejuvenating effect, especially for the face and neck. Koumiss has a beautiful impact as well. It can be used to moisturize the skin, remove dark scars and spots, smooth the skin, and make it white and silky. To treat chloasma, Inner Mongolia Hospital used koumiss to manufacture face lotions and masks. The skin of the patient became soft, white, smooth, and flexible after applying the Koumiss. It has a high level of efficiency on the skin, with total effectiveness of 95% [48].

5.8. ANTIMICROBIAL PROPERTIES

Yeasts are the most common microorganisms in Koumiss, and they are vital in the fermentation process as well as therapeutically [29, 30]. Some yeasts have been shown to have antibacterial effects on *E. coli*, which is most likely due to the antibacterial chemicals produced by their metabolism, such as killer toxins and organic acids, which are toxic to bacteria. [49]. Four antibacterial compounds isolated from yeasts in Koumiss (*Kluyveromyces marxianus* and *Saccharomyces cerevisiae*) were tested against three

Gram-negative bacteria, three Gram-positive bacteria, and five pathogenic *Escherichia coli* strains [30].

The antibacterial compounds from yeasts in Koumiss had better antibacterial effects on Gram-positive bacteria and Gram-negative bacteria, possibly because the antibacterial compounds (such as organic acids and killer toxins during metabolism) from yeasts in Koumiss had essential oils, thereby their antibacterial effects being similar to Chinese herbal medicines [31, 50].

Acetic acid, propionic acid, and formic acid, formed in small amounts together with lactic acid due to fermentation in Koumiss, increase the positive effect of this fermented milk product on health because of its antimicrobial properties [51]. Koumiss can be infected with *Escherichia coli, Mycobacterium tuberculosis, Bacillus mesentericus, Bacillus cereus, Bacillus subtilis, Serratiamarcescens, Bacillus mycoides, Bacterium prodigiosus, Mycobacterium citreum, Staphylococcus aureus, Shigellasonnei* etc. The presence of an antibiotic effect against microorganisms has been documented [52].

According to Hrisanova [53], the antibacterial action of Koumiss is related to the Koumiss microbiota, as Koumiss made from cows' milk had the same antibacterial effect as Koumiss made from mare milk against *M. tuberculosis* (H36Rv strain).

5.9. INCREASE OF IMMUNITY

Fresh mare milk has been shown to improve the thymus and spleen indexes, macrophage capacities, and hemolysin ratio in blood serum. Additionally, fresh mare milk increases the weight of rats' immune organs and enhances normal immunological processes, regulates cell immune capacities, and regulates the immune system of a typical body fluid [54].

Mare milk, according to Jirillo et al. [55], boosts the immune system. It was explained by the milk's high albumin and globulin content, which serve as building blocks for antibodies [56].

5.10. BENEFICIAL FOR LACTOSE INTOLERANT AND PROTEIN ALLERGY

Children allergic to cow's milk proteins will benefit from mare milk. In consequence, mare milk is sold as an alternative to baby formula in countries such as France, Germany, Belgium and Italy [23]. In addition, lactose-sensitive folks will appreciate Koumiss's low lactose content. The majority of Mongolians (88 percent) are lactose intolerant, but they are able to drink Koumiss without experiencing any discomfort. [57].

5.11. TREATMENT OF CANCER

Probiotics such as Koumiss are likely to inhibit tumor growth by lowering carcinogenic chemicals in the body and boosting the immune system, according to research. LAB fermentation results in the production of bacteriocins, ethanol, acetic acid, aroma compounds, exopolysaccharides, bioactive peptides, vitamins, and specific enzymes, among other substances. The bioactive peptides produced are advantageous to human health due to their anticancer and antioxidant properties. In vitro, enterocyte growth inhibition, apoptosis induction, substantial suppression of NF-B activation, and rearrangement of anti-inflammatory cytokine IL-10 are caused by *Lactobacillus helveticus* NS8 present in koumiss culture. A number of theories have been advanced to explain how koumiss probiotics can decrease tumor growth by inhibiting the formation of carcinogenic chemicals and strengthening the immune system [58]. Researchers have suggested that mare milk be used

in cancer treatment because, in addition to its anti-tumor properties, Koumiss can help combat adverse chemotherapy effects [56, 59].

5.12. THE TREATMENT OF HEPATITIS

In a trial on the use of Koumiss in the treatment of hepatitis in children, 60 children aged 3 to 14 years were separated into two equal groups at different phases of the disease. One group received only drugs, whereas the other received 100 mL five times a day as well as drug treatment. As a result, 8-10 liters of Koumiss were supplied. The symptoms in the Koumiss group were said to vanish in a short period [4].

Koumiss is also successfully used to treat stomach infections, typhoid fever, para-typhoid fever, dysentery, and intestinal laziness. In addition, it is reported that Koumiss is a good medicine against anemia, asthma, hyperlipidemia, indigestion, nephritis, diarrhea, gastritis fatigue, and loss of appetite [4, 44, 60, 61].

6. CONCLUSION

Koumiss, which is considered one of the symbols of nomadic culture, is a fermented milk product that has gone through a long process ranging from traditional medicine to modern medicine in the light of scientific data, in the solution of many health problems from past to present.

Koumiss has appropriate amounts of organic acids like lactic, acetic, and citric acids, amino acids like leucine, glutamic acid, and phenylalanine, and micronutrients like zinc, magnesium, copper, and vitamin C. As a result, it is rich in nutrients that nomadic communities need and lack. It is necessary since it is a nutrient-dense food. Consuming koumiss is reported to have beneficial effects on the gastrointestinal tract, metabolism, cardiovascular and neurological systems, endocrine glands, and kidneys. It aids in immune development and has been used to treat anemia and weight loss.

In addition to being high in probiotics and having antibacterial and antifungal properties, koumiss has a number of health benefits, including regulating immunity, maintaining a healthy gastric-intestinal system, regulating cholesterol and sugar levels, regulating blood pressure, alleviating lactose intolerance, and inducing the production of some essential vitamins.

Koumiss is gaining popularity as a functional food ingredient, as it is effective in the treatment of numerous health issues. Koumiss has been studied extensively since the beginning of the century. There are many ailments that it can heal.

REFERENCES

[1] Mann, EJ Kefir and Koumiss. Dairy Industries International, 1989;54(9):9–10.

[2] Di Cagno R, Tamborrino A, Gallo G, Leone C, de Angelis M, Faccia M, Amirante P, Gobbetti M Uses of mares' milk in manufacture of fermented milks. International Dairy Journal, 2004;14:767-775.

[3] Ulugtuğ N Kımız. Ankara: Ankara Halkevi Dil. Tarih ve Edebiyat Şubesi;1939.Turkish

[4] Yaygın H Kımız ve Özellikleri. Yeni matbaa. Antalya, 69 s;1992.Turkish

[5] Kırdar SS Kısrak sütü ve Kımız. Süt Dünyası Süt Ürünleri Gıda Tarım ve Hayvancılık Dergisi, 2017;12:58-62.Turkish

[6] Shaimardanova Z D Koumiss And Its Medical Qualitis (Based On Foreign Sources Xix-Early Xx Centuries). Международный журнал экспериментального образования, 2012;(12-1):53-55.

[7] Wu Y, Li Y, Gesudu Q, et al. Bacterial composition and function during fermentation of Mongolia koumiss. Food Science and Nutrition, 2021;4146-4155

[8] Jagielski VA On the various preparations of koumiss and their use in medicine. British Medical Journal, 1874;1(686);229.

[9] Svetla D, Kaloyan P, Plamen P, Penka P Isolation and characterization of Lactobasillus strains involved in koumiss fermantation. İnternational Journal of Dairy technology, 2006; 58(2):100-105.

[10] Sun T, Wang J Analysis of chemical composition and microorganism flora of traditionally home-made Koumiss in Xinjiang. China Dairy Industry, 2005;33(10):9.

[11] Abdel-Salam AM, Al-Dekheil A, Babkr A, Farahna M, Mousa HM High fiber probiotic fermented mare's milk reduces the toxic effects of mercury in rats. Am. J. Med. Sci. 2010; 2: 569–575.

[12] Mu Z, Yang X, Yuan H Detection and identification of wild yeast in Koumiss. Food Microbiolology, 2012;31:301-308.

[13] Askarov A, Kuznetsova A, Gusmanov R, Askarova A, Kovshov V Cost-effective horse breeding in the Republic of Bashkortostan, Russia. Veterinary World, 2020; 13(10):2039.

[14] Chandan RC History and Consumption Trends, in Manufacturing Yogurt and Fermented Milks (ed R. C. Chandan), Blackwell Publishing, 2007; Ames, Iowa, USA.

[15] Tegin RAA, Gönülalan Z All Aspects Of Koumiss, The Natural Fermented Product. MANAS Journal of Engineering, 2015; 2(1): 23-34.

[16] Donmez N, Kısadereİ, Balaban C, Kadiralieva N Effects of traditional homemade koumiss on some hematological and biochemical characteristics in sedentary men exposed to exercise. Biotechnology.Histochemistry, 2014;89:558–563.

[17] Erdem B, GündoğduİKoumiss Treatment in the Context of Health Tourism: A Research in Kyrgyzstan. International Journal of Medical Research & Health Sciences, 2018;7(11): 135-155.

[18] Wu RN, Wang LP, Wang JC, Li, HP, Menghe B, Wu, JR, Guo M, Zhang H Isolation and preliminary probiotic selection of Lactobacilli from koumiss in Inner Mongolia. Journal of Basic Microbiology, 2009; 49(3):318–326.

[19] Kaya F “Koumiss treatment in Central Asia”. Journal of Actual Culture: Human and Life, March; 2016.

[20] Erdem B, Gündoğdu İ An investigation on koumiss treatment in the context of health tourism: a literature review. Turizam, 2015; 22(3):107-120.

[21]Anonymous.https://ru.sputnik.kg/infographics/20170525/1033394423/kumysolechenie-v-kyrgyzstane.html.; 2021.

[22] Akbulut U “Koumiss: Thousand-Year Drink of Central Asia”, 2015.http://www.uralakbulut .com.tr/wp-content/uploads/2015/03/KIMIZ-ORTA-ASYANIN-BİNLERCE-YILLIK-İÇECEĞİ - 1-MART-2015.pdf.

[23] Pieszka M, Łuszczynski J, Zamachowska M, Augustyn R, Długosz B, Hedrzak M Is mare milk an appropriate food for people? A review. Annals of Animal Science, 2016;16:33-51.

[24] Billige M, Liu W, Rina W, Wang L, Sun T, Wang J, Li H, Zhang H Evaluation of potential probiotics properties of the screened Lactobacilli isolated from home-made koumiss in Mongolia. Annals of Microbiology, 2009;59 (3): 493-498.

[25] McGuire G Cultural histories of koumiss: tuberculosis, heritage and national health in post-Soviet Kazakhstan. Central Asian Survey, 2017;36(4):493-510.

[26] Aksoy M, Türklerde At Kültürü ve Kımız. Türk Dünyası Tarih Dergisi, 1998;38-44. Turkish

[27] Montanari G, Zambonelli C, Grazia L, Kamesheva GK, Shigaeva MK Saccharomyces unisporus as the principal alcoholic fermentation microorganism of traditional koumiss. Journal of Dairy Research, 1996;63:327-331.

[28] Ishii S, Konagaya Y Beneficial role of koumiss intake of Mongolian Nomads. Journal Japanase Society Nutrition Food Science, 2002;55:281-285.

[29] Khrisanfova LP Antimicrobial properties of Koumiss from cow and mare milk. MolochnayaPromyshlennost, 1969; 30,16-19.

[30] Chen Y Effects of antibacterial compound of Saccharomyces cerevisiae from koumiss on immune function and fecal microflora of mice challenged with pathogenic ACTA Veterinaria. BRNO 2019;88:233–241.

[31] Berlin PJ Koumisss. Annual Bulletin, Part IV, Section A, pp. 4–16, International Dairy Federation, Brussels; 1962.

[32] Zha M Koumiss Therapy. Huhehaote, China: Inner Mongolian People’s Publishing House;1987.

[33] Lozovich S Medical uses of whole and fermented mare milk in Russia. Cultured Dairy Products Journal, 1995;30:18-21.

[34] Akhmetova BKH, Enıkeeva DG Result of koumiss treatment in 'Yumovo' sanatorium during the rehabiliation stage of patients with myocardial infaction. Dairy Science Abstract, 1980;31(2):5162

[35] Wang J, Chen X, Liu W,Yang M, Zhang AH Identification of *Lactobacillus* from koumiss by conventional and molecular methods. European Food Research Technology, 2008;227:1555-1561.

[36] Cengiz B, Geleneksel süt ürünlerinden Kefir ve Kımız. 1. Uluslararası “Adriyatik’ten Kafkaslar’a Geleneksel Gıdalar Sempozyumu, s 194 s, 15-17 Nisan 2010, Tekirdağ.Turkish.

[37] Gunes Y, Dogrul C Geleneksel süt ürünlerinden Kefir ve Kımız". III. Süt ve Süt Hayvancılığı Öğrenci Kongresi, 21 Mayıs 2012, Aksaray;2012. Turkish.

[38] Zha M, Liu Y, Jin Z 50 clinical samples of koumiss fat reduction and anti-clotting. Inner Mongol Journal of Traditional Chinese Medicine 1994;13:16.

[39] Chen Y, Wang Z, Chen X, Liu Y, Zhang H, Sun T Identification of angio 1-converting enzyme inhibitory peptides from koumiss, a traditional fermented mare’s milk. Journal of Dairy Science, 2010;93:884–892.

[40] Sharmanov TSH, Kadyrova RKH, Salkhanov BA Effectiveness of peptic ulcer diet therapy using rations containing whole mare's and camel's milk. Voprosypitaniia, 1981;(3):10-14.

[41] Afzal M, Naneed F, Anjum F, Waris N, Hussain M, Ikam A, Ateeq H, Anjum FG, Sulrria H Nutritional and ethnomedicinal scenario of koumiss: A concurentreiew. Food Science and Nutrition, 2021;00:1-8.

[42] Li CK, Hou QC, Duolana WL, Liu HX, Siqinbateer BY, Sun A, Menghe B Koumiss consumption alleviates symptoms of patients with chronic atrophic gastritis: A Possible link to modulation of gut microbiota. Journal of Nutrition Oncology, 2017;2(1):48-63.

[43] Yanaoka K, Oka M, Ohata H, Yoshimura N, Deguchi H, Mukoubayashi C, et al. Eradication of Helicobacter pylori prevents cancer development in subjects with mild gastric atrophy identified by serum pepsinogen levels. International Journal of Cancer, 2009;125:2697-03.

[44] Hou Q, Li C, Liu Y, Li W, Chen Y, Bao Y, et al. Koumiss consumption modulates gut microbiota, increases plasma high density cholesterol, decreases immunoglobulin G and albumin. Journal of Functional Foods, 2019;52:469-478.

[45] Dhewa T, Kumar N, Mishra V, Sangu K Koumiss: The Nutritional and Therapeutic Values. In A.K Puniya (Eds.). Fermented Milk and Dairy Products Edition. Publisher: Boca Raton, FL: CRC Press: 2015.

[46] Ha S, Leng AMG, Mang L. Koumiss and its medicinal values. China Journal of Chinese Material Medica, 2003;28(1):11-14.

[47] Apostolidis E, Kwon YI, Ghaedian R, Shetty K Fermentation of milk and soymilk by Lactobacillus bulgaricus and Lactobacillus acidophilus enhances functionality for potential dietary management of hyperglycemia and hypertension. Food Biotechnology, 2007;21(3): 217-236.

[48] Bao D, Wu J, Ma F, Wang S, Hao B The 144 samples of chloasma treatment with Koumiss facial mask. The Chinese Journal of Dermatovenerology, 1995;12:110-110.

[49] Etienne-Mesmin L, Livrelli V, Privat M, Denis S, Cardot JM, Alric M, et al Effect of a new probiotic *Saccharomyces cerevisiae* strain on survival of *Escherichia coli* O157:H7 in a dynamic gastrointestinal model. Applied and Environment Microbiology, 2011;77:1127-1131.

[50] Chen Y, Aorigele C, Wang C, Simujide H, Yang S Screening and extracting mycocin secreted by yeast isolated from koumiss and their antibacterial effect. Journal of Food and Nutrition Research, 2015;3:52-56.

[51] Rubin HE, Nerad T, Vaughan F Lactic Acid Inhibition of *Salmonella typhimurium* in Yogurt. Journal of Dairy Science, 1982;65:65-197.

[52] Özer M Farklı yöntemlerle inek sütünden kımız üretimi üzerine bir araştırma. Yüksek Lisans Tezi. Ankara Üniversitesi. Fen Bilimleri Enstitüsü, Ankara, pp76:1997.Turkish.

[53] Hrisanova LP Scientific bases of koumiss production on pure cultures (Autoreferat of dissertation for the degree of candidate in biological sciences).Moscow, Russia: Moscow Agricultural Academy;1966.

[54] Ya T, Zhang Q, Chu F, Merritt J, Bilige M, Sun T, et al. Zhang Immunological evaluation of Lactobacillus casei Zhang: A newly isolated strain from koumiss in Inner Mongolia. China. BMC Immunology, 2008;9(1):1-9

[55] Jirillo E, D'Alessandro AG, Amati L, Tafaro A, Jirillo F, Pugliese V, et al. Modulation of the human aged immune response by donkey milk intake. In, 2010;Vol. 16. 61st annual meeting of the European Association for Animal Production (p.45).Wageningen, The Netherlands: Wageningen Academic Publishers. book of abstracts.

[56] Stuparu AA, Oroian T, Strugariu CE Pharmaceuticals and dietary supplements extracted from mare's milk. Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Animal Science and Biotechnologies,2016;73:1-10.

[57] Fox PF, Uniacke-Lowe T, McSweeney PLH, O'Mahony JA Dairy chemistry and biochemistry. Cham, Switzerland: Springer International Publishing;2015.

[58] Afzaal M, Saeed F, Anjum F, Waris N, Hussain M, Ikram A, et al. Nutritional and ethnomedicinal scenario of koumiss: A concurrent review. Food Science and Nutrition, 2021; 00: 1-8

[59] Uniacke-Lowe T, Huppertz T, Fox PF Equine milk proteins: Chemistry, structure and nutritional significance. International Dairy Journal, 2010;20:609-629.

[60] Kınık Ö, Akalın S, Gönç S Kımız üretimi ve özellikleri üzerinde bir araştırma. Gıda, 2000;25(5):379-384. Turkish.

[61] Salimei E, Fantuz F Horse and donkey milk. In E. Muehlhoff, D. McMahon, & A. Bennett (Eds.), Milk and dairy products in human nutrition (pp.594e613). Oxford, UK: John Wiley & Sons;2013