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The impact of traditional cheeses and whey on health

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Summary

In the modern world proper nutrition is becoming an issue of great importance and more and more effort and means are being channelled into finding a solution to it. Scientific researches in the field of nutrition have shown that high quality foods are not sufficiently present in our diet. The insufficient intake of milk and dairy products leads to protein, calcium, vitamin A and vitamin D deficiency, and thus leads to the development of various diseases and disorders. While in the past milk was considered a complete food that satisfies many nutritive needs in humans, today we can speak about yet another role of dairy products. They are believed to have a preventive role in the development of various diseases. Functional foods are becoming increasingly popular among consumers due to rising consumer health awareness. By introducing functional foods into our standard diet, many nutritional deficiencies in human organisms can be remedied. In today's food market of functional foods, milk and dairy products are mostly present. Traditional cheeses and whey have high nutritive and health benefits. This paper deals with the nutritive benefits of traditional cheeses and whey, as well as their positive impact on human health. Products like traditional cheeses and whey are, due to their ideal ratio of nutrients, superior to other foods, while the new technological developments and enlarged assortment of foods enriched with high-quality proteins or with reduced levels of fat have made them irreplaceable in the modern diet.

Keywords: whey, cheese, functional foods, health

Introduction

Milk and dairy products belong to the category of basic foods in human diet. The indigenous dairy products are of special importance within that category. It is the food that not only satisfies the basic needs for nourishment, but is at the same time a part of the material culture and tradition of a certain country. Therefore, there are many cheeses that have been named after the place of their origin, and the number of places which have become famous because of their cheeses is even greater. The production and consumption of cheese began several thousand years ago, which makes cheese one of the oldest foods in the human diet. Ever since our ancestors started taming wild animals, people wanted to preserve various foods for longer periods of time. Therefore, together with meat preserving, cheese-making started (Josipović et al., 2016). The historic development of cheese production went from primitive cheese-making to mass production in the 19th century, and the cheese industry became an important branch of the economy in many countries. Since the beginning of the industrial production of cheese, the traditional methods have been neglected (Puđa, 2009).

In the course of history, the production of cheese has grown and undergone various modifications, hence, according to some authors, there are over 1,000 varieties of cheese today. Some authors, though, believe that there are a lot more. In many places and countries numerous indigenous kinds of cheese have been developed. Dairy products, including cheese, have always been important ingredients in human diet and a crucial factor in the survival of the population, particularly in rural areas. In the countries where cattle-breeding was developed, the consumption of dairy products became a part of the culture. Many populations would not be able to balance their diets if they didn't include dairy products. The consumers are increasingly aware of the nutritional values of these products, but often do not make use of the available knowledge and expertise. The difference in the consumption of dairy products depends on a variety of factors, ranging from psychological sources to marketing policies (Lukač Havranek, 1995). Due to automated production, the production of cheese has taken one of the leading positions in the food processing industry in the second half of the 20th century.

Today, there is a growing consumer interest in organic products, with the origin and the methods of production known and labelled. Traditional cheeses have additional value since they also preserve both tradition and culture of a certain area, and contribute to the standard of living of cheese-makers and their farms. Traditional cheeses are made according to the

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recipes handed down from generation to generation and they also form a base for the industrial production of cheeses. Numerous factors contribute to the specificity and uniqueness of each traditional cheese, such as: cattle breed and feeding, customs and habits of the population, soil type, geographical position and climate. The traditional cheeses are produced from raw milk with natural rennet and spices, with or without dairy cultures. Such a production requires a lot of work and effort, but the final product is different in taste, aroma and texture from the industrially produced cheeses.

Croatian traditional cheeses combine a centuries-old tradition of cheese-making in Croatia. Among the most famous are the high-quality, sheep milk cheeses made on the islands and in the Dinaric region. For hundreds of years sheep have represented real treasure for the local population. Hard sheep cheese was the basic, if not the only dairy product in their diet. In most parts, the making of hard sheep cheeses has survived until today. The cheeses from the islands of Brač, Krk and Pag, and the cheese from Grobnik prove that. In other parts of Croatia more famous goat and sheep cheeses are made according to the traditional methods.

There are more and more new brands of farm cheeses made in the market and many of them have won various domestic and international prizes and awards. The Croatian Chamber of Economy has labelled certain cheeses as Authentic Croatian, thus marking them as the products of extreme importance in the food processing industry.

Since the consumers are increasingly aware of the importance of proper nutrition, the additional demands for a wider assortment of high-quality products have risen. One of the advantages of cheese is that it is considered an alternative source of proteins, which is extremely important in the vegetarian diet. Furthermore, in comparison to milk, it contains more fat, proteins and has high calcium content. In addition to all these characteristics, complex biochemical processes occur during cheese ripening. Certain components are separated into simpler substances, which are more easily absorbed by the human body (Bijeljac and Sarić, 2005). At the global level, the quantities of the produced whey are constantly growing in parallel with the production of cheese. The nutritive value of whey is manifested in its numerous biological and functional properties (Lisak Jakopović et al., 2016).

Cheese in human diet

Cheese is rich in various nutrients, which are essential for everyday functioning. The value of cheese is even mentioned in Greek mythology. According to Greek mythology, cheese is the food of gods, and the god himself sent Aristaeus, the son of Apollo, to Earth to teach people how to make cheese. Cheese belongs to the category of fermented dairy products with high nutritional values, which are essential in a healthy diet.

Nutritional and health values of cheese depend on the quality and the type of milk from which it is made, and also on the type of cheese. Cheese contains carbohydrates, proteins, milk fat, minerals and vitamins. It is actually a protein concentrate. A widespread opinion of the profession today is that higher protein content and lower fat content enhance the nutritional benefits of cheese. The proteins contain amino acids necessary for the growth of tissues, enzymes and hormones in the human body. Glycolysis, lipolysis and proteolysis are the three main biochemical processes which are responsible for the odour, taste, texture and nutritive value of each cheese (Lukač Havranek et al., 2000).

Nutritionists recommend the fat intake for an adult of 20-35% of total calories. One of the best foods to meet that criterion is milk fat. Milk fat provides the necessary energy for the human organism and is also a good source of essential fatty acids, linoleic, linolenic, arachidonic and fat-soluble vitamins (A, D, E, K). As far as cholesterol in cheese goes, the studies have shown that only around 3% of the total daily intake of cholesterol comes from cheese. Cheese has a beneficial effect on tooth enamel, and therefore prevents dental caries. The bacteria present in the mouth produce acids in the process of metabolising food residue and lead to tooth enamel demineralisation. Cheese has a protective effect by stimulating saliva production, which elevates pH levels in the mouth (Kaić-Rak and Antonić-Degač, 1996).

The nutritionists recommend a daily intake of between 50-100 g of cheese. The intake of 100 g of cottage cheese satisfies 30-40% of the daily protein requirements for adults, while the intake of 100 g of hard cheese will cover 40-50% of protein requirements. More mature cheeses are easier to digest by humans compared to less mature cheeses. Cheese ripening degrades the basic components of cheese (e.g. proteins, lactose and fat) to a greater or lesser degree (Matijević et al., 2014).

It is commonly known that cheese is one of the richest sources of calcium. Phosphorus and magnesium are present in significant quantities, and the presence of other trace elements, such as iodine, iron, zinc, selenium, and copper is not negligible (Tudor, 2008).

The specific value of cheese is manifested in its protective effect in reducing the risk of some types of cancer. Recent studies have shown that a regular intake of cheese reduces the risk of breast cancer. Also, calcium contents are hypothesized to reduce digestive tract cancer and it could be attributed to the nitrites derived from nitrates, which are sometimes added in the production process of some cheeses. These hypotheses are still to be proved (Božanić, 2015).

Compared to milk, cheese contains proteins which are far easier to digest, as during the ripening process the main protein casein is cleaved into smaller peptides and amino acids. Lactose content in cheese, compared to milk, is considerably lower, because during the ripening process lactose is converted into lactic acid. Cheese is therefore ideal food for lactose intolerant people. The major objection to cheese is a higher salt content, but only 5% of the total salt intake comes from cheese (Tudor, 2008).

Importance of traditional cheeses in nutrition

Traditional cheeses are considered unique, primarily because they are hand-made, but also because raw milk and natural rennet are used in their production. Apart from that, traditional cheeses have intense flavour and aroma and specific composition and appearance. Traditional cheeses contain high quality proteins, calcium, phosphorus, minerals and some B-group vitamins (Lukač Havranek et al., 2000).

Due to their specific production, traditional cheeses have a very high nutritive value. For example, soft and mature cheeses contain easily absorbed, decomposed proteins. They also contain enzymes and bacteria which have a beneficial effect on the gut and overall health. People who have allergic reactions to milk usually tolerate cheese well (Miletić, 1962).

The nutritive value of traditional cheeses depends on the type of cheese and the milk they are made from. Due to the activity of micro-organisms during the ripening process, this value increases. For example, the Mediterranean traditional cheeses play an increasingly important role, as most world famous cheeses originate from the Mediterranean countries. Such cheeses are the ingredients intrinsic to the Mediterranean cuisine. It is a characteristic of hard and semi-hard cheeses that they have a higher concentration of short-chain fatty acids and medium-chain fatty acids, due to the longer ripening process, which makes them more easily digestible. High concentration of calcium has a beneficial effect on dental and bone protection, as well as on hypertension and osteoporosis prevention.

Whey production and utilization

Whey has been a well-known by-product in the production of cheese ever since the beginnings of its making, i.e. for more than 8,000 years. Hypocrites (460 BC) underlined the worthiness of whey and suggested it as a therapy in the treatment of tuberculosis, skin diseases, digestive problems and jaundice. In the 18th century in Switzerland, Austria and Germany whey was used in the treatment of diarrhoea, dysentery and some forms of poisoning. It was a common belief then that whey has diuretic properties and invigorating effect on the body (Tratnik, 2003). Later it became an unwanted by-product in the production of cheese. For a long time it was used as a fertilizer, or was simply discarded into the rivers or the sea. In the mid-20th century the laws which prohibited the disposal of whey into the environment were adopted all over the world. Today the annual growth of whey production is 2% on the global level, and is growing in parallel with the annual milk and cheese production growth. Therefore, many researchers have focused their research on studying alternative possibilities of the economic exploitation of whey.

Over the years whey, which was initially considered a by-product, became a value added product. The problem of the environment protection put pressure on the governments to pass laws on whey disposal which resulted in numerous scientific studies. Such studies encouraged the development of various technologies for the exploiting of what had previously been categorized as “waste” and turning it into an economically significant raw-material in the food-processing industry. One of the more recent ideas is that whey could be used in the production of bioethanol which would make it more profitable, reduce the production costs and ensure sustainability. Out of 100 litres of milk used in the cheese production, approximately 80-90 litres of whey are produced. Depending on the various types of cheese, the average yield is 1 kg per 10 litres of milk and 9 litres of whey are produced in the process. Therefore, it can be concluded that the daily production of whey can amount to several million litres in the large manufacturing plants. The world production of whey is higher than 160 million tons per year with 1-2% annual growth rate. Out of the total production of whey, some 70% is used in the production of various products, while 30% is used either as pig feed, fertilizers or is disposed of in rivers and seas. In spite of all the above mentioned, whey is considered one of the biggest pollutants in the food processing industry.

Importance of whey in human diet

Whey is a product rich in lactose, proteins, vitamins and minerals. The average content of whey dry residue is: 70% lactose, 14% proteins, 9% minerals, 4% fats and 3% lactic acid. The most important proteins in whey are beta-lactoglobulin and alpha-lactalbumin, which account for 90% of whey proteins. Beta-lactoglobulin causes allergic reactions to food and is therefore removed from whey before further processing of certain foods. On the other hand, lactalbumin is among the most the valuable proteins with the highest nutritive values, and is therefore essential in the production of infant formulae. These proteins are used in the production of functional food, beverages, sports nutrition and infant formulae. Lactose is present in whey in two forms: alpha-lactose and beta-lactose. Whey protein has a high content of lysine, which is 40% higher than in casein. Mineral content includes: potassium, sodium, calcium, magnesium, chlorides and phosphates which are present in whey in almost the same amount as in milk. The content of lactic acid in whey varies depending on the storage period and conditions (Lučić, 1983).

It is also important to emphasize that whey has only 25 kcal (105 kJ). Therefore, whey is a low-calorie, highly nutritive product which makes it an ideal ingredient of various diets and a highly valuable component in the food processing industry **(**Jarc et al., 1994**)**. Whey, as a by-product in cheese production, is a great source of proteins. It is a widely held view that one litre of whey can satisfy the daily need for riboflavin (vitamin B2), which gives it its yellowish-green colour. The level of riboflavin in whey is often higher than in milk due to the activity of the lactic acid bacteria in the production of cheese, hence this vitamin can be derived from it. Cobalamin (vitamin B12) and folic acid are bound to the whey proteins, while up to 95% of riboflavin exists in the free form. Nutritional value of 3 kg of whey is equivalent to the nutritional value of 1 litre of milk (Tratnik, 2003). It is still widely believed in our region that whey is a less valuable product, although numerous studies have shown that it is exactly the opposite. There are a great many possibilities in the dairy industry for exploiting both concentrated and dry whey. For example, lactic dry substance can be increased in yoghurt and ice-cream, or whey protein concentrate can be derived. By adding concentrated or dried whey during milk processing, the ratio of casein-lactalbumin in cow's milk could approach the levels present in human milk, thus making it more easily digestible. But it should be noted that whey can have laxative properties. There is also a possibility of processing sweet whey into albumin cheese (Baković and Tratnik, 1979). Whey preparation can be used in the production of processed cheese. It enhances the taste, consistency and the odour of the product (Lučić, 1983). Whey can also be used in making fermented and probiotic drinks. More economical processing of whey is enabled by the pressure membrane filtration and demineralisation (Tratnik, 2003).

The physiological significance of milk sugar in human nutrition is recognized more and more in the world today. Milk sugar, unlike other carbohydrates, is absorbed gradually in the digestive tract; therefore it reaches the intestines where it promotes the development of lactic acid bacteria which suppress the growth of coli bacteria. This is yet another proof that the use of whey in all its forms has not only economic, but also health benefits (Fatejev, 1956).

The most important whey protein-based products are: protein concentrates, isolates and hydrolysates of whey proteins (Jovanović et al., 2005). Whey protein concentrates have functional properties, they are completely digestible and suited for the production of cheese (Božanić et al., 2000).

Apart from functional characteristics, whey proteins have other advantages due to their high nutritive values and the GRAS status (generally recognized as safe). They are available in several different forms. The most common are: WPI (whey protein isolate), which has a higher concentration of proteins in dry matter (above 90%), and WPC (whey protein concentrate), which has a lower concentration of protein in dry matter (50-70%) (Herceg and Režek, 2006). The positive impact of whey proteins on reducing the incidence of cancer, combating HIV, boosting immunity, elevating serotonin levels in the brain, improving liver function in hepatitis patients, lowering blood pressure and enhancing performance in sports has become a subject of numerous studies.

Whey proteins are of special significance in raising the levels of glutathione (GSH), which has a huge impact on the immune system. GHS is considered essential in boosting the immune system, in preventing the oxidative stress and improving general health. The reduced levels of GSH in the body are closely related to a number of illnesses. Therefore, whey proteins should have a special place in the nutrition programme.

Whey proteins have been used in the dairy industry for a long time because of their nutritional and functional properties. Recently, they have been used in other food processing industries, such as baby food, baking and meat industry (Herceg and Režek, 2006). Whey proteins are essential in infant formula processing as cystein has a positive effect on the brain development and enhances the function of the underdeveloped liver in babies. Infant liver lacks the enzyme cystathionine gamma-lyase, responsible for conversion of methionine to cysteine. These enzymes are active in adults due to consumption of cow's milk (Tratnik, 2003).

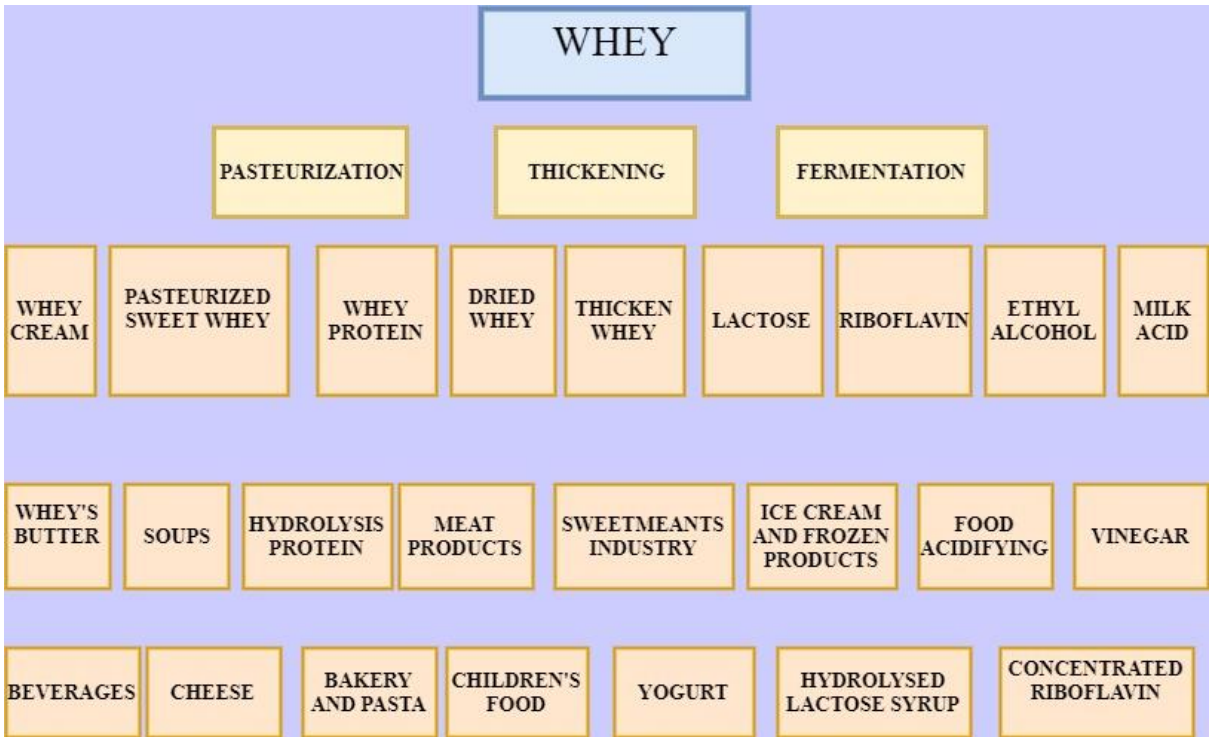

Fig. 1. Whey in diet (Baković and Tratnik, 1979)

Conclusions

Mankind is increasingly aware of the importance of taking good care of nature, origins, safety and nutritional values of the traditional products, which are gradually taking a specific place in the nutrition of modern man. The consumption of traditional cheeses and whey are among the key elements of a well-balanced diet. They have been categorized as value added products since they have a positive impact on overall health by reducing the risk of diseases (for example cancer, HIV, osteoporosis prevention) and enhancing the overall condition of the human body. Educational programmes should be more focused on providing consumers with education about proper nutrition in which the products of high nutritional and biological value play a special role.
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