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Chemical Composition of Milk Whey

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Annotation: The problem of waste-free technology of the industry, that is, the complete and rational use of all components of milk, is present all over the world. The essence of the problem lies in the existing traditional technology for the production of dairy products.Secondary milk raw material is characterized by a unique, balanced composition and properties that differ from the original milk of the raw material. The amount of secondary milk raw material and its value deserve the attention of processors. In the dairy industry, most secondary milk raw materials, such as whey, are thrown away because it is cheaper for the producer to throw it away than to spend money on processing it. Whey is a valuable source of essential components of food, so it is rational to use it for further food and nutrition purposes. Waste-free technologies make it possible to use all components of milk for food products, medicines, feed concentrates and technical semi-finished products based on industrial processing. Thus, the chemical composition of milk whey, which is a secondary product in the production of dairy products, was analyzed. The content of proteins, lipids, lactose, mineral substances, vitamins, enzymes and organic acids in whey was studied. Their quantity, biological significance and other properties in the milk serum were analyzed.[4].

Key words: Secondary milk raw materials, whey chemical composition, energy value, biological value, whey composition and properties, caloric content, waste, useful product.

Whey is a secondary product in the production of various dairy products, including cheese, cottage cheese, casein, yogurt and ultrafiltrates. for example, in the production of cheese. Whey consists of 6.5% solids, of which 4.8% is lactose, which is purified by crystallization. [7] The chemical composition of milk whey varies depending on the technology and devices used in the primary processing and finishing of milk raw materials.

93-95% of whey consists of water, which is free, physico-chemical and chemically bound in the product. It has been determined that whey contains more than 200 different components. The main ones are the following (in terms of dry matter): lactose - 70%, whey proteins - 14%, mineral substances - 7.7%, lipids - 5.7%, other substances - 0.9%.

The fact that whey has a high biological and therapeutic value, good digestibility and an optimal ratio of nutrients. It contains proteins, carbohydrates, minerals, enzymes, hormones and a very small amount of fat. Skimmed milk (Table 1) contains proteins (3.0-3.2%), carbohydrates (4.7-4.8%) and minerals (0.7%) like whole milk, but its it has a very low fat content (0.05%). [2].

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Chemical composition of whey,%

1-table

Naming	Dry matter %	Protein %	Milk sugar, %	Oil %	Ash %	Calories NOST 1 kg, cal
Cheese whey	6,5	0,4	4,8	0,4	0,5	233
Cottage cheese whey	6,0	0,5	4,0	0,3	0,7	217

Whey is a product with a natural collection of vital mineral compounds. In terms of mineral content, secondary raw milk is similar to whole milk. Compounds of particular value are phosphorus, calcium, magnesium, as well as micro- and ultra-microelements. In general, the complex of mineral salts of whey is the same as raw milk, and it seems to be the most optimal from a biological point of view, both in terms of their wide range and composition of compounds. Enzymes, vitamins, phospholipids and other biologically active substances play a role in skimmed milk whey. [1].

The energy value of skimmed milk and butter is almost 2 times, and whey is almost 3.5 times less than milk, and their biological value is approximately the same. This makes it appropriate to use whey in the diet of people in the current period, when physical exercise is significantly reduced, there is a tendency to be overweight, neuropsychological and their energy value is increasing, it is necessary to introduce the use of whey in the diet of people.. [1].

The composition of whey varies significantly and depends on the type of cheese produced and its fat content; cheese - cheese production method and its fat content; casein - depends on the type of casein produced.

Depending on the type of main product, cheese, curd or casein whey is obtained (Table 2).

Composition and properties of whey

2-table

	Milk Whey		
Indicators	Cheese	Cottage cheese	Casein
Dry matter, %	4,5-7,2	4,2-7,4	4,5-7,5
including: no milk	0,05-0,5	0,05-0,4	0,02-0,1
Protein	0,5-1,1	0,5-1,4	0,5-1,5
Lactose	3,9-4,9	3,2-5,1	3,5-5,2
mineral salts	0,3-0,8	0,5-0,8	0,3-0,9
Acidity, °T	15-25	50-85	50-120
Density, kg/m^3	1018-1027	1019-1026	1020-1025

In the cheese production technology, the amount of the main carbohydrates in the milk is transferred to the whey. Their main mass, i.e. 90%, is lactose, the rest consists of glucose, galactose, oligosaccharides and glycoproteins.

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At the same time, due to fermentation in lactic acid, which affects the acidity of the whey, lactose is slightly less in the curd whey. The degree of transfer of individual components of milk to whey is related to the processes of gelation and syneresis. 6.3-12.4% of fat passes into whey, and its absolute content varies widely, depending on the fat content of food and technology - from 0.05 to 0. up to 5%. Whey milk fat is more diffusible than whole milk. For example, the number of fat globules smaller than 2 microns in serum is 72.6, and in milk 51.9%. 100 g of whey contains 0.135 mg nitrogen, 65% protein and 35% non-protein nitrogenous compounds. Milk contains easily digestible proteins - albumin and globulin, as well as valuable phospholipids and vitamins for the body. If the caloric content of milk is taken as 100%, then the caloric content of cheese whey is 37%, and that of cottage cheese is 34%. The main reasons for the underutilization of whey are the sharp seasonality of whey production, the rapid spoilage of products made from it and insufficient resistance, the distance of obtaining raw materials from the places where these products are sold, the relatively high price of the whey feed unit, and the difficulties associated with its transportation. [2, 3].

In the composition of whey proteins in the milk of various mammals, the protein component can be from 6 to 10 g/l. The main protein components of cow's milk serum are as follows: β-lactoglobulin and α-lactoalbumin are low-molecular proteins that make up 70-80% of the total protein in milk serum. In addition, some fractions of serum albumin, immunoglobulins and casein are found. Whey also contains glycomacropeptides, proteose peptones, lactoferrin, a large number of bioactive substances and enzymes belonging to the class of "minor" protein substances.

The lactoferrin component in milk serum is considered a natural antioxidant, and its biological value is very high. Lactoferrin has been found to perform many functions. For example, its bactericidal properties can be mentioned. That is, it has the ability to kill infections that enter from outside in newborn babies. It is present in a large amount (17%) in mother's milk, in the milk of lactating animals during the first days of childbirth, it is found in a much larger amount (four times or more) than in mother's milk. This component helps to increase the immunity of their newborn child (calf), increases the ability to resist external negative factors.

Lipids in whey are more dispersed than lipids in milk. They have a positive effect on biochemical processes in the digestive system.

The mineral content of whey consists of a wide range of complexes from the point of view of biological value. Almost all the composition of macro- and microelements is transferred to milk whey during the production technology of dairy products. They are potassium, sodium, calcium, phosphorus, magnesium, chlorine and other elements. The complex of mineral substances is the following dissociable substances

NaCl, KCl, $K(H_2PO_4)$, $K_3(C_6H_5O_7)$, $MgHPO_4$, $Ca_3(PO_4)_2$, $CaCl_2$, Na_2CO_3, K_2CO_3 and others appear. The composition of microelements in whey is as follows (μg/kg): iron - 674, zinc - 3108, copper - 7.6, cobalt - 6.08, and more than 20 types of ultramicroelements are also found.

Whey also contains water- and fat-soluble vitamins. Almost all of the water-soluble vitamins contained in milk or milk products pass into the whey. It was found that their amount is higher in sweet whey than in sour whey.

The rate of transfer of vitamins from whole milk to whey is as follows (%):

- thiamine (B1) – 81,
- riboflavin (B2) – 91,
- pyridoxine (B6) – 88,

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- cobalamin (B12) – 58,
- ascorbic acid (C) – 78,
- nicotinic acid (PP) – 54,
- retinol (A) – 11 ,
- choline – 102,
- biotin – 90,
- tocopherol (E) – 32.

The most important vitamins transferred from milk to whey are riboflavin, folic acid and cobalamin. Oilrig two vitamins are bound to whey proteins, which are transferred to the whey during cheese production. The content of vitamin B2 in whey is higher than in milk. This is explained by the increase as a result of the activity of strains of lactic acid microorganisms used in cheese production technology. Due to the high content of vitamin riboflavin in whey, its color is yellowish-green.

Whey contains the following organic acids: lactic acid, citric acid and nucleic acids.

Whey contains the following enzymes: hydrolase, phosphorylase, lactase, lipase, in addition, there are also decomposition, transfer, redox and isomerization enzymes.

The chemical composition of whey and whey powder is presented in Table 3.

Chemical composition of whey and whey powder

3-table

Content	Milk Whey		Milk Whey powder	
	Sweet	Sour	Sweet	Sour
Dry matter content, %	6,4	6,5	96,0	96,0
Water, %	93,7	93,5	3,6	4,0
Lipids, %	0,5	0,1	0,8	0,6
Proteins, %	0,8	0,8	13,1	12,5
Lactose, %	4,9	4,9	75	67,4
Ash content, %	0,5	0,8	7,3	11,8
Lactic acid, %	0,1	0,4	0,2	4,2

The practical analysis of milk serum shows that it contains very valuable natural components, it shows the need to improve the technologies of their extraction, to conduct research.

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