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NUTRITIONAL AND MEDICAL PROPERTIES OF MARE'S MILK (review)**AT MUSAEV, BS ZHUSSUPOV, ZM ZHANEN, BOMMAGANI SAI CHANDANA, ZhY MERGENBAYEV, MACHERLA SAI CHARAN, PEDDINTI VENKATA MANOJ KUMAR, DG SYZDYKBAYEVA***National Medical University, Almaty c., Republic of Kazakhstan*

Recent interest in mare's milk is associated with the fact that it was used by many people around the world, is an ancient relic of Turkic people and contains a wide variety of nutrients with health-promoting properties. Among milk of many mammal species, mare's milk is highly appreciated for similarity to human milk in terms of chemical composition allowing its use as a substitute for mother's milk in infant feeding. It can also be used in feeding people with various health conditions, particularly the patients in group of risk or suffering from Tuberculosis and Hepatitis C. This article is making a review of rich composition of mare's milk.

Keywords: mare's milk, composition, fats, proteins, carbohydrates, vitamins.

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Т Ұ Ж Ы Р Ы М**БИЕ СҮТІНІҢ ҚОРЕКТІК ЖӘНЕ ЕМДІК ҚАСИЕТТЕРІ (әдеби шолу)**

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Бие сүтіне деген соңғы қызығушылық оның әлемнің барлық халықтарымен қолданылып, сонымен қатар түркі халықтарының ежелгі байлығы болып табылатындықтан және пайдалы қасиеттері бар қоректік заттары мол сусын екенімен анықталады. Көптеген сүтқоректілердің ішінде бие сүтін оның ана сүтіне ұқсастығы үшін бағалайды, өз кезегінде бұл қасиет оны ана сүтін алмастырғыш ретінде пайдалануға мүмкіндік береді. Сондай-ақ, ол әр түрлі денсаулық мәселелері бар адамдарда, әсіресе туберкулезбен, С гепатитімен және әр түрлі иммунды тапшылығымен ауру қаупі бар науқастарда қолданылады. Мақалада бие сүтінің құрамы кеңінен келтірілген.

Негізгі сөздер: бие сүті, құрамы, белоктар, майлар, көмірсулар, дәрумендер.

Р Е З Ю М Е**ПИТАТЕЛЬНЫЕ И ЛЕЧЕБНЫЕ СВОЙСТВА КОБЫЛЬЕГО МОЛОКА (обзор)**

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Недавний интерес к кобыльему молоку обусловлен тем, что оно употребляется всеми народами мира, а также является древней реликвией тюркских народов и содержит большое количество питательных веществ с полезными свойствами. Среди молока многих видов млекопитающих кобылье молоко высоко ценится за сходство с грудным молоком, позволяющее использовать его в качестве заменителя грудного молока. Оно также используется для питания людей с различными состояниями здоровья, в частности у пациентов в группе риска или страдающих туберкулезом, гепатитом С и различными видами иммунодефицита. В статье описывается богатый состав кобыльего молока.

Ключевые слова: кобылье молоко, состав, белки, жиры, углеводы, витамины.

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Mare's milk is one of the most important drinking product for the human populations in those areas of central Asia, where a lactic alcoholic beverages called kumis and saumal are traditionally produced through fermentation [1].

Mare's milk is not like a cow's milk neither organoleptically nor by taste. It is clear, whitish, and sweeter than cow's milk, which makes it just like a human milk. Mare's milk differs greatly from milk of human or cow in terms of the key elements content.

Fat

The fat content of mare's milk is considerably lower as compared with human and cow's milk (Figure 1). The quantitative relation of unsaturated-to-saturated fatty acids in mare's milk (1:3) is near to that in human milk (1:2), whereas it deviates from the values typical for cow's milk (2:1). Mare's milk is a good source of linoleic acid and α -linolenic acid, which are not synthesized by the human body and which are essential for the growth and development of nervous system [4]. Mare's milk contains fewer triglycerides, but it is richer for free fatty acids (FFA) and phospholipids for 9 and 5 times respectively, which is necessary for cellular membranes. This way, it may save cell wall from oxidative phosphorylation.

Proteins

Mare's milk is similar to human milk in terms of protein composition, 8.30% and 7.60% respectively. Compared to other fractions (Figure 2), the percentage of whey protein in mare's milk is more than 20% higher than in cow's milk, amounting to approximately 40%, but lower than in human milk (more than 50%). Cow's milk has the highest amount of caseins. For that reason it is called casein type milk, whereas mare and human milk are called albumin type milk [2]. Due to the fact that cow milk contains big amount of caseins (coarse proteins), which induces allergy, infants develop allergy for it more often. On the other hand, mare's milk contains more albumins (finely dispersed), therefore it doesn't develop allergy.

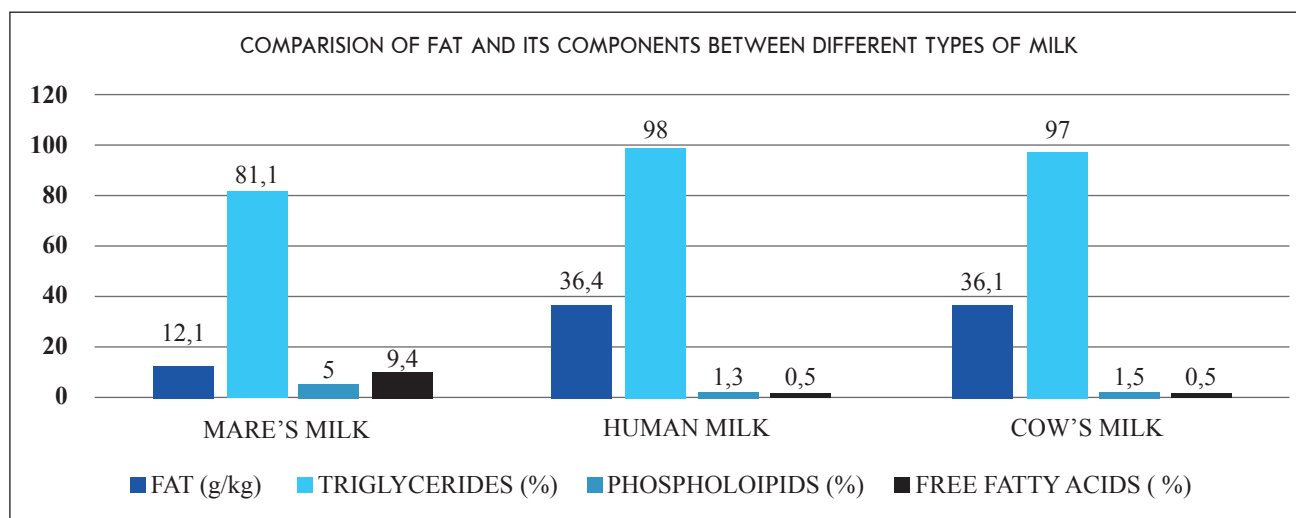


Figure 1 - Comparison of fat and it's components between different types of milk

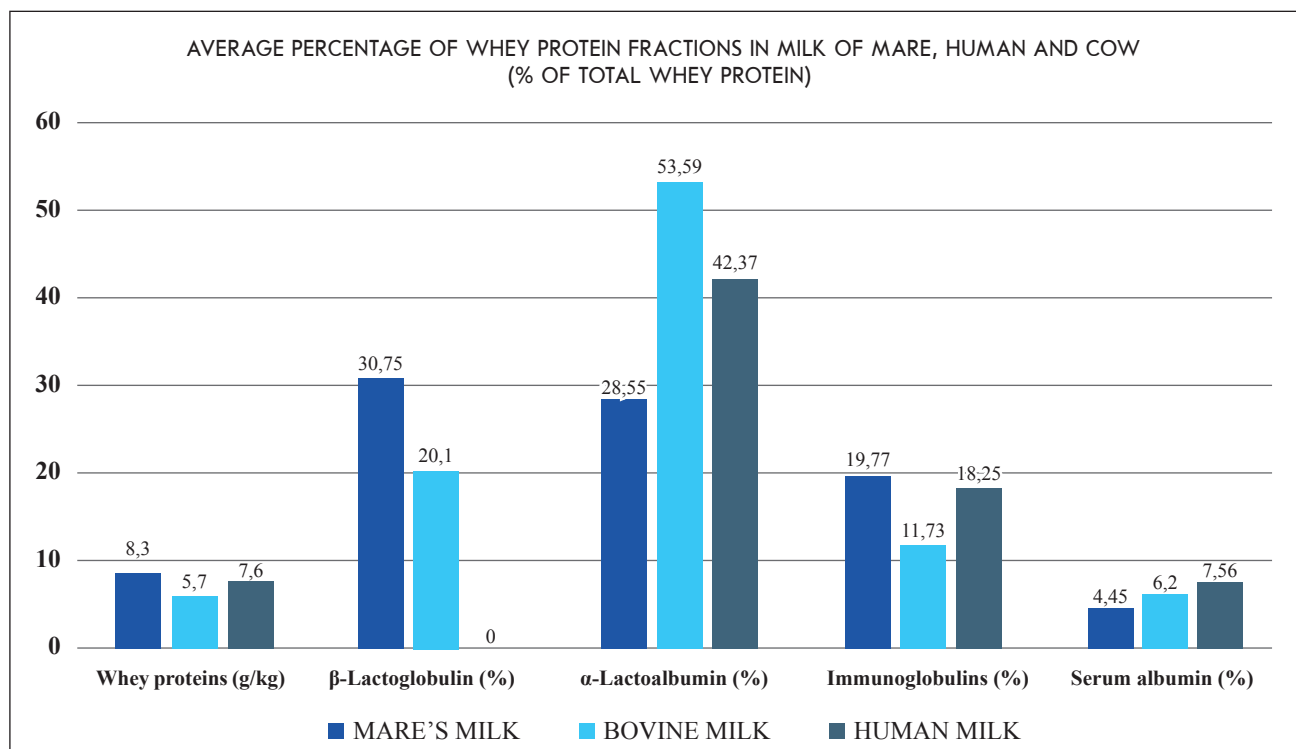


Figure 2 - Average percentage of whey protein fractions in milk of mare, human and cow (% of total whey protein)

The large amount of whey protein and exogenous amino acids in mare's milk make it a more beneficial source of nutrients for people than cow's milk [2].

Amino acids

Amino acids are important constituents of food. They supply the required building blocks for protein biosynthesis.

Due to a high percentage of whey proteins and exogenous amino acids, mare's milk is a better source of nutrients for humans than cow's milk [2] (Table 1).

The quantity of Asparagine, Threonine, Serotonin, Proline, Leucine and Lysine is almost 6 times higher in comparison with cow milk. On the other hand, Glutamine level is 3 times greater. But, however, human milk indexes are 10 times more in all points, which proves its' significance, for infant's muscular and skeletal system development.

a symbiosis in which favorable microflora is created that compete with and exclude many potential pathogens [4].

Galactose, as a part of lactose, takes part in the myelination process and brain development in young organisms, which require significant amounts of galactosylceramides and galactolipids [7]. That's why milk galactose play a unique role in providing the requirements of the rapidly developing infant brain [5].

Vitamins

Mare's milk has been proven to contain vitamins A, D3, E, K2, C, B1, B2, B3, B6, B12. With the exception of vitamin C, the content of other vitamins in mare's and cow's milk does not differ significantly [7] (Table 2). Mare's milk is much richer in vitamin C as compared to cow's milk, and this vitamin has a high nutritional value due to its resistance to oxidation and anti-inflammatory properties. Mare's milk contains a similar

Table 1 - Comparison of essential and non-essential amino acids content (g/100g milk) in milk of mare, human and cow

Amino acid	Mare's milk	Cow milk	Human milk
Essential amino acids			
His	0.492	0.10	2.50
Ile	0.492	0.14	6.09
Leu	1.444	0.29	10.02
Lys	1.444	0.27	6.33
Met	0.213	0.06	2.94
Phe	0.738	0.16	4.48
Thr	1.132	0.15	4.22
Trp	0.229	0.05	-
Val	0.853	0.16	5.17
Non-essential amino acids			
Asp	1.543	0.26	9.85
Ser	1.444	0.16	3.6
Glu	2.281	0.77	-
Pro	1.346	0.32	-
Gly	0.558	0.06	-
Ala	0.673	0.10	5.03
Cys	0.164	0.02	0.99
Ile	0.492	0.14	6.09
Tyr	0.771	0.15	4.19
Arg	0.706	0.11	3.91

Carbohydrates and lactose

Literature analysis showed that human milk contains a little bit more lactose (6.71%) than mare's milk (6.37%). It is the main source of carbohydrates. Lactose can be delivered to an organism only as a part of milk. As a constituent of milk, it can influence the process of seeding the gastrointestinal tract with microorganisms responsible for its breakdown. This results in

level of vitamin A as compared to cow's milk but some authors [7] pointed out that it is less than in human milk. Results of recent studies showed that vitamin D was found in greater amount in mare's milk as compared to human milk [4]. According to [7], supplementation with vitamin D significantly decreased the risk of premature death and death from cancer as well as supporting general health. Mare's milk is characterized

by an average concentration of vitamins from the B group, while human milk contains less and cow's milk more as compared to mare's milk (Table 2). The level of cobalamin was shown to be higher and vitamins B2 and B9 to be lower in mare's milk compared to human and cow's milk [10]. On the other hand, the level of Vitamin K is almost 9 times more compared with human milk, which means that it has a positive effect on blood coagulation system.

Table 3 - Comparison of minerals content (mg/100 ml milk) in milk of mare, human and cow

Mineral component	Mare's milk	Human milk	Cow milk
Ca ²⁺	50–135	28–34	112–123
P ⁺	20–121	14–43	59–119
K ⁺	25–87	53–62	106–163
Na ⁺	8–85	10–18	58
Cl ⁻	19	60–63	100–119

Table 2 - Comparison of fat soluble vitamins and watersoluble vitamins content in milk of mare, human, and cow

Vitamins	Mare's milk	Human milk	Cow milk
Vitamin A (mg/l)	0.403	0.455	0.435-0.799
Vitamin B1 (µg/l)	20-40	14-17	28-90
Vitamin B2 (µg/l)	10-37	20-60	115-202
Vitamin B3 (µg/l)	70-140	147-178	50-120
Vitamin B5 (µg/l)	277-300	184-270	260-490
Vitamin B6 (µg/l)	30	11-14	30-70
Vitamin B9 (µg/l)	0.13	5.2-16	1-18
Vitamin B12 (µg/l)	0.3	0.03-0.05	0.11
Vitamin C (µg/l)	1280-8100	3500-10000	300-2300
Vitamin D3 (µg/l)	4.93	0.03-0.12	2.31-15.39
Vitamin E (mg/l)	1.13	5.09	1.05-1.95
Vitamin K2 (µg/l)	17.93	1.8	4.81-17

Minerals

Mare's milk contains relatively few minerals (0.5%) compared to cow's milk (0.8%) (Table 6) [7]. However, its calcium-to-phosphorus ratio (1.6–1.8:1) is more favorable to the proper growth of the skeleton of young organisms than cow's milk (approximately 1.4:1) and is closer to that in human milk (approximately 1.9:1) [7].

Sodium in the form of cations plays an important role as a constituent of blood and extracellular fluid, potassium as a cation takes part in maintaining the integrity of intracellular fluid. Milk is generally a good source of calcium and phosphorus which are necessary for the process of bone growth and development, and also magnesium, which is needed for mineralization of bones [7].

There are major differences in the mineral content of mare's, cow's and human milk: the concentration of most minerals is higher in mare's milk than in human milk but much lower than in cow's milk (Table 3). The investigation showed that cow's milk contains about 50% more non-ionized Ca²⁺ and nearly twice as much P⁺ and K⁺ than mare's milk but horse milk contains about 2 times more ionized Ca²⁺ and P⁺ than human milk [10]. Ca²⁺ to P⁺ ratio of human and mare's milk are report-

ed to be more favorable for intake of Ca²⁺ compared to the ratio in cow's milk, because it is ionized, which means is not connected with proteins. However, microelements concentration is low in all milks discussed.

Enzymes and hormones

Analysis of literature showed that beside valuable nutrients it also contains some enzymes and health promoting hormones.

Lysozyme

Also called N-acetylmuramidase, lysozyme is a hydrolyse-type enzyme that catalyses the breakdown of peptidoglycan polymers of bacterial cell wall at the 1-4 bond between N-acetylmuramic acid and N-acetylglucosamine residues, thereby lysing sensitive bacteria [6].

Antibacterial activity of lysozyme is essentially directed towards gram-positive bacteria, as their target cell-wall component (peptidoglycan) is freely accessible to the enzyme, compared to that of gram-negative bacteria, which is covered by the lipopolysaccharidic layer of the outer membrane [3]. In addition to bacteria, lysozyme has also been reported to inhibit viruses (HIV) and eukaryotic micro-organisms including parasites (*Entamoeba histolytica* trophozoites) and fungi (Can-

didalbicans) despite the absence of typical peptidoglycan in their envelopes [3,6].

This way mare's milk is considered as not only perfect thirst quenching, but also as antibacterial drink. Therefore, nowadays it is used in treatment therapy against Tuberculosis.

Insulin and Insulin-like Growth Factor I

According to literature analysis, it was discovered that mare's colostrum contains a high amount of immunoreactive insulin (iI) and immunoreactive insulinlike growth factor I (iIGF-I). IGFs and insulin, in addition to their growth-promoting actions, are considered to play valuable role in the maintenance and development of normal cell functions throughout life. Theoretically, in near future it may be used as a supportive therapy in Diabetes Mellitus patients.

Leptin

Another hormone identified in mare's milk is a leptin. It can serve as an adiposity signal to inform the brain of the adipose tissue mass in a negative feedback loop regulating food intake and energy expenditure. Leptin also plays important roles in angiogenesis, immune function, fertility, and bone formation [8].

CONCLUSION

Mare's milk has long been a popular gourmet food with an exceptionally delicious flavor and subtle nuances found in no ordinary dairy product in Central Asia. On the basis of literature data analysis and review findings, it was found that it is not only

food product and thirst quenching but also provides valuable nutrients for human body and has got treatment features due to its enzymes and hormones present in it. It is rich in proteins and carbohydrates, but it is low in fat, which makes it a dietary product. Due to the high percentage of whey proteins and exogenous amino acids, mare's milk is the best source of nutrients compared to cow's milk. And its high content of vitamin C confirms its importance and value in immunomodulation. A high concentration and optimal ratio of Ca²⁺ and P⁺ in mare's milk was also detected. Data analysis showed that it also contains enzymes and hormones such as lysozyme, aminotransferases, insulin and insulin-like growth factor I, prolactin binding proteins and leptin. All medical and pharmacological aspects of mare's milk composition were discussed. However, discovering another features and its effectiveness in treatment of other diseases is in future perspective.

Research transparency

Research did not have a sponsorship. The authors are absolutely responsible for presenting the release script for publication.

Declaration about financial and other relations

All authors took part in elaboration of article conception and writing the script. The release script was approved by all authors. The authors did not get the honorary for the article.

Conflict of interest

The authors declare no conflict of interest.

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