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Ricotta - A by-product or cheese of the new generations

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Abstract

This work aims to present the research results obtained on the nutritional values of the ricotta cheese by-products in the production of the Trappist cheese. The production of albumin cheese is possible thanks to the specific properties of whey proteins which are not sensitive to the action of acid or rennet enzymes, so they remain unchanged during the coagulation of milk, and after separating the curd, they almost completely turn into whey. This paper presents the nutritional benefits of ricotta made from the whey remaining after the production of the Trappist cheese. The content of the total dry matter in ricotta was 27.9% and fat amounted to 15.00%. The milk fat content in the dry matter was 55.17%, the protein content obtained by the tests was 8%, and the ash content of 0.62% was obtained. The energy value of whey was 181 kcal or 752 kJ.

***Key words**:* Ricotta, Nutritional value, Whey.

Introduction

New generations of consumers are looking for products that are suitable for their lifestyle. Shifts in the market have led to certain dairy products, once considered affordable essentials, becoming popular among higher-income consumers. One such product category is albumin cheese made from whey. In the past, and even now, whey has been considered a by-product of the cheese production and its role is often minimized. It is thrown away or used for animal feed. According to research, 10 litres of milk yield about 1 kilogram of hard cheese and 9 litres of whey, which contains 88-99.3% lactose; 6.3-12.4% fat,

21.4-25.1% nitrogen fractions, 61.8-88.5% salt, and 49-50% of total dry matter of the original milk (Pintado et al., 2001). Hypocrites (460 BC) underlined the value of whey and suggested it as a therapy in the treatment of tuberculosis, skin diseases, digestive problems, and jaundice (Blažić et al., 2017). In the 18th century in Switzerland, Austria, and Germany whey was used in the treatment of diarrhoea and dysentery. It was a common belief then that whey had diuretic properties and an invigorating effect on the body (Elattar et al., 2010). Whey is of green-yellow colour that originates from vitamin B2 (riboflavin). Depending on the method of coagulation of casein, it can be classified as either acid whey (from acid action) and sweet whey (from enzyme action). The content of lactic acid in whey varies depending on the storage period and conditions (Lučić, 1983; Zandona et al., 2021). Lactose is a major ingredient of whey dry matter and it has a multiple role in the human body: it stimulates intestinal peristalsis and enhances the absorption of calcium and phosphorus, ensures an optimal level of magnesium, and prevents the growth and reproduction of harmful bacteria in the intestines by establishing a slightly acidic reaction in the intestines (Antunac et al., 2011). The annual growth of whey production is 2% on the global level, and is increasing in parallel with the annual milk and cheese production growth (Tratnik, 2003). There is rapid growth in global markets of food ingredients, including whey-based protein powders, which are among the winners of several new nutrition trends and food developments (Vik and Kvam, 2017). An indication of this trend is a large and growing market for functional food ingredients, i.e., probiotics, proteins, and amino acids. In 2018 these were estimated at US$ 68.6 billion worldwide, rising to US$ 94.2 billion by 2023 (PR Newswire, 2018). Whey proteins have a high biological value thanks to the high proportion of essential amino acids such as lysine, methionine, and cysteine (Jeličić et al., 2008). Therefore, whey is a low-calorie, only 25 kcal (105 kJ), highly nutritional product which makes it an ideal ingredient of various diets and a highly valuable component in the food processing industry (Jarc et al., 1994). The nutritional value of 3 kg of whey is equivalent to the nutritional value of 1 litre of milk (Popović-Vranješ and Vujičić, 1997). The most important whey protein-based products are protein concentrates, isolates, and hydrolysates of whey proteins (Jovanović et al., 2005). Whey proteins are polypeptides of high molecular mass that remain in serum or whey after precipitation of casein at pH of 4.6 and the temperature of 20 °C (Antunac et al., 2011). They have a globular structure and are thermolabile, i.e., sensitive to heat denaturation, which begins already at the temperatures above 60 °C (Vieria Arriaga, 2011). Whey proteins have been used in the dairy industry for a long time because of their nutritional and functional properties.

Whey is also considered a rich source of vitamins B, minerals (Ca, P, Na, K, Cl−, Fe, Cu, Zn, and Mg), and lactose (Macwan et al., 2016; Papademas and

Kotsaki, 2019). Because of the excellent nutritional and functional properties of whey solids, a substantial portion of whey is processed into whey powders, while the remainder is used for the production of sweet whey powder, demineralised whey, delactosed whey, whey protein concentrate, whey protein isolate, or lactose (Çelik, 2016). The composition of whey obtained from the production of the "Marija Zvijezda" Trappist cheese from Banja Luka is as follows: fat - 0.41%, saturated fatty acids - 0.20%, carbohydrates - 4.80%, protein - 0.92%, and NaCl content amounts to 0.11%. The energy value of 100 g of whey is 27 kcal or 112 kJ (Budimir, 2023). The average dry matter composition of whey is the following: 70% lactose, 14% proteins, 9% minerals, 4% fats, and 3% lactic acid (Blažić et al., 2017). Nutritional value of 100 g of the Trappist cheese amounts to 34.5 g of milk fat content, 24.7 g of saturated fatty acids, 0.8 g of carbohydrates, 27.5 g of protein, and 2.05 g of NaCl. The energy value of the Trappist cheese is 424 kcal or 1758 kJ/100 g of cheese (Budimir, 2021).

Ricotta and other albumin types of cheese are made possible due to distinct characteristics of whey proteins, which are resistant to coagulant enzymes. These proteins remain stable during the rennet coagulation of milk and mostly stay in the whey after the curd is separated.

The thermal instability of whey proteins compared to casein is due to the lack of phosphorus, low proline content, and higher cystine, cysteine, and methionine (Popović-Vranješ and Vujičić, 1997). Heating whey at high temperatures (>90 °C) for a specific time, denaturation and coagulation of thermolabile fractions of whey proteins are achieved, which can then be used for food purposes in the form of albumin milk (5-10% of dry matter), protein mass (15-20% dry matter), or albumin cheese (more than 20% dry matter) (Tratnik and Božanić, 2012). There are numerous versions of albumin cheese in the world, and Salvatore et al. (2014) emphasize that they are mostly produced according to traditional recipes, depending on the area they originate from. Most often, sheep's or goat's whey is used in the production, and depending on the area, it has different names (Table 1). Compared to the cheese made from milk, the albumin cheese has a much softer consistency, is easier to digest, and has a much higher nutritional value. Because whey proteins stimulate the growth of many probiotic bacteria, concentrates, isolates, and especially hydrolysates can also be used in the production of probiotic fresh cheese, both albumin and casein. Due to the numerous, most nutritionally valuable proteins found in whey, whey arouses constant interest of many scientists around the world (Tratnik and Božanić, 2012).

Tab. 1 - The names of albumin cheese in some countries around the world

Country	Names
France	*Serac, Brousse, Broccio, Greuil*
Germany	*Zieger, Schottenzieger, Schabzieger*
Greece	*Manouri, Myzithra, Anthotyros*
Italy	*Ricotta*
Malta	*Cacio-ricotta*
Romania	*Ziger, Urda*
USA	*Ricotone, Ricotta*
Croatia	*Skuta*

Source: Pintado et all., 2001

Ricotta is probably the oldest and best-known cheese, which is produced by thermal denaturation of whey proteins (Pizzillo et al., 2005). Originally, ricotta was produced from sheep's whey in the area of Lazio, Sicily, and Sardinia, and later it was distributed throughout Italy as well as other countries of the world, such as the USA where it is known as ricotone (Salvatore et al., 2014). The basic principle of albumin cheese production is based on heating the whey and separating the proteins (Antunac et al., 2011). To achieve greater utilization of the raw material and improve the properties of the product, whole or skimmed milk or cream can be added to the whey. Whey, or its mixture, acidified to the pH value of 4.5 (mainly with the addition of citric acid or vinegar) is heated for 30 minutes at 90-95 °C, when flocculation of whey and milk proteins occurs (Kirin, 2006). Namely, due to its thermolability, heating whey at the mentioned temperature leads to optimal curdling of all whey proteins (Tratnik, 1998; Antunac et al., 2011). The curd thus formed is filled into perforated plastic moulds and left for 12-24 hours. The cheese is then packed and stored in suitable conditions (Kirin, 2006). Salting can be done in two ways: by adding salt to the whey during heating, or by salting the curd after draining the remaining whey (Antunac et al., 2011).

The albumin cheese refers to products that are mostly consumed fresh, however, considering the different variations of this cheese, depending on its consistency, we distinguish between whey cheese ranging from fresh cheese types up to hard cheese for grating (Kirin, 2006). Baković (1959) studied albuminous cheese from the Dalmatian region and concluded that the proportion of water in the Dalmatian albuminous cheese is higher than in foreign albumin cheese. The curd is of the same white colour on the outside and on the inside with a slight transition to greyish-yellow. Small cracks are visible on the cross-section,

and the cheese itself is so soft that it can be spread on bread, but it does not stick to the bread easily. However, it easily disintegrates and melts in the mouth, while its taste is sweet, empty, and specifically reminiscent of sheep's milk, which gives it a typical or local significance. Due to the large proportion of water, the shelf life of albumen cheese is short and amounts to only a few days, hence it must be stored in the refrigerator (Baković, 1959).

This work aims to present the research results obtained on the nutritional values of the ricotta cheese by-products in the production of the Trappist cheese.

Material and Methods

Cheese sampling

The research and sampling were done on the Livač agricultural cooperative farm located in Aleksandrovac, the municipality of Laktaši, Bosnia and Herzegovina. The cooperative deals with the production of raw cow's milk. Since 2008, the Trappist cheese by Marija Zvijezda has been produced according to the recipe owned by the Marija Zvijezda monastery in the newly built dairy for cheese production and in cooperation with the Trappist monks.

The cheese-making process

The ricotta-type cheese is made according to the procedure for the production of albumin cheese, from fresh whey, immediately after the curd release process, which has already been heated to 35-40 °C. It is poured into a container and heated using a gas burner. At a temperature of 65 °C, fresh full-fat milk was added, with a milk fat content of 3.92%, in a ratio of 10% in relation to the amount of whey. Acidification was done with anhydride citric acid, at a temperature of 85°C and heating was done up to 90°C. After that, the mass was collected in moulds and cooled to 12 °C and packed in vacuum bags or smaller boxes of 350 g each. Five units from one batch were taken for testing after the extraction process was completed. The samples for analysis were vacuum-packed and a certain amount of whey was released inside, which was taken into account when determining the content. No salt was added to the analysed ricotta cheese, as requested by the customer who uses it in the preparation of desserts and dishes. The shelf life of fresh ricotta is 3-5 days, while vacuum packaging can extend the shelf life up to 2 months.

Packaging of the finished ricotta was done after 12 hours of straining, and due to work operations.

Cheese composition analysis

The analysis was performed to establish the content of the total dry matter (BAS EN ISO 5534:2006), fat (BAS ISO 3433:2010), protein (BAS EN ISO 8968-1:2005), ash (25UMI48), the milk fat content in the dry matter, and the moisture content in the fat-free matter (calculating). Physico-chemical analyses

were performed at the Public institution Veterinary Institute of the Republic of Srpska “Dr. Vaso Butozan”, which is an accredited laboratory for food testing in Bosnia and Herzegovina.

Results and Discussion

Table 2 shows the chemical composition and nutritional value of the albumin cheese obtained from whey after the production of the Marija Zvijezda Trappist cheese.

Tab. 2 - Chemical composition and nutritional value of albumin cheese

Parameter	Content (%)
Dry matter	27.19
Fat	15.00
Protein	8.00
Ash	0.62
Fat content in the dry matter	55.17
Content of water in the fat-free matter	85.66
Energy value in 100 g:	181 kcal (752 kJ)

The content of total dry matter was 27.9%. This value also depends on the time the albumin cheese was pressed, and increases with the duration. The content of fat in ricotta was 15%. The content of fat depends on the milk that is added, that is, on the season of production. On the other hand, the amount of milk that is added also affects it, and it can vary from 2-10%. In Italy, this amount varies depending on whether ricotta is obtained in mountainous or lowland areas. The milk fat content in the dry matter was 55.17%. The reason for this amount can be what we have just stated. The protein content was 8% and the ash content 0.62%.

The energy value of ricotta obtained after the production of the Trappist cheese was 181 kcal, or 752 kJ.

Havranek (2003) states that the albumin cheese contains 40-76% water and 40-77% fat in the dry matter. The Istrian albumin cheese contains an average of 56.62% water and 64.47% fat in the dry matter, while the Pag albumin cheese contains an average of 63.03% water and 59.69% fat in the dry matter (Antunac et al., 2011).

Conclusion

There are many possibilities for using albumin cheese, such as fresh or in the production of sweets, meals, and cheese cakes. In addition to its high nutritional value due to the high content of essential amino acids, whey proteins are widely used in the food industry and due to their significant functional properties. The low proportion of milk fat in albumin cheese certainly represents an advantage in the production of traditional dishes, because during the preparation process there is no separation of fat.

Moreover, the consumption of albumin cheese represents a good basis for new dietary trends, as low-fat products have been increasingly sought after in the last few years. Therefore, the albumin cheese produced from the whey obtained after the Trappist cheese production, due to its low fat and high protein value, fits well into this trend.

There is a possibility of adding different ingredients in the production process of albumin cheese, which enables a whole new range of products and provides consumers with some new tastes. The promotion of traditional areas and traditional dishes is one of the trends that should be used as part of the tourist offer, a trend which ricotta fits perfectly.

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Ricotta, нуспроизвод или сир нових генерација

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Сажетак

Циљ овог рада је приказати резултате истраживања добивених за нуспроизводе riccotta сира у производњи сира Трапист. Производња албуминских сирева могућа је захваљујући специфичним својствима бјеланчевина сирутке, које нису осјетљиве на дјеловање киселине или ензима сирила, па тијеком згрушавања млијека остају непромијењене, а након одвајања груша готово у потпуности прелазе у сирутку. Овај рад представља нутритивне вриједности riccotta сира направљеног од сирутке преостале након производње сира Траписта. Удио укупне сухе твари у ricotti је 27,9 %, удио масти 15,00 %. Удио млијечне масти у сухој твари износи 55,17, удио бјеланчевина добивен испитивањима 8 %, удио пепела 0,62 %. Енергетска вриједност сирутке је 181 kcal или 752 kJ.

Кључне ријечи: ricotta, нутритивна вриједност, сирутка.

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