# THE PRODUCTS OBTAINED BY MILK PROCESSING WITH A SPECIAL REFERENCE TO OBTAINING WHEY IN THE PRODUCTION OF CHEESE[1]

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## Abstract

*For the economy of every country, milk represents one of the strategic products, therefore the aspiration is to ensure sufficient quantities to meet the needs of the population with the development of primary milk production. Analyzes have established that of the total milk produced in Serbia, about 1.5 billion liters of milk per year, almost half (50%) is purchased by the processing industry, which is focused on the production of products that do not require a lot of time and for which the technological processes are not complex and long-lasting. These products are the most used in the market, even though they have a short shelf life.*

*The paper will show that in the process of cheese production, whey is created as a side product, which is one of the insufficiently used side products of the dairy industry. Also, the production of cow's milk as well as the products obtained in dairies for realization on the market for the period from 2015 to 2021 will be processed, with special reference to the use of whey in the food industry, where it is most often used as concentrated or whey powder.*

**Key words:** *Milk, cheese, whey and its use in production.*

## Introduction

The cow's milk represents the most complete and most balanced foodstuff from the nutritious point of view. Due to its nutritional composition, it is also the most represented by its quantity, and is used for the production of all dairy products. In regard to the cow's milk, as the most represented, with

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around 1.5 million litres, there are as well increased number of goat and sheep milk origin production on the market, although with small quantities. When it comes to a total quantity of produced milk, the production of this kind of milk in husbandries is only 3%, which points out to an increase in regard to previous years, when it was only 2% (Kljajić et al., 2009; Arsić et al., 2011., Arsić et al., 2015).

According to the Statistical Office of the Republic of Serbia data, a share of milk that is delivered to dairies from the husbandries is 60%. The significant amount of milk (35%) is used for personal consumption in husbandries, feeding calves, as well as for the processing of dairy products meant for the market, it is usually cheese, kaymak (cream), paprika in sour cream, curd cheese (whey cheese) that sell on the market. Milk delivered to dairies is used as a raw material with a great potential, since many products are obtained by it: cultured buttermilk, yoghurt, various kinds of cheeses, sour creams, butters as well as numerous fermented dairy products (Kljajić et al., 2009; Arsić et al., 2011.).

The annual production and use of milk in dairies for the year 2022 is shown in the table 1, where there can be noticed the movement of all kinds of milk quantities in dairies.

**Table 1.** Annual production and use of milk (total) in husbandries for the year 2022

| **Availability of milk** | **Quantities (1000 t)** |
|---|---|
| Cow's milk in husbandries | 1468,037 |
| Milk from dairy cows | 1436,146 |
| Sheep's milk | 9,300 |
| Goat's milk | 34,771 |
| Total | 1512,108 |

*Source*: Statistical Office of the Republic of Serbia, Belgrade. 2022

The cheese used to be a privileged class food, however since the Middle Ages it has become everyday food of all classes of the population (Siso, 1996). The production of cheese has been developed from a homemade cheese to the industrial mass production, and it has been the product of a certain nation and country. In accordance to a method of production, each country can have their specificities, which depends on region, climate, as well as the market requirements. The cheese can be fresh or mature that is obtained by thickening of egg whites in milk with separation of whey, and is one of the basic foodstuffs. During the production of cheese, the quantity of an obtained whey is

almost equal to the quantity of milk necessary for making cheese. Depending on a cheese sort that is produced, there gets from 8 to 12 l of whey from the production of 1 kg of cheese. (Savant et al., 2000.)

In this paper was also given the table of all kinds of cheeses production, as well as of whey, which was left after their production (Table 2).

**Table 2.** Annual use of milk in dairies for cheese production

| **Cheese by firmness** | **Quantity (1000 t)** |
|---|---|
| Soft cheese | 23,519 |
| Semi-soft cheese | - |
| Semi-hard cheese | 13,068 |
| Hard cheese | 2,103 |
| Extra hard cheese | 0,016 |
| Fresh cheese | 11,385 |
| Processed cheese | 1,798 |
| Whey total | 6,753 |
| Delivered liquid whey | 2,632 |
| Delivered concentrated whey | 0,031 |
| Whey powder or in blocks | 0,014 |

*Source*: Statistical Office of the Republic of Serbia, Belgrade, 2022

Fifty percent of the globally obtained quantities of whey transform in various food products. The liquid whey is used 45%, as powder 30%, as well as lactose 15%, and the rest as the protein concentrates (OECD, 2010; Börgardts et al., 1998). According to the predictions about the cheese production, the scientists consider that the production of whey will increase for at least 2% with the production of cheese (Arsić et al., 2018; Siso, 1996.). In dairy and fermentation industry uses around 50% of the obtained whey, however, the remaining quantity discharges in waterways without any previous processing. Such rejected whey represents a loss of nutritionally valuable raw material, and also causes big environmental problems regarding high values of the chemical consumption of oxygen (CCO) and the biological consumption of oxygen (BCO), because it affects the physical and chemical structure of soil, and therefore the reduction of yield. On the other hand, discharging into waterways leads to the high consumption of oxygen and the death of flora and fauna. (Savant et al., 2000; Klasnja et al., 2000; Peters, 2005; makroekonomija.org)

Different ways of whey exploitation in various technological processes were shown in this paper.

## The production of milk and cheese in Serbia

The total production of milk in Serbia origins from the family husbandries (92%), while only 8% comes from the social enterprises and cooperatives. Fifty percent of the total milk production delivers to dairies, while the rest uses for own needs and sale on markets as fresh or processed. In the period 2015-2017 the production of milk has stabilized to 1.5 billion litres, which has resulted thanks to the increased production of milk per cow. Since the beginning of reducing number of cows and heifers in 2019, on which the entire COVID-19 situation has affected, there had come to the production of milk and dairy products, as well as the production of various kinds of cheeses. Investing in this production is very profitable, because in cheese making the profit is 2-3 times higher than a raw milk sale. Except the profit in this production, there is also obtained a by-product whey, with nowadays numerous commercial uses (Arsić et. al., 2011).

In accordance to the Statistical Office of the Republic of Serbia, there can be noticed that the production of milk has reduced since there was noticeable a number of cattle decrease, and therefore in 2021 was reduced for 100 million litres. Decreasing trend of cattle was continued in 2022. That is the reason why there was 3.3% less milk in regard to the year 2021. The reason of decreasing number of cows and heifers, as well as milk, is abandoning production by many farmers, due to a low purchase price of milk and expensive forage. Big milk producers stimulate more, while smaller producers produce small quantities, and due to numerous criteria, they cannot fulfil the conditions. Decreasing the production of cheese comes parallel with the reduction of milk, and for now it is 60,000 tons of all kinds of cheeses. Annually, 10 kg per capita has been eaten, and 15,600 tons of the total cheese production has been exported, mostly in the Russian Federation and the surrounding countries. However, Serbia imports 12,000 tons mainly from Germany, Poland and Croatia (Vlahović et al., 2018; SEEDEV, 2020).

The production of milk and dairy products are one of the most important agricultural branches in Serbia, and on an annual basis 180 to 200 kg per capita is spent; in some other countries like Finland it is more than 300 kg or in Denmark up to 900 kg (Gulan, 2018).

According to the amount of milk collected in 2021, there are 104 dairies per collection interval of 5.000 liters and less; from 5.001 to 20.000 liters there are 24 larger dairies and from 20.001 to 50.000 liters there are 8 dairies that

are among the largest milk collectors. When it comes to purchasing centers up to 1.000 liters, there are 9 centers and over 1.001 to 5.000 liters there are 3. According to the amount of processed milk (t/year) of 5.000 and less, there are 129 dairies (149.25 t/year), from 5.001 to 20.000 there are 20 dairies (184.18 t/year) and from 20.001 to 50.000 there are 8 dairies (with 279.53 t/year) (RZS, 2022).

When it comes to the amount of production of all types of cheese in 2021, the interval of the amount of cheese tons per year, there is a smaller number of dairies engaged in this production, so there are 75 dairies with a production of up to 100 (t/year) whose annual production is 2.56 thousand tons, then from 101 to 1000 tons per year, there are 67 dairies with an annual production of 18.37 thousand tons and from 1001 to 4000 t/year. 9 dairies whose production is 18.1 thousand tons. There are also larger quantities of production, but they are unavailable, from the Statistical Office of republic of Serbia, whose source was used (stat.gov.rs).

## Utilization of whey in production

Whey is the liquid phase obtained during the production of protein milk (cheese, casein). Casein is the liquid that separates from curds after coagulation of milk by enzymes, acids or heat. The largest quantities of produced whey are obtained from milk processors, who in their production processes, by processing milk, especially various types of cheese, obtain whey as a by-product.

The largest quantities of produced whey are obtained from milk processors, who in their production processes, by processing milk, especially various types of cheese, obtain whey as a by-product. By using whey in further production processes, processors have a direct economic benefit because it has multiple uses as a high protein product. In industry, it is used as an ingredient in baby food, supplements, protein nutrition, production of cheese spreads and butter. Also, whey is very important for the pharmaceutical industry through lactose, which as a pure preparation is used in the production of tablets, most often as an inert carrier for medicinal substances (Marshal, 2004).

According to its composition of whey, which depends on the basic composition of milk as well as on the technological processes of making various types of cheese, i.e. casein, in which whey is produced, it contains 93% water and over 50% dry matter that passes from milk. The largest part of the dry matter of 70% is lactose, which is a very important source of the energy value of

whey, 1% are proteins and in a smaller amount there are minerals and water-soluble vitamins.

Whey is one of the underutilized by-products of the food industry in Serbia. In the dairy industry, the main problem is that only 10 to 20% of the milk is used to make cheese and/or casein, while 80 to 90% goes to whey, which is not used. Due to insufficient utilization, whey becomes a serious environmental problem because it is a very big polluter, which is inconsistent with the possibilities it has as a raw material.

The most important reason why whey is less used as a raw material in industry is its easy perishability and low content of dry matter. Therefore, it must be processed in the shortest possible time, because its composition favors the development of harmful bacteria. Bearing this in mind, whey must, if not used immediately after cheese production, be cooled to 5 degrees C to reduce the growth of harmful bacteria (Arsić, 2018).

Of the total amount of whey produced, 50% is waste, bearing in mind the development of modern industry tends towards more efficient use of whey in order to better preserve the environment. In processing processes, products with added value can be created by using whey, which at least partially reduces the costs of not using it.

The production of functional fermented beverages based on whey is a simple solution related to its full utilization. The process of lactic acid fermentation utilizes all the nutritional potential of whey as a raw material, which removes from the environment a material that is a biologically very dangerous pollutant, and creates a product that is cheap, healthy and completely natural (Bulatović, 2015).

Whey can be used in different ways in the food industry, most often as whey powder or concentrates and isolates of whey protein or lactose are produced. Whey is widely used in the bread and pastry industry, in confectionery, in the meat industry and in the production of various creams, soups, sauces and toppings, where it is most often used as concentrated whey or whey powder.

## Conclusion

For the economy of every country, including Serbia, milk is one of the strategic products, so the development of primary milk production is always aimed at ensuring sufficient quantities for the needs of the population as well as for milk processing, i.e. dairy industry. According to the analyzed period, we can see that the number of dairy cows stagnated and that milk production remained at 1.5 billion liters, thanks to the increase in milk production per cow. When it comes to the production of all types of cheese, production remained at 60.000 tons. Given that in the very process of obtaining cheese, whey is obtained as a by-product, which has multiple uses as a high protein product. Due to its composition, it is used in various biotechnological processes that include the production of lactose, protein concentrates, enzymes, as well as the production of functional and nutritious foods.

That is why certain support measures should be used to influence the development of livestock, as well as to maintain or increase the number of quality cows, because a large number of milk products and various processed products have a commercial character.

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