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CHARACTERISATION AND PROCESSING ALTERNATIVES OF MILK WHEY

Abstract: *Nowadays, much attention is being paid to a more complete and rational use of all components of milk in the process of its industrial processing. The purpose of this work were to study secondary dairy raw materials (curd whey and cheese whey) and use them for further processing. This paper presents data on the composition of whey: physico-chemical parameters of whey and mineral composition and further prospects for the processing of whey. The demand for whey in the world is growing. This is mainly because whey is used in various industries: food, feed industry, etc. The development of the manufacturing sector in most developing countries generates demand for food ingredients, primarily for the production of functional nutrition. Increased consumption of meat products is a major factor in the development of the feed industry. Whey is often used to produce high-quality balanced feeds. Due to its composition, whey is a promising basis for obtaining functional food products. The results of the physicochemical analyses showed that the composition of the whey (cheese and curd) consists of the primary and most valuable components and also the nutritional value of whey, such a milk, which characterized by harmlessness, high quality, good digestibility, optimal ratio of nutrients, sufficient calorie content, biological also physiological usefulness. In addition, cheese whey contains potassium, which accounts for 16,70%, calcium – 14,14%, and main macronutrients of the curd whey are calcium – 26,08%, and phosphorus 18,40%. Based on the results, it can be concluded that this determines the expediency of using whey in the production of functional foods.*

Key words: *Milk whey, food production, secondary raw materials, mineral composition, rational processing, functional food.*

Introduction

The purpose of this study was to examine secondary milk raw materials and use them for further processing. The most problematic part of secondary milk raw material processing remains whey – a by-product of milk processing obtained in the production of cheese (cheese whey), cottage cheese (curd whey) [1,2]. The main problems of whey processing are associated with a complex

physico-chemical composition, impressive volumes of its production and low marginality of finished products [3].

The production of protein-fat products from milk is accompanied by the production of a number of by-products with increased biological value, but little used for further processing. The rational use of secondary raw materials is a reserve for the growth of dairy production volumes. Milk is a complex of colloidal suspension that is comprised of fat globule, casein micelle colloidal and serum or whey phase. Whey (sometimes called milk serum) is a yellowish to greenish clear solution strained from milk curd coagulated by either rennet or acid. Whey components are those small molecules that are not involved in the milk curdling and are able to be strained out [4]. Milk whey is an important source of lactose, calcium, milk proteins and soluble vitamins, which make this product be considered as functional food and a source of valuable nutrients [22].

The use of serum has a good effect on the organism of the human, expressed in the ability to excite the secretion of digestive glands, maintain the microflora of the intestinal tract, reducing putrefactive processes in it. Whey also strengthens the function of the liver and kidneys, helping to remove harmful substances from the body that may contribute to neuropsychiatric disorders, reduces stress levels [5]. Whey contains 80-90% of the amount of milk entering the process and about 50% of the nutrients in raw milk: soluble protein, lactose, minerals and vitamins [6]. In cheese production, approximately 50% of milk solids are drawn off into the whey, most of the lactose, hydrosoluble minerals and vitamins and 20% of milk proteins. Its composition provides it with interesting nutritional and sensory properties [22].

By-products of processing milk and dairy products can be divided into recyclable industrial waste (substandard sawn-off from stripping cheese also cottage cheese, product with expired shelf life and/or not conforming to safety indicators, washing water, etc.) and secondary dairy raw materials subject to further processing. Scientific research by scientists and dairy manufacturers shows that whey protein is essential for human nutrition. Whey contains 80-90% of processed milk and 50% of the various nutrients in raw milk, including soluble protein, lactose, minerals and vitamins [7]. Cheese whey wastewater (CWW) is a strong organic and saline effluent whose characterization and treatment have not been sufficiently addressed [16]. Some paper results considered that native whey an excellent starting material to produce a whey protein concentrate with unique functional properties [17]. There are wide variations in composition depending on milk supply, and the process involved in production of the whey [20].

Studies shows that when analyzed the fermented milk produced with added acid whey, the acceptance test resulted in 90% of acceptance; the purchase intention showed that 54% of the consumers would ‘certainly buy’ and 38% would ‘probably buy’ the product. Using acid whey in a fermented milk formulation was technically viable, allowing by-product value aggregation, avoiding discharge, lowering water consumption and shortening the fermentation period [15].

Due to the expansion of the dairy industry in the Republic of Kazakhstan, the export volume of this industry has also increased. The main products used and exported from 2018 to 2020 are: various types of cream, milk, milk, various types of cheese and cheese. In recent years, Kazakhstan's milk production has been increasing, that is, the production of cheese and cheese has increased by 7,900 tons of milk in the last five years [8, 9]. At this point,one of the problems with all dairy companies, especially those making various types of cheese, is the constant waste of work - whey. Nowadays all over the world, this problem is solved by producing different products, especially drinks or taking whey powder. It is well known that whey products using natural ingredients can benefit human health by improving the body's resistance to various diseases [10,11]. It is imperative that milk whey possess tremendous therapeutic properties [18]. The properties of the product on the type of the whey being processed and also on the specifics of the process used to make the product [21].

Reaserch methods

The following types of whey, curd whey and cheese whey, were selected as objects of research. The whey composition varies significantly and also it depends on the type of cheese produced and its fat content for the subcutaneous whey; for cottage cheese – about the production of cheese and its content of fat. Whey refers to bulk food made from milk and its products. Taking full advantage of all the components of whey, the products produced can not only be consumed directly, but also can be stored for a long time [10]. Features of quality analysis: Sensory analysis was conducted, along with measurements of moisture, fat, protein content, according to relevant

standards by GOST 34352-2017 [19]. The sensory parameters and physical-chemical parameters (mass fraction of fat, acidity, density) of whey were determined by standard methods. The quality parameters such a physical and chemical of the raw materials are then determined and a guarantee is issued based on their compliance with standard requirements. To determine the mineral composition of the selected whey species, the methods of a scanning electron microscope JSM-6490LV with energy dispersive microanalysis systems INCA can allow you to examine samples without spraying with a conductive layer. In addition, it has the dispersive microanalysis system INCA Energy 350 and a link for the study of the structure and composition of HKL Basic polycrystalline samples, the purpose of which is the laboratory testing the history of the technology "Structural and Engineering Technology" (IRLIP "KBM") based on SKU named after M. Auezov.

Research results

For the present, consumer interest in the use of natural ingredients and products in nutrition for therapeutic purposes is increasing. Such kind of the products include milk whey. In our country, they are produced in limited quantities. At the same time, it is desired to use whey, which is a byproduct in the manufacture of products such cottage cheese and cheese, rather than producing it from whole milk. They, actually for many years has been considered like a problematic byproduct that does not have any commercial value, is beginning to be widely processed and used in various forms. Comparing with chemical medicinal preparations, they had no adverse side effects on the body and practically has no contraindications for use.

The sensory parameters of curd whey and subcutaneous whey in comparison with GOST 34352-2017 [19] are presented in Table 1.

Table 1 – Sensory parameters of curd whey and cheese whey

Name of indicators	Curd whey	Cheese whey	GOST 34352-2017
Appearance	Homogeneous liquid has a slight sediment	Homogeneous liquid has a slight sediment	A homogeneous or translucent liquid. The presence of a slight protein precipitate is allowed
Colour	Greenish yellow	Light Yellow	From light yellow to pale green
Smell and taste	Relatively sweet and sour without foreign tastes and smells	Relatively salty without foreign tastes and smells	The indicators are typical of whey

According to organoleptic parameters, it corresponds to GOST 34352-2017 [19]. The selected whey are clean and have a smooth and homogeneous liquid without any impurities, whey are without foreign tastes and smells. Almost all compounds currently found in milk are converted to whey to one degree or another. The approximate content of the primary components in cottage cheese and cheese whey is shown in Table 2.

Table 2 – The content of curd whey and cheese whey

Name	Curd whey	Cheese whey
Mass fraction of protein,%	4,25±0,02	2,26±0,01
Mass fraction of fat,%	0,12±0,001	0,44±0,002
Mass fraction of moisture,%	92,95±0,5	96,33±0,5
Dry matter content,%	7,05±0,03	3,67±0,02
Titrated acidity, deg	130±0,65	158±0,79
pH,psc	2,5±0,01	2,78±0,01

From the data that shown in the table, it should be noted that the composition of the whey (cheese and curd) consists of the primary and most valuable components and also the nutritional value of whey, such a milk, which characterized by harmlessness,high quality, good digestibility, optimal ratio of nutrients, sufficient calorie content, biological also physiological usefulness. additionally to the basic components, vitamins, mineral salts, organic acids, non-protein nitrogenous compounds, hormones,enzymes, immune bodies, i.e. almost all the components of the milk solids and water.

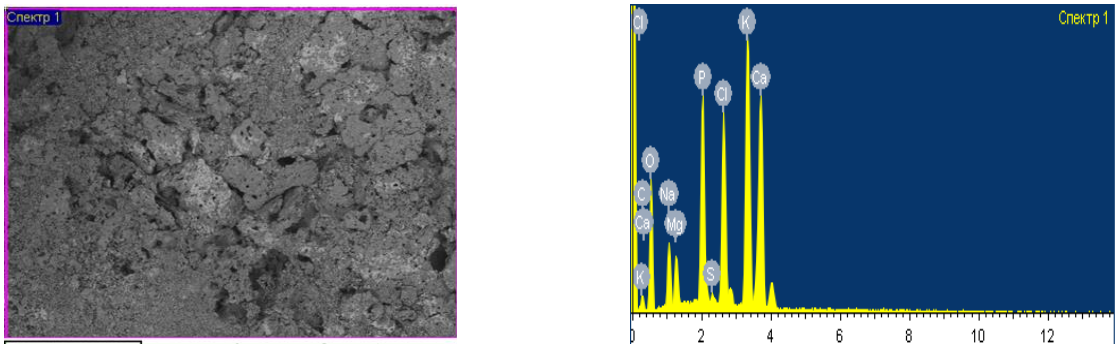

Figure 1 – Electronic image of the composition of elements in cheese whey

Figure 1 shows an electronic image of the composition of the elements in the cheese whey. The value of degree of transition of several milk components into whey is associated with the processes of syneresis and gelation. 6,3 – 12,4% of fat passes into whey, and its absolute content, depending on the fat content and technology of the feedstock, it varies widely – from 0,05 to 0,5%.

The mineral composition of the cheese whey is shown in Table 3.

Table 3 – The composition of elements in cheese whey

Name of elements	Weight indicators %
C	8,89
O	34,87
Na	4,71
Mg	2,32
P	8,89
S	0,36
Cl	9,12
K	16,70
Ca	14,14
Total	100,00

From the above data, it can be noted that the main macronutrients of cheese whey are potassium, which accounts for 16,70%, calcium – 14,14%, chlorine – 9,12% and phosphorus 8,89%, carbon 8,89%, sodium 4,71%, magnesium – 2,32% of the total mineral content.

The manufacturing of whey beverages are implicated all countries with a developed dairy industry. The main ingredient of beverages – whey – is a valuable secondary raw material of the dairy industry, which is not utilized by every enterprise in that industry. In conclusion, it can be established that the processing of whey is one of the promising areas of the food industry [12,13].

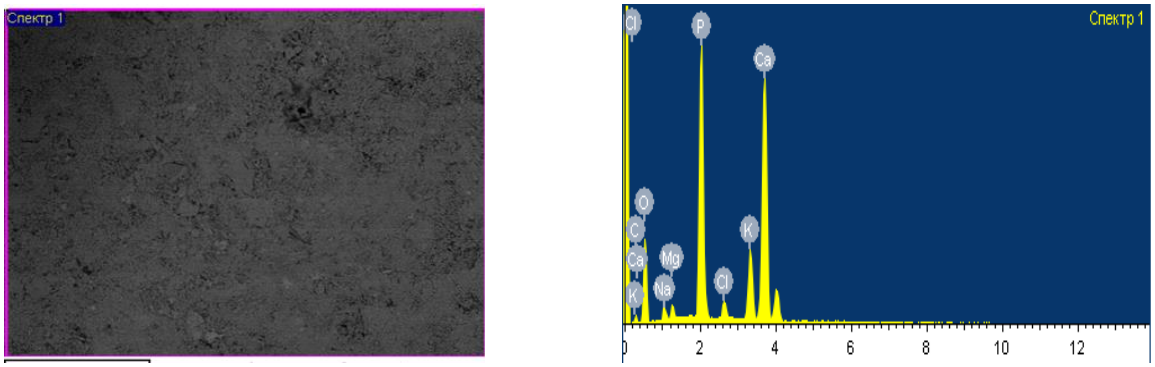

Figure 2 – Electronic image of the composition of elements in cheese whey

Figure 1 shows an electronic image of the composition of the elements in the cheese whey. The composition of elements in curd whey is shown in Table 4.

Table 4 – The composition of elements in curd whey

Name of elements	Weight indicators %
C	7,33
O	37,28
Na	1,74
Mg	0,99
P	18,40
Cl	1,44
K	6,73
Ca	26,08
Total	100,00

From the above data, it can be noted that the main macronutrients of the curd whey are calcium – 26,08%, and phosphorus 18,40%, carbon 7,33%, potassium 6,73%, chlorine – 1,44%, sodium 1,74%, magnesium – 0,99% of the total mineral content.

Discussion of scientific results

The study of secondary raw materials of dairy industry and their use for further processing is one of the urgent tasks of the food industry. And the most problematic segment in the field of processing secondary dairy raw materials remains whey – as a material that can be recycled or repurposed from waste, the byproduct of milk industry obtained during the production of cheese (cheese whey) and cottage cheese (curd whey) has been found to have similar biological properties to whole milk. There is currently a focus on maximizing the utilization of all components of milk in industrial processing due to various reasons. Economically, it is more advantageous to efficiently process agricultural raw materials rather than producing additional raw materials. However, the challenge of fully and rationally utilizing secondary dairy raw materials remains unsolved both domestically and internationally. Literature research studies indicate that a considerable amount of whey is still being used as animal feed and some are not used.

Conslusion

The studies carried out showed the following results:

– the best organoleptic characteristics of curd whey and cheese whey. The selected whey has a homogeneous liquid without foreign impurities and a clean, whey taste without foreign tastes or odors;

– cheese whey is rich in basic macroelements such as potassium – 16,70%, calcium – 14,14%, chlorine – 9,12% and phosphorus 8,89%, carbon 8,89%, sodium 4.718.89%, magnesium – 2,32% of the total mineral content.

The utilization of secondary raw materials from the dairy industry is a crucial undertaking as it results in the production of a substantial quantity of top-quality food products and technical semi-finished goods and feed products can be obtained. Therefore, the whey is very promising for obtaining functional products for the intended purpose.

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ХАРАКТЕРИСТИКА И АЛЬТЕРНАТИВЫ ПЕРЕРАБОТКИ МОЛОЧНОЙ СЫВОРОТКИ

Сегодня отдельное внимание уделяется более безотходному и рациональному использованию второстепенных отходов и всех компонентов молока в процессе его промышленной переработки. Целями данного исследования являются изучение вторичного молочного сырья (творожной и сырной сыворотки) и использование их для дальнейшей переработки. В статье представлены данные о составе молочной сыворотки: физико-химические параметры молочной сыворотки и минеральный состав, а также дальнейшие перспективы переработки молочной сыворотки. Спрос на молочную сыворотку в мире растет. В первую очередь это связано с тем, что сыворотка используется в различных отраслях промышленности: пищевой, комбикормовой и т.д. Развитие производственного сектора в большинстве развивающихся стран формирует спрос на пищевые ингредиенты, в первую очередь для производства функционального питания. Увеличение потребления мясных продуктов является основным фактором, способствующим развитию комбикормовой промышленности. Сыворотка часто используется для производства высококачественных сбалансированных кормов. Благодаря своему составу сыворотка является перспективной основой для получения функциональных пищевых продуктов.

Ключевые слова: *Молочная сыворотка, пищевое производство, вторичное сырье, минеральный состав, рациональная переработка, функциональное питание.*

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СҮТ САРЫСУЫНЫҢ СИПАТТАМАСЫ ЖӘНЕ ОНЫ ӨҢДЕУДІҢ БАЛАМАЛАРЫ

Бүгінгі таңда өнеркәсіптік өңдеу процесінде қалдықсыз және екінші реттік қалдықтар мен сүттің барлық компоненттерін ұтымды пайдалануға ерекше назар аударылады. Бұл жұмыстың мақсаты қайталама сүт шикізатын (сүзбе және ірімшік сарысуы) зерттеу және оларды одан әрі өңдеу үшін пайдалану болып табылады. Мақалада сүт сарысуының құрамы туралы мәліметтер келтірілген: сүт сарысуының физика-химиялық параметрлері және минералды құрамы, сондай-ақ сүт сарысуын өңдеудің одан әрі перспективалары. Әлемде сүт сарысуына сұраныс артып келеді. Бұл, ең алдымен, сарысудың әртүрлі салаларда қолданылатындығына байланысты: тамақ, құрама жем және т.б. дамушы елдердің көпшілігінде өндірістік сектордың дамуы тамақ ингредиенттеріне, ең алдымен функционалды тамақтану өндірісіне сұранысты қалыптастырады. Ет өнімдерін тұтынудың артуы құрама жем өнеркәсібінің дамуына ықпал ететін негізгі фактор болып табылғандықтан сүт сарысуы көбінесе жоғары сапалы, теңдестірілген жем өндіру үшін қолданылады. Бай құрамының арқасында сарысу функционалды тамақ өнімдерін алудың перспективалық негізі болып табылады.

Түйін сөздер: *сүт сарысуы, тамақ өндірісі, қайталама шикізат, минералды құрам, ұтымды өңдеу, функционалды тамақтану.*

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