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Beneficial effects of consumption of probiotics from cheeses in diabetes patients

Abstract

The consumption of functional foods has been growing worldwide, motivating the development of beneficial foods for consumers. Based on this, we highlight the probiotic functional foods that, containing the appropriate concentration of microorganisms, are beneficial to the host organism. Thus, probiotic cheeses are considered relevant because of their pH range that are ideal for probiotics, usually between 5.5 to 6, and high water concentration, when compared to other dairy products, such as yoghurts and fermented milks. In this sense, research has been carried out on the benefits of consuming probiotic functional foods for people with diabetes. Thus, from the consumption of probiotic foods, this bibliographic review highlights positive aspects for diabetic consumers, such as the decrease in body fat, the decrease in cholesterol and the improvement of skeletal muscle. However, to obtain more satisfactory results, the journals consulted highlight the need to combine physical activities with the consumption of probiotic foods together with whole grains, in a sugar-restricted diet.

Keywords: functional foods, probiotics, diabetes, cheeses

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Introduction

Historically, the Russian scientist Elie Metchnikoff, awarded the Nobel Prize at the Pasteur Institute, observed that the ingestion of fermented milks could be conducive to the intestinal microbiota.[1] Thus, Elie Metchnikoff proposed the word probiotic to represent bacteria that, in adequate quantities, are beneficial to the health of the host.[2] Thus, probiotics are commonly found in various foods, from dairy to organic, and are called functional foods because they present benefits to the human body in addition to macronutrients. The most common dairy foods are fermented milk, yogurts and cheeses, however, probiotics can be found in organic foods such as fermented fruits, nuts, pickles, among others.[3,4] From this perspective, dairy products are more common for marketing probiotic bacteria in food. However, other milk derivatives are supplemented with probiotics and have been developed, aiming to provide the consumer with a greater variety of functional foods.[5–7] Thus, cheeses stand out with some advantages over other probiotic foods. Most different types of cheeses have a higher pH than yogurts and milk, which makes the environment more conducive to the survival of cultures for longer. In addition, cheeses, preferably fresh ones, offer excellent conditions for the survival and multiplication of probiotic strains, such as high water activity, pH above 5.0, low amount of sodium chloride and does not contain preservative chemical additives.[8–10]

Among the many benefits of probiotic foods, the most notable is the maintenance of the balance and composition of the intestinal flora. This maintenance helps to increase the body's ability to resist the invasion of pathogenic bacteria, maintaining the well-being of the host.[11] The minimum daily dose of probiotic culture considered therapeutic is 108 to 109^{CFU}, obtained through the ingestion of 100 g of product containing $106^{-}107^{CFU}$ /g or mL. This amount of probiotic microorganisms must be maintained in all steps of food processing, from its manufacture to ingestion by the consumer, and such microorganisms must also be able to survive the gastrointestinal tract.[12] Probiotic strains for incorporation into food must be considered safe and cannot generate undesirable mutations in relation to flavor, aroma and consistency.[13] The various species of the *Lactobacillus* and *Bifdobacterium genera* are widely used in the preparation of probiotics for food. Thus, Lactobacillus is isolated from the small intestine and *Bifdobacterium* from the large intestine. Microorganisms of the *Lactobacillus genus* are classified as gram-positive, do not form spores, do not have flagella, are bacillus or coccobacillus in shape, and are commonly anaerobic or aerotolerant.[14] Furthermore, the ideal conditions for its multiplication are temperatures between 35 and 40ºC and pH between 5.5 and 6.0. The most common species are *Lactobacillus acidophilus, Lactobacillus rhamnosus* and *Lactobacillus casei* . Most *L. acidophilus* degrade amygdalin, cellobiose, fructose, galactose, glucose, lactose, maltose, mannose, sucrose and esculin.[15]

Regarding bifidobacteria, they are characterized as being gram-positive, non-spore-forming, have no flagella, are catalase-negative and anaerobic. According to their morphology, they can be cane-shaped, bifurcated, short or curved bacilli. In addition, they are heterofermentative, being able to produce acetic acid and lactic acid in a stoichiometric molar ratio of 3:2, based on two moles of hexose, without the production of CO2 except during the degradation of gluconate. In addition to glucose, all bifidobacteria of human origin are capable of using galactose, lactose and fructose as carbon sources.[15] Furthermore, the probiotic needs to survive the body's natural conditions until it reaches the intestine to colonize. In this way, the balance of the intestinal microbiota prevents pathogenic microorganisms from causing harm to the host. Therefore, the imbalance and low concentration of probiotics in the intestine can cause the proliferation of pathogens, which can cause various diseases for the host. Thus, the presence of probiotics can act to prevent diseases such as irritable bowel syndrome, Crohn's disease, allergies and intolerances, neurological diseases such as Parkinson's and Alzheimer's, obesity, hypertension, diabetes, among others.[16,17] Based on this, functional foods based on probiotics have been marketed and consumed in increasing demand. In addition, such foods are more present in the diets of people with chronic diseases, such as diabetes.[18]

Diabetes is a common chronic medical condition that causes high blood sugar levels. Serious complications are common causes of diabetes, such as heart disease, vascular disease and poor circulation, blindness, kidney failure, poor healing, stroke and other neurological diseases.[19]

There is still no cure for diabetes, but it can be well treated if followed according to medical guidelines. Complications of diabetes can be avoided with careful control of blood glucose, control of high blood pressure and high cholesterol levels, when present.[20] Diabetes is categorized according to existing types, with type 1, referred to as young-onset or insulin-dependent diabetes, occurring when the pancreas does not produce enough insulin to process glucose. Type 1 diabetes is commonly diagnosed in childhood or adolescence and requires lifelong insulin treatment. Type 2 diabetes is becoming increasingly common in children and adolescents due to the increase in obesity among young people. Insulin resistance is a major problem in type 2 diabetes, as the body produces insulin but is unable to process glucose correctly. However, people with type 2 diabetes also have insulin deficiency, which is a more serious degree than type 1 diabetes.[21] The most common risk factor is being overweight, which is the main and most controllable factor for type 2 diabetes. Thus, achieving and maintaining a healthy weight may be the only treatment needed for many people who are at risk of developing type 2 diabetes. Another factor is people with a family history of type 2 diabetes, who are more likely to develop diabetes, and exercising together with a controlled diet rich in probiotic foods, whole grains and low in fat, can reduce the risk of type 2 diabetes.[22] In this perspective, this work aims to refine journals published between 2015 and 2021, containing the terms diabetes, cheeses and probiotics. In addition, it also aims to carry out reflections from bibliographic reviews, regarding the beneficial effects of probiotics from cheeses in diets aimed at people with diabetes.

Materials and methods

This research proposed a bibliographic review on diabetics and the consumption of probiotic foods. For this, the study was carried out through scientific papers published between 2015 and 2021. To carry out the refinement, the combined words were used, namely: diabetes, cheese and probiotics, having also used some synonymous words for diabetes, such as Type 1 and 2 diabetes, insulin resistance, diabetes mellitus and ICD 10 - E10. In addition, for the word probiotics, the terms intestinal microbiota were also used, without specifying the genus of the bacteria. The survey of academic papers was carried out succinctly, remotely and online, through the Capes Journals website. According to the isolated and combined keywords, 735 articles published within the stipulated interval were obtained. Of these articles, 588 papers that presented only some of the terms in isolation were excluded. In addition, 64 articles that presented only the words probiotics and cheese and 28 articles that presented only the words cheese and diabetes combined were excluded. Another 22 were also excluded, after reading the title and abstract, as these were not directly related to the topic developed. Thus, the papers that presented *in vivo* research were considered, with 5 in the final phase in murines and 16 in humans.

Results and discussion

From the journals analyzed, it is noted that research was carried out in different places around the world, with diabetics of different ages, regardless of the type of diabetes, emphasizing the inability to produce insulin, as well as insulin resistance. Those with this pathology require a restrictive diet, which controls sugar intake without compromising the necessary amount of protein and mineral intake.[23] in their work, emphasized the need to control blood sugar, hypertension and dyslipidemia in the control of diabetes. Thus, the researchers evaluated, through the consumption of probiotic cheeses, the beneficial effects in people with type 2 diabetes, as well as the effects of the consumption of probiotics alone and the consumption of probiotics together with pumpkin (*Cucurbita ficifolia*) on the glycemia and lipids of diabetic patients. For this purpose, eighty participants were selected and randomly distributed into four groups, with group 1 consisting of consumers of pumpkin (100 g), group 2 consisting of consumers of probiotic foods (150 g) and group 3 consisting of consumers of pumpkin combined with probiotic foods (100 g of pumpkin plus 150 g of probiotics); for 8 weeks. Based on this, blood pressure, glycemic response, lipid profile and high-sensitivity C-reactive protein were monitored before and after the proposed experiments.[23]

Thus, total cholesterol decreased significantly in the probiotic and probiotic plus pumpkin groups. The pumpkin plus probiotic consumption group resulted in a decrease in triglycerides and an increase in high-density lipoprotein cholesterol. All interventions led to a significant decrease in blood sugar, hemoglobin, and low-density lipoprotein cholesterol levels within the groups. In addition, blood pressure decreased significantly in the pumpkin consumption group and probiotic group, and all variables changed significantly between the groups, evidencing that pumpkin and probiotic consumption can significantly help in the treatment of diabetic patients.[23] In the work of Gizard , Fernandez and Vadder,[24] the researchers emphasize that the intestinal microbiota is one of the main contributors to the nutrition, metabolism, immunity and neurological functions of the host with diabetes. Based on this, the authors assessed that the imbalanced microbiota, or dysbiosis, is directly related to the host's growth retardation, as well as inflammatory and metabolic diseases. In addition, skeletal muscle also participates in the metabolism, immunity and health of the host.[24] Thus, the researchers point out the reciprocal influence of the intestinal microbiota and skeletal muscle in relation to body development, performance, aging and chronic diseases, such as diabetes.

Thus, Gizard, Fernandez and Vadder[24] point out several routes that involve the vascular system and organs such as the liver and adipose tissue that connect the intestinal microbiota and skeletal muscle, with effects on physical fitness and health, and the well-being of these is related to the improvement of the conditions of the diabetic patient. Thus, a balanced diet containing probiotic cheeses and physical exercises that encourage the good functioning of the intestinal microbiota and skeletal muscle, which are presented as beneficial therapeutic forms for the health of diabetics.[24] In this sense, Huang et al.[15] in their research showed that the modulation of the intestinal microbiota by a probiotic is a new therapy to improve pathologies related to high cholesterol and insulin resistance. Thus, the researchers initially investigated the potential hypocholesterolemic effect of *Bacillus sp*. DU-106 in mice with high cholesterol and evaluated its relationship with the intestinal microbiota, and in the experiment they received a high-fat diet and compared it with a high- fat diet supplemented with 7.5×109 and 1.5×1010 ^{CFU} /kg day *Bacillus sp*. DU-106 (low and high dose groups).[25]

Based on this, at the end of 9 weeks, treatment with DU-106 significantly decreased body weight, liver index and total cholesterol.

The DU-106 intervention showed a significant increase in bacteria, with an increase in the abundance of the genera *Turicibacter, Acinetobacter, Brevundimonas* and *Bacillus* significantly reduced the abundance of pathogenic bacteria of the genus *Ralstonia.*[26] Furthermore, the metabolic data also indicated that *Bacillus supplementation* sp remarkably altered the intestinal metabolic profiles of hypercholesterolemics and in particular, elevated the metabolites of indole-3-acetate, methylsuccinic acid, creatine, glutamic acid, threonine, lysine, ascorbic acid, and pyridoxamine. Based on this, Bacillus improved high-fat diet-induced hypercholesterolemia and showed potential benefits of probiotics for the intestine of diabetics.[25,27] Regarding the research carried out by Neis and Rensen, the dysfunction of the intestinal microbiota is an aggravating factor in the pathogenesis of obesity, insulin resistance and type 2 diabetes mellitus. Thus, the intake of functional foods such as probiotic cheeses are beneficial for the intestinal microbiota, as well as short-chain fatty acids and amino acids, which are important for improving these disorders. Thus, intestinal bacteria can alter the bioavailability of amino acids by using several amino acids from dietary and endogenous proteins, and intestinal bacteria also provide amino acids to the host.[28] Based on this, Neis and Rensen state that there are possible implications in the context of insulin resistance and type 2 diabetes, conditions associated with high concentrations of certain amino acids, such as aromatic and branched-chain amino acids. Thus, several amino acids released by intestinal bacteria in dysbiosis can serve as precursors for the synthesis of short-chain fatty acids, which also play a role in the development of obesity, being an aggravating factor for diabetics.[29]

Thus, as a way to minimize such factors, there is the possibility of a diet rich in prebiotics and probiotics, to stimulate the balance of the intestinal microbiota. With this, the authors highlighted the importance of homeostasis in the feeding process and immunity of diabetics. In addition, the research also showed that the amino acids metabolized by the host and the good functioning of the intestinal microbiota were presented as relevant ways to prevent obesity from worsening in overweight type 2 diabetics.[28,30] According to the journals chosen for the review, it is evident that dairy probiotics from cheeses, added to diets, are healthy ways to maintain the balance of the intestinal microbiota, as long as the host is not allergic or intolerant to any compound present in milk, such as lactose.[31,32] In addition, the intestinal microbiota in good condition appears to contribute to lowering cholesterol, improving skeletal muscle, reducing fat accumulation, as well as obesity, evidencing great contributions to the well-being of people with diabetes.

Final considerations

The demand for the consumption of functional foods has been growing more and more. In view of this, foods composed of probiotics stand out, as they can have several beneficial effects on the host organism. In addition, probiotic cheeses have advantages over yogurts and fermented milks, mainly due to storage, pH range and high water activity. In this sense, functional foods are also being included in the diets of people with chronic diseases, such as diabetes. Thus, from the consumption of probiotics, positive responses are evident in diabetics, in relation to the reduction of body fat, reduction of cholesterol and improvement of skeletal muscle. However, to obtain more satisfactory results, it is necessary to combine physical activities with the consumption of probiotic foods together with prebiotics, in a sugar-restricted diet.

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None.

Conflicts of interest

The authors declared that there are no conflicts of interest.

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