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CHEMICAL COMPOSITION OF MILK OF FARM ANIMALS

Ibragimov Furkat
Candidate of Veterinary Sciences, Docent

Oripova Shakhnoza
Master Student Samarkand Institute of Veterinary Medicine, Animal Husbandry and Biotechnology

Abstract:

This article describes the chemical composition, useful properties, as well as features of milk of farm animals.

Keyword

milk, casein, albumin, glabulin, milk fat, lactose, macronutrients, trace elements.

Milk is a product of normal secretion of the cow's mammary gland. From the physicochemical point of view, milk is a complex polydisperse system in which the dispersed medium is water, and the dispersed phase is substances in the molecular, colloidal and emulsion state. Milk sugar and mineral salts form molecular and ionic solutions. Proteins are in a dissolved (albumin and globulin) and colloidal (casein) state, milk fat is in the form of an emulsion [1; 105-106]. Cow's milk surpasses any other food products in the richness and diversity of its chemical composition. There is no other food product that could compete with milk. Milk contains many components that are necessary for the normal functioning of the body. Cow's milk contains about 50 different micro- and macroelements. The main minerals contained in cow's milk are magnesium, calcium, phosphorus, potassium, sulfur and chlorine. The fat and protein contained in cow's milk are a source of energy for the body, as well as a building material for cells.

Milk is very well absorbed by children, since fat is present in it in the form of tiny fat droplets. With regular use of cow's milk, immunity increases, memory improves, mood improves, and life expectancy increases. The benefits of cow's milk should not be overestimated, its use should be correct. Many adults lose the ability to digest milk. In this case, it should be replaced with fermented milk products [2].

Of the mineral elements, perhaps the most valuable and essential element of the composition is the macronutrient calcium. It is included in the chemical composition of cow's milk in an optimal form for easy assimilation by the body, in an average amount of 100 to 150 mg%. It also includes potassium, phosphorus, chlorine, sulfur, magnesium, sodium, various chlorides and citrates, a number of trace elements.

The amount of mineral elements and vitamins, as well as the percentage of fat content in milk may vary depending on the time of year, housing conditions, health and diet of cows, age and other factors affecting lactation. [3]

The chemical composition of milk is unstable and depends on factors such as the breed and age of the animal, the lactation period, feeding and maintenance conditions, productivity level, milking method, etc. During the lactation period (about 300 days), the properties of

milk change significantly three times. Milk obtained in the first 5-7 days after calving (the first period) is called colostrum, in the second period ordinary milk is obtained, and in the third (the last 10-15 days before calving) — old milk. Colostrum is thicker in consistency than ordinary milk, its color is intensely yellow, it tastes salty, has a specific smell. Colostrum is characterized by a high content of proteins (up to 11%) and minerals (up to 1.2%), high acidity (40-50 ° T). Colostrum is not subject to admission to the plant and processing [4; 57-58].

The mineral composition, vitamin content and the ratio of proteins, fats and carbohydrates in milk directly depends on what the animal ate, what were the conditions of its maintenance and other external factors. In general, it is considered that 100 g of cow's milk contains a large number of substances and compounds important for human health, listed in Table 1 [5]. Mineral substances are metal ions, as well as salts of inorganic and organic acids of milk. Milk contains about 1% of minerals. Most of them are medium and acidic salts of phosphoric acid. Of the salts of organic acids, mainly casein and citric acid salts are present. Minerals are found in all tissues of the body, participate in the formation of bones, maintain osmotic blood pressure, are an integral part of enzymes, hormones.

Chemical composition of cow's milk per 100 g of product

Substance	**Content**
Water	88 g
Squirrels	3,2 g
Fats	2,35 g
Carbohydrates	5,2 g
Retinol (Vitamin A)	28 mkg
Thiamine (Vitamin B1)	0,4 g
Riboflavin (Vitamin B2)	0,18 mg
Cobalamin (Vitamin B12)	0,44 mkg
Vitamin D	2 ME
Calcium	113 mg
Magnesium	10 mg
Potassium	143 mg

Milk salts and trace elements, along with other main components, determine the high biological value of milk. An excess of salts entails a violation of the colloidal system of proteins, as a result of which they precipitate. This property of milk is used to accelerate protein coagulation in the production of cottage cheese and cheeses. Depending on the concentration in milk, minerals are divided into macro- and microelements. The content of macronutrients, such as Na, K, Ca, Mg, P, Cl, $S0_4$, HCO_3, in milk depends on the breed of cows, the stage of lactation. Trace elements are present in milk in the form of ions and are

vital substances. They are part of many enzymes, activate or inhibit their action, can be catalysts for chemical transformations of substances that cause various milk defects. Therefore, the concentration of trace elements should not exceed the permissible values. These include: Fe, I, Co, Mp, Si, Zn, Sn, F, Al. The human body has a high need for trace elements such as iron, copper, cobalt, zinc, iodine. A growing child's body especially needs calcium, phosphorus, iron, and magnesium [6].

Milk proteins are divided into 2 large groups – casein and whey. The former are present in the product in the form of complex soluble granules of calcium salt. Their size depends on the number of ions. If it is very small, the molecules dissolve in solid casein complexes. Under the action of acids and enzymes, casein proteins curdle and settle to the bottom of the milk. This property underlies the production of fermented milk products. After the separation of the coagulated casein, only simple whey proteins, represented by globulin and albumin, appeared in the product. They are more useful than casein, because they are easily absorbed by the human body (up to 98%) and detect more essential amino acids [7].

Milk fat is considered the most valuable component, so the price of the product depends on the fat content (2.8-5%). It is characterized by the highest energy value and versatile biological activity. Milk fat is a source of a group of vitamins, tocopherols, phosphates and other important components. In milk, milk fat is in the form of a suspension consisting of small fat balls ranging in size from 0.1 to 20 microns. 1 ml of cow's milk contains 1.0-12.0 billion fat globules. The melting point of milk fat is 25-28 ° C, solidification is 18-23 ° C, density at 20 ° C is 0.918-0.924, refraction number is 42-45, refractive index is 1.453-1.455, iodine number is 25-28. By chemical composition, milk fat is a derivative of alcohol glycerin and fatty acids, which account for 93-95% of the fat mass. Currently, over 150 fatty acids have been found in milk, but 25-28 are most common, of which 18-20 are considered basic (in other fats there are no more than 5-7 names). [8]

Milk sugar (lactose) $C_{12}H_{22}O_{11}$, in the modern nomenclature of carbohydrates belongs to the class of oligosaccharides. This disaccharide plays an important role in the physiology of the development of living organisms, as it is practically the only carbohydrate obtained by newborn mammals with food. Lactose is broken down by the enzyme lactase, acts as an energy source and regulates calcium metabolism. In the human stomach, the enzyme lactase is detected already in the third month of fetal development, and the content is sufficient throughout life if milk is constantly included in the diet. Lactose exists in isomeric forms α- and β- having different physical properties. Milk is dominated by the "α-form of lactose, which gives milk a sweet taste, is easily absorbed by the body, but does not exhibit pronounced bifidogenic properties (it is not a regulator of microbiological processes) [9].

The chemical composition, properties and energy value of mammalian milk depend on the type of animal, ambient temperature and other factors. The milk of all mammals contains proteins, fats, lactose and minerals, but their quantitative and qualitative compositions are different.

Goat's milk is closest to cow's milk in composition and properties. It is characterized by a sweet taste and a characteristic smell. Goat's milk contains more fat, calcium, phosphorus, milk fat has a higher dispersion.

Sheep's milk has a white color with a grayish tinge, which is explained by the absence of carotene, although the vitamin A content is significant.

Mare's milk has a sweet, slightly tart taste and smell, more viscous, white with a bluish tinge of color. Compared with cow's milk, it contains less fat, protein, minerals, albumin and globulin predominate in its proteins. Milk is rich in vitamins, especially vitamin C (5-7 times more than in cow's milk). Mare's milk has a bactericidal effect. The fat in mare's milk is more dispersed than in cow's milk.

Donkey milk differs slightly from mare's milk in chemical composition and organoleptic parameters. Donkey's milk forms a flake-like clot when coagulated, has a high biological value and belongs to medicinal foods. Buffalo milk has a pleasant taste and smell, more viscous than cow's milk, due to the significant fat and CO MO content. Camel milk is characterized by a sweet taste, viscous consistency, high content of phosphoric and calcium salts [10].

For each type of animal, depending on the breed, individual characteristics, climatic conditions, lactation stage and other factors, the composition of milk will vary.

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