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Probiotic dairy-based desserts with cocoa addition

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Abstract

Dairy based-desserts include a large group of different products such as cream, pudding, mousse and ice cream. To improve their nutritional value and sensory properties, probiotic bacteria can be added, in addition to cocoa, fruits and cereals. Puddings and mousses with coccoa have been proven as an excellent medium for the growth and multiplication of probiotic bacteria, which could be the main reason for the growing demand for this type of product. The aim of this article is to give an overview of the research on the use of probiotic bacteria in the production of dairy-based desserts with added cocoa.

Keywords: probiotic bacteria, dairy-based desserts, cocoa

Introduction

Due to their sensory and nutritional properties, dairy-based desserts are consumed by consumers of all ages (Nastaj et al., 2007; Toker et al., 2013; Szwajgier and Gustaw, 2015; Aguilar-Raymundo and Ve'lez-Ruiz, 2018; Zarzycki et al., 2019). Marketing activities also contribute to their popularity, which is why there are a large number of different types of desserts based on milk and milk ingredients on the market today (Buriti and Saad, 2014). The advantages of consuming dairy desserts are: easy to use, long shelf life, can be a complete meal, can be used as an additive in the preparation of desserts, can have a reduced fat content and provide a source of nutrients through the addition of nutrients (Early, 1998). Nowadays, it is common to add different ingredients to dairy desserts to improve their sensory properties and their beneficial effects on human health, such as cereals and fruits as well as cocoa which is the most popular. Probiotic bacteria can also be included and in this sense such desserts are categorized as functional dairy desserts. The addition of probiotic bacteria could be one of the reasons for the increasing consumption of this type of product. The aim of this article is to give an overview of the research on the use of probiotic bacteria in the production of dairy-based desserts with added cocoa.

Dairy-based desserts

For many years, dairy-based desserts were not considered nutritionally valuable, but the perception of this type of product has changed. Namely, in recent years, dairy desserts have become one of the better examples of healthier diets (Saunders, 2011, Verruck et al., 2019) due to the high quality proteins, fats, carbohydrates, vitamins and minerals in their composition, which is why they are consumed by all age groups of consumers (Ferrar et al., 2011, Verruck et al., 2019). Their high nutritional value is one of the most important factors that play a role in consumer choice. In addition, dairy desserts with a lighter texture, such as puddings and mousses, are acceptable foods not only for the younger population but also for older people who have difficulties with swallowing (Quinchia et al., 2011, Verruck et al., 2019). In addition, dairy desserts have a long shelf life, can be used as a supplement when preparing desserts, are a meal in themselves and provide refreshment when chilled (Early, 1998). Dairy-based desserts, according to Codex Alimentarius (2015), include a large group of different products, including ready-to-eat flavoured dairy desserts, dessert mixes, frozen dairy desserts, flavoured and/or frozen yoghurt, ice cream, frozen milk, junket, Dulche de leche, pudding, mousse and many others. Dairy-based desserts are products made by transforming milk into a semi-solid form (smooth texture, „on the spoon“) with the addition of milk powder and non-dairy ingredients. They are produced by the process of heat treatment of milk and/or whey and added ingredients, which, through a special technological process, must obtain a firm, thick and/or foamy consistency and have a characteristic taste, smell and colour, depending on the basic raw material used or ingredient added (Official Gazette 133, 2007).

Probiotic

According to the World Health Organisation (WHO) and the Food and Agriculture Organisation (FAO), probiotics are defined as living microorganisms that, when consumed in appropriate amounts, have a positive health effect on the host (FAO/WHO, 2001). Experts from the International Scientific Association for Probiotics and Prebiotics recommend using the term probiotics only for products in which the microorganisms contained have a sufficient number of well-defined strains that contribute to the well-being of the host. In this sense, candidate probiotic strains can be divided into three categories: I) strains with no health effect , II) strains with possible health effect and III) strains that can be used for the prevention and treatment of diseases (Hill, 2014). The best known probiotics to date are lactic acid bacteria (LAB) and bifidobacteria, but some slow-growing strains of bacteria, as well as yeast strains, have been found to have possible health benefits when consumed appropriatelyLAB strains used as probiotics include *Lactobacillus acidophilus*, *Lacticaseibacillus rhamnosus* (GG), *Lactobacillus* ssp. and *Bifidobacterium*. Slow-growing bacteria that have a probiotic effect include strains of the bacteria *Bacillus cereus*, *Bacillus subtilis*, *Bacillus licheniformis*, *Bacillus pumilus*, *Bacillus clausii* and *Bacillus coagulans* (Hong et al., 2005; McHugh et al., 2017), as well as the yeast *Saccharomyces boulardii*.

Probiotics are usually supplied to the body in two ways: through the consumption of fermented foods or through dietary supplements. It should be noted that for clinical efficacy, the product to which probiotic bacteria are added must provide the samesufficient conditions for growth and temporary colonisation in the gut. Probiotics used as food supplements consist of freeze-dried bacteria in the form of powder, capsules or tablets. Milk has been shown to be the best transport medium for probiotics, as 100 times less viable bacteria are needed when they are in a milk medium than when they are in a frozen or dried medium (Khalighi et al., 2016). In this sense, dairy-based desserts are also a good medium for the growth and multiplication of probiotic bacteria (Table 1).

Table 1. Milk desserts with the addition of different strains of probiotic bacteria

Dairy-based dessert type	Probiotic strain	Author
Pudding	*Lacticaseibacillus casei*Shirota	Gul (2017)
Pudding with the addition of cocoa	*Lactobacillus acidophilus* LAFTI L10 *Bifidobacterium animalis* ssp. *lactis* LAFTI B94 *Lacticaseibacillus casei* LAFTI L26 *Lacticaseibacillus rhamnosus* GG	Irkin and Guldas (2011)
Mousse with the addition of cocoa	*Lacticaseibacillus paracasei* subsp. *paracasei* LBC 82 *Lacticaseibacillus paracasei* subsp. *paracasei* LBC 81 *Lacticaseibacillus paracasei* subsp. *paracasei* NCDC 022	Aragon-Alegro et al. (2007), Cardarelli et al. , (2008), Valencia et al. (2016), Patel, et al. (2008)
Rice pudding	*Lactobacillus acidophilus* LA-5 *Bifidobacterium bifidum* BB-12	Ozcan et al. (2010)
Pudding with the addition of cereals	*Lactobacillus acidophilus* La5 and 1748 *Bifidobacterium animalis* Bb12 *Lacticaseibacillus rhamnosus* GG	Helland et al. (2004)
Fermented dessert	*Lactobacillus acidophilus* MJLA1 *Bifidobacterium* spp. BDBB2 Mixed culture *Lactobacillus acidophilus* SAB 440-A and *Bifidobacterium animalis* subsp. *lactis*	Shah and Ravula (2000), Tavares Estevam et al. (2017)

Source: according to Verruck et al. (2019)

Probiotic dairy-based desserts with added cocoa

The production technology of all dairy desserts is similar, and the individual steps depend on the type of product. With the exception of ice cream, mousse and pudding with added cocoa are the best-known representatives of desserts made from dairy products. This is supported by the antioxidant properties of cocoa and its beneficial effects on cardiovascular diseases, inflammatory processes and cancer (Andújar et al., 2012). Due to its foamy texture, the production technology of mousse is somewhat more demanding than that of pudding. The ingredients for the production of mousse are cream cheese, butter, cream, skimmed milk, skimmed milk powder, sugar, chocolate, cocoa powder as well as emulsifiers and stabilisers. Mousse is characterised by a light, foamy texture. Therefore, it is desirable that the proportion of milk fat is more than 12%, the non fat dry matter 7-12% and the added sugar 8-15% (Early, 1998). The technology of pudding production involves mixing dry (powdered) ingredients that are added to the mixture of milk and cream. Industrial production of pudding uses whole or skimmed milk mixed with cream, sugar or sugar substitutes (natural or artificial sweeteners), additives such as starch and gelatin, and other ingredients prescribed by Codex Standard 192-1995. Eggs may also be added to the pudding, and flavourings and colourings are added in the production of some types of pudding (fruit, chocolate, vanilla, caramel, hazelnut) to give a distinctive taste and appearance (Chandan and Kilara, 2016). The resulting mixture is then heat-treated, filled into jars, cooled and stored. Apart from the fact that the best known representatives of dairy desserts are those with added cocoa, these products have also been shown to be a good medium for the growth and multiplication of probiotic bacteria, as they are favoured by a pH above 6, a moisture content of more than 70% and the absence of competing microorganisms (Silva et al. , 2012; Morais et al., 2014, 2015; Valencia et al., 2016). Due to their functional properties, the production of probiotic dairy desserts represents an increasingly important segment of the dairy industry. The fortification of various dairy desserts with probiotic bacteria and the increasing acceptance by consumers show the potential to include this type of product in the daily diet. This is confirmed by the study of Ares et al. (2008), in which consumers concluded that dairy desserts contribute most to the maintenance of health and are credible carriers of functional claims. At the same time, it should be taken into account that the possible health benefits of probiotics for human health can only be achieved if sufficient numbers of live bacteria are supplied. It is generally believed that it is necessary to supply the body with 10^8 - 10^{10} live bacteria per day through various products. Irkin and Guldas (2011) in their research describe the sustainability and sensory properties of probiotic pudding with the addition of cocoa and the addition of: I) *Bifidobacterium animalis* ssp. *lactis* LAFTI B94 DSL, II) *Lactobacillus acidophilus* LAFTI L10 DSL, and III) *Lacticaseibacillus casei* LAFTI L26 DSL. The number of live bacteria in all samples of the probiotic pudding with added cocoa was 10^8 - 10^9 during 25 days of storage at a temperature of 4°C. Changes in sensory properties were only found in the pudding with added cocoa, to which the strain *Lacticaseibacillus casei* LAFTI L26 DSL was added. The appearance of syneresis was also observed in this pudding during prolonged storage, while the sample with the addition of *Bifidobacterium animalis* ssp. *lactis* LAFTI B94 DSL showed more pronounced sensory properties compared to the control sample (Irkin and Gludas, 2011). Rosa et al. (2016) conducted a study on the effect of the probiotic bacterium *Lactobacillus acidophilus* in milk desserts with added cocoa on the presence of pathogenic bacteria. For research purposes, 9 samples were prepared with the addition of: I) *Lactobacillus acidophilus* LA -05, II) *Escherichia coli* O157:H7 (CDC EDL -933), III) *Salmonella* spp. ATCC 00150, IV) *Staphylococcus aureus* ATCC 00358, V) *Bacillus cereus* ATCC 14579, VI) *Lactobacillus acidophilus* LA -05 and *Escherichia coli* O157:H7 (CDC EDL -933), VII) *Lactobacillus acidophilus* LA -05 and *Salmonella* spp. ATCC 00150, VIII) *Lactobacillus acidophilus* LA -05 and *Staphylococcus aureus* ATCC 00358 and IX) *Lactobacillus acidophilus* LA -05 and *Bacillus cereus* ATCC 14579. The prepared samples were stored at a temperature of 8 °C and analysed during 24, 48 and 72 hours, i.e. after 7 and 28 days. The results of the study showed that the total number of pathogens did not increase beyond the safety level, which the authors interpret as a possible effect of bacteriocins or microbial competition. The physicochemical properties of probiotic dairy desserts depend on the probiotic strain added and whether the strain was added as a monoculture or mixed culture. The ingredients added in the production process influence the metabolism of the probiotic bacteria, especially the pH of the product, which is a consequence of the production of lactic and citric acid (Buriti and Saad, 2014). For example, Helland et al. (2004) in their study found that *Lacticaseibacillus rhamnosus*GG was responsible for the highest production of lactic acid (10 g/kg) and citric acid (1,819 g/kg), while the lowest amount of lactic acid (5 g/kg) was found in puddings with the addition of the strain *Lactobacillus acidophilus* 1748. A similar study was conducted by Aragon-Alegro et al. (2007) on mousse with the addition of cocoa and probiotics (*Lacticaseibacillus paracasei* LBC 82) and/or synbiotics (inulin). Samples I) mousse without additives (control sample), II) mousse with added probiotics, III) mousse with added probiotics and prebiotics, were analysed at a

temperature of 4°C for 28 days. Sensory analysis and pH verification were performed on the 1st, 7th, 14th, 21st and 28th day of storage. It was found that the pH changed the most when the probiotic *Lacticaseibacillus paracasei* LBC 82 and the prebiotic inulin were used. On the first day of storage, the pH of the mousse was 6.21 and on the 28th day it was 5.37, while the pH of the control sample was 6.22 on the first day of storage and 6.01 on the 28th day. Mousse with the addition of cocoa and the probiotic *Lacticaseibacillus paracasei* LBC 82 changed the pH from 6.26 (1st day of analysis) to 5.67 (28th day of analysis). The mousse with the addition of cocoa proved to be an excellent base for the probiotic strain *Lacticaseibacillus paracasei* LBC 82, while the addition of the prebiotic inulin did not affect the viability of the probiotics nor did their combination affect the sensory properties of the product.

Valencia et al. (2016) conducted a study on the microbiological and sensory properties of a creamy chocolate dessert with the addition of the probiotic strain *Lacticaseibacillus paracasei* subsp. *paracasei* LBC 81 and fructooligosaccharide prebiotics. Three samples were prepared to perform the analyses: I) without the addition of probiotics and prebiotics (control sample), II) with the addition of *Lacticaseibacillus paracasei* subsp. *paracasei* LBC 81 (probiotic sample), III) with the addition of *Lacticaseibacillus paracasei* subsp. *paracasei* LBC 81 and fructooligosaccharides (synbiotic sample). The analyses of all three samples included the determination of pH, acidity, syneresis index and viability of the number of bacteria in the product for 28 days. The samples were also sensory evaluated to assess consumer acceptance of the product and intention to purchase this type of product. The product analyses were carried out on the 1st, 7th, 14th, 21st and 28th day. The storage time has an influence on the decrease in pH, i.e. the increase in acidity in the probiotic and symbiotic sample. Thus, on day 1 and day 28, the pH of the control sample is 6.6 and 6.8, that of the probiotic is 6.1 and 5.0, and that of the symbiotic sample is 6.1 and 5.1. In the analysis, no syneresis was observed during the 28-day storage for all three types of samples, which is a consequence of the addition of xanthan gum. On a scale of 1 to 9, the average score for all three samples is 7, which corresponds to very good consumer acceptance. Also on a scale of 1 to 5, the evaluators gave an average score of 4, which means that they would gladly buy one of the products. The number of viable cells of *Lacticaseibacillus paracasei* subsp. *paracasei* LBC 81 remained constant during the storage period. That is, the number of viable cells in the probiotic sample was 8.3 log cfu/g on day 1 and 8.9 log cfu/g on day 28, and 8.5 log cfu/g and 8.7 log cfu/g in the symbiotic sample.

Conclusion

Dairy-based desserts with the addition of cocoa belong to a group of dairy products that are extremely popular with consumers of all ages due to their recognisable sweet taste and tender texture. The enrichment of dairy-based desserts with probiotic bacteria, especially with the addition of cocoa, and their possible beneficial effects on human health are leading to increasing consumption of this type of product. In this sense, there is great potential for the development and production of new types of probiotic dairy-based desserts.

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