

Non-dairy based desserts: a literature review
Sobremesas de base não láctea: uma revisão da literatura
Postres sin leche: revisión de la literatura

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Abstract

The Brazilian market for food products with low lactose content and foods for the vegan population, lactose intolerant and even the public that seeks lactose-free food by preference needs diversification. This review sought to describe articles that addressed the development and characterization of non-dairy based desserts. A search was made for references in the CAPES, Lilacs, Scielo, and ScienceDirect databases in September 2019 covering the period 2010-2020 and using the descriptive terms "Frozen desserts " or "Dairy alternatives " or "Non dairy " or "Ice cream ". As selection criteria, research articles in English and Portuguese involving non-dairy desserts were used. The search allowed the identification of 5 articles that met the established criteria. Although the use of cow's milk substitutes has been explored by the dessert industry, there is still much to explore about the alternatives available to innovate in the design of non-dairy based desserts, so a review on the subject is extremely interesting.

Keywords: Milk alternatives; Herbal milk substitutes; Edible ices; Cold desserts.

Resumo

O mercado brasileiro de produtos alimentícios com baixo teor de lactose e alimentos destinados à população vegana, intolerantes à lactose e mesmo o público que busca por alimentos isentos de lactose por preferência, carece de diversificação. Essa revisão buscou descrever os artigos que abordassem o desenvolvimento e caracterização de sobremesas de base não láctea. Foi feita uma busca de referências nas bases de dados Periódicos CAPES, Lilacs, Scielo e ScienceDirect em setembro de 2019 abrangendo o período de 2010-2020 e utilizando os termos descritores "Frozen desserts" or "Dairy alternatives" or "Non dairy" or "Ice cream". Foi utilizado como critério de seleção artigos de pesquisa no idioma inglês e português envolvendo sobremesas de base não láctea. A busca permitiu a identificação de 5 artigos que se adequaram aos critérios estabelecidos. Embora o uso de substitutos do leite de vaca tenha sido explorado pela indústria de sobremesas, ainda há muito para se explorar acerca das alternativas disponíveis visando a inovar na elaboração de sobremesas de base não láctea, assim, uma revisão sobre o assunto é extremamente interessante.

Palavras-chave: Alternativas ao leite; Substitutos do leite à base de plantas; Gelados comestíveis; Sobremesas geladas.

Resumen

El mercado brasileño de productos alimenticios con bajo contenido de lactosa y alimentos para la población vegana, intolerante a la lactosa e incluso el público que busca

preferentemente alimentos sin lactosa, necesita diversificación. Esta revisión buscó describir artículos que abordaran el desarrollo y caracterización de postres no lácteos. Se realizó una búsqueda de referencias en las bases de datos CAPES, Lilacs, Scielo y ScienceDirect en septiembre de 2019 cubriendo el período 2010-2020 y utilizando los descriptores “Postres helados” o “Alternativas lácteas” o “No lácteos” o “ Helado ”. Como criterio de selección se utilizaron artículos de investigación en inglés y portugués relacionados con postres no lácteos, la búsqueda permitió identificar 5 artículos que cumplieron con los criterios establecidos. Aunque el uso de sucedáneos de la leche de vaca ha sido explorado por la industria de los postres, aún queda mucho por explorar sobre las alternativas disponibles para innovar en el diseño de postres no lácteos, por lo que una revisión sobre el tema es sumamente interesante.

Palabras clave: Alternativas a la leche; Sucédáneos de la leche a base de hierbas; Helados comestibles; Postres fríos.

1. Introduction

Problems related to the consumption of cow's milk and its derivatives are old and frequent and compromise health and quality of life, consequently, generate discomfort in a large part of the world population. Lactose intolerance, that is, the pathophysiological situation that occurs due to the insufficiency of the lactase enzyme present in the jejunum, is present in 65% of the world population and affects around 2 to 15% of individuals of northern European descent, 60 to 80% of blacks and Latinos and 80 to 100% of American and Asian Indians (Suri et al., 2018; Batista et al., 2018).

This type of intolerance is the most common metabolic food sensitivity, affecting 60-70% of people worldwide. Inadequate levels of the lactase enzyme result in abdominal discomfort, bloating, gas, and diarrhea because undigested lactose in the colon is fermented by bacteria (Luthy et al., 2017). Hypolactasia or lactase deficiency has three distinct classifications: primary, secondary, and congenital. In this sense, the primary insufficiency of lactase, also known as adult hypolactasia, is distinguished by an inadequacy in the gene that encodes lactase and its manifestation is due to hereditary factors. Already deficiency secondary is caused by changes in the wall of the microvilli of the intestine, originating in diseases such as gastroenteritis, celiac disease, Crohn's disease, among others. And yet, there is congenital intolerance, which occurs in the newborn after the first or second intake of milk (Marciana et al., 2019).

Thus, it is known that it is not only the public with hypolactasia but also those who do

not consume dairy foods due to the lifestyle they adopt, such as vegans and vegetarians, who are interested in non-dairy products. Therefore, the food industry, aiming to meet the expectations of different audiences and market niches, has invested heavily in innovation (da Silva et al., 2020).

The alternative milk options include other dairy milk of mammals (not standardized dairy milk), like a goat, burr to and camel, as well as alternative statement herbal including soymilk, almond, rice, and coconut (Astolfi et al., 2020). And yet, in some countries, camel and buffalo milk are commonly consumed, but globally, the predominant choice is cow's milk, with fewer people opting for goat or sheep milk (Walsh & Gunn, 2020).

In the context, the consumer interest in nutriçã the plant-based increases increasingly, consequently, there is a significant variety of alternative milk on the rise (Garrison, 2019). Herbal milk substitutes have positive effects due to the rich antioxidant activity and fatty acids that reduce the risk of cardiovascular disease, cancer, atherosclerosis, and diabetes. However, milk-substitute plant products may also lack protein, and low bioavailability of minerals and vitamins (Aydar et al., 2020).

Soy milk is still the most common milk substitute. However, 14% of individuals who suffer from cow's milk allergy also have reactions against soy (Jeske et al., 2018). Besides, soy (in the form of water-soluble extract), has some disadvantages, such as the fact that it is potentially allergenic, causes flatulence, and provides a flavor considered unpleasant by most of the western population (Nishinari et al., 2018). Thus, an option of the raw material of vegetable origin for obtaining water-soluble extract would be rice, as it is free of lactose, is present in the usual Brazilian diet, and has a mild flavor (Bento; Sgrass; Ambrosio- Ugri, 2012).

In Brazil, there is no established legal definition of dairy dessert. By the Codex (1995), dairy desserts include those ready to consume and dehydrated mixtures. They are belonging to this category frozen desserts, the s milk-based fillings, and flavored yogurts, which may or may not be heated after the fermentation. Also are presented as examples of this category ice cream à bas and milk, ice cream to base water, gelled milk, yogurt flavored frozen (frozen yogurt), sweet milk, pudding, and chocolate mousse (Zacarchenco, 2017).

Ice creams are products made basically with milk and/or dairy derivatives and or other food raw materials and in which the levels of fat and or protein are totally or partially of non-dairy origin, and can be added to other food ingredients (Brasil, 1999). Ice cream is tasty food, easy to accept, and very adaptable to the tropical climate of Brazil. Ice cream is available in many forms. The composition patterns differ around the world, as does the

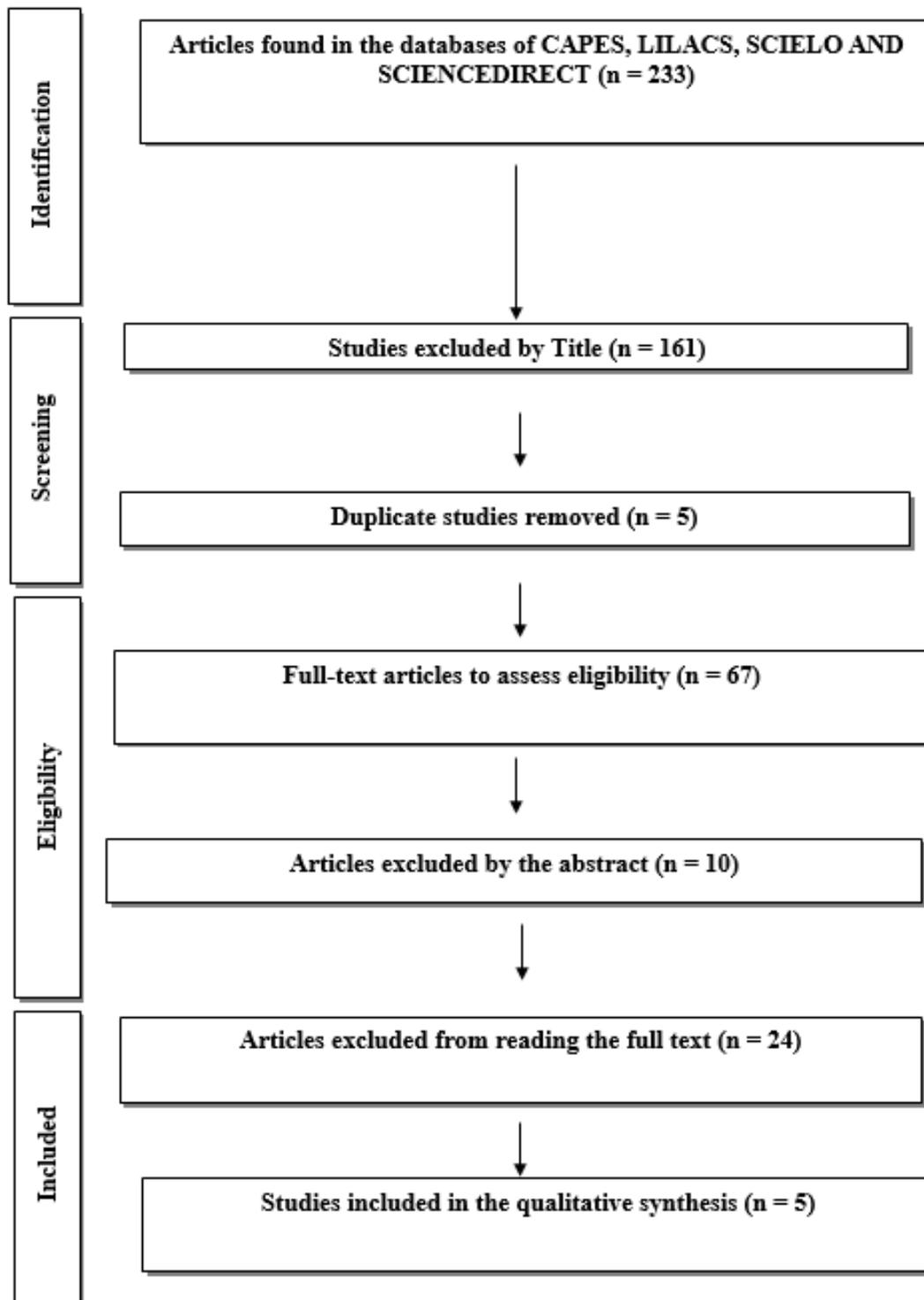
understanding of what constitutes "ice cream". The various types of products in this category include, in addition to ice cream and its low-fat varieties, sherbet, water-based ice cream, frozen yogurt, among other frozen desserts (Goff et al., 2013).

Although vegetable kinds of milk have gained notoriety in the edible ice cream sector, and many vegan desserts today have a better taste than their counterparts made with animal products; there are still many challenges in non-dairy dessert versions, with an emphasis on texture parameters, since the appeal of ice cream to improve mood is partly due to its creaminess, a quality that is difficult to achieve in non-dairy versions or low calorie (Shelke, 2017). Therefore, this study aimed to review articles that addressed the development and characterization of non-dairy based desserts.

2. Methodology

A literature survey was carried out in September 2020, in the CAPES, Lilacs, Scielo, and ScienceDirect databases. The methodology of this type of scientific research was supported by the studies by Pereira et al. (2018). Articles published between 2010 and 2020 were considered. The descriptors used were as follows: "Frozen desserts "or "Dairy alternatives " or "Non-dairy" or "Ice cream ” in all databases. They were selected five items being included under the eligibility criteria as shown in Figure 1. The criteria's inclusion were: articles research in English and Portuguese, in the last ten years involving no dairy-based desserts. The exclusion criteria were articles of review, encyclopedias, and book chapters.

Figure 1. Flowchart and criteria for selection and inclusion of articles.



Source: Authors (2020).

3. Results and Discussion

The results of the present study are in Table 1.

Table 1. Statement of articles that integrate the Integrative Review.

#N	Date	Title	Authors	Periodical	Goals	Results
1	2015	The rheology and physical properties of fermented probiotic ice cream made with dairy alternatives	Fatemeh Aboulfazli, Ahmad Salihin Baba e MisniMisran	International Journal of Food Engineering	To investigate the effect of substituting cow's milk for soy, coconut, or compound milk on the rheology and the physical and sensory properties of fermented probiotic ice cream	Fermented ice cream containing vegetable kinds of milk showed a slower melting rate and higher apparent viscosity and particle size and also lower total acceptability than fermented cow's milk ice cream (control). Ice creams containing <i>Lactobacillus acidophilus</i> (La-05; L) showed a slower melting rate and higher apparent viscosity and particle size than ice creams containing <i>Bifidobacterium bifidum</i> (Bb-12; B). Regardless of the initial culture used, all scores from the sensory analysis decreased in ice cream with a higher amount of soy milk. Vegetable kinds of milk can offer ice cream manufacturers an alternative source of cow's milk as functional ice cream.
2	2016	New trends in engineered dairy products	Jayani Chandrapala and Bogdan Zisu	Journal of Dairy Research	Review the history and current status of some engineered dairy products and speculate on future trends. Much of the progress was directed towards production capacity, mechanization, automation, hygiene within the processing plant, safety, extensions in the useful life, and launch of new products that bring variety and convenience to the consumer	Significant advances in product quality have been made, many of them due to better knowledge of the functional properties of the ingredients and their impact on structure and texture. Besides, other improvements focused on energy efficiency and environmental sustainability have been made and will be needed in the future.
3	2017	Sensory and physical properties of coconut milk ice cream modified with fat substitutes	Nattavong Fuangpaiboon e Kongkarn Kijroongrojana	Maejo International Journal of Science and Technology	Investigate the impact of fat substitutes of various types and conferences on the sensory and physical properties of coconut milk ice cream.	All mixtures of ice cream showed shear dilution characteristics indicated by a flow behavior index (n) less than 1. The use of modified tapioca starch led to a more pronounced increase in the consistency index. All the fat substitutes used tend to increase the freezing point and the glass transition temperature, as well as the melting rate of the ice cream. The hardness of low-fat ice cream was superior to that of low-fat ice cream, except for those with inulin and added Dairy LoTM. Regardless of which fat substitute was used, the low-fat ice cream had greater mouth coverage and coconut flavor, but less ice and less skimmed-milk powder flavor than skimmed ice cream (p <0.05). Low-fat ice creams with Simplese®100 added showed the most similar sensory characteristics to the control. However, the results of the acceptance test showed that low-fat ice cream with the addition of inulin, maltodextrin, and Simplese®100 did not differ significantly from the control in any of its attributes (p> 0.05). For low-fat

#N	Date	Title	Authors	Periodical	Goals	Results
4	2018	Impact of stabilizers on the freezing process and physical-chemical and organoleptic properties of coconut milk-based ice cream	Góral, M., Kozłowicz, K., Pankiewicz, U., Góral, D., Kluza, F., & Wójtowicz, A.	LWT - Food Science and Technology	To characterize the effects of selected stabilizers in the freezing process and the physical and chemical properties of coconut milk ice cream	ice cream, there were no significant differences in flavor scores, except for odor, between the addition of inulin and the control ($p > 0.05$). The increase in the concentration of inulin and LBG resulted in a decrease in the cryoscopic temperature and in the melting time of the ice cream. On the other hand, ice creams produced from mixtures with a higher concentration of inulin and a lower concentration of LBG were characterized by a greater overshoot. The addition of inulin and LBG cause statistically significant changes in the hardness of the ice cream. The color differences in the tested ice creams were shown. The highest scores in the sensory evaluation were obtained for ice cream with LBG and 0.8 g / 100 g and 4 g / 100 g of inulin.
5	2019	Research on the survival of Lactobacillus paracasei in fermented and unfermented frozen soy dessert	Sharareh Norouzi, Hadi Pourjafar, Fereshteh Ansari, Aziz Homayouni	Biocatalysis and Agricultural Biotechnology	To determine the survival rate of Lactobacillus paracasei in frozen fermented and unfermented soy dessert, as well as to evaluate the physical-chemical, rheological, and sensory properties of the products.	The viable cell count of <i>L. paracasei</i> was monitored during 180 days of storage at -24°C . A significant increase ($p < 0.05$) was observed in the exceedance values (42.57 ± 8.5) in frozen probiotic fermented soy dessert compared to other samples. The viscosity of the control sample and the unfermented dessert after 50 minutes was higher than the viscosity of the frozen fermented soy dessert (966 cp). The sensory properties of the frozen probiotic fermented soy dessert were significantly improved by fermentation. In contrast to the frozen unfermented probiotic soy dessert, there was no significant decrease ($p < 0.05$) in viable <i>L. paracasei</i> cell counts during storage. Both probiotic frozen soy desserts have promising potential for use as functional products. But, fermentation can increase the stability of probiotic bacteria, especially <i>L. paracasei</i> in frozen soy dessert. Also, the physical-chemical and sensory properties of the frozen soy dessert were improved by fermentation.

Source: Authors (2020).

The offer of lactose-free products requires investment in innovation to meet the requirements of the dairy market trend.

Aboufazli et al. (2015) studied rheology and physical properties of fermented probiotic ice cream made with dairy alternatives to investigate the effect of replacing cow's milk with soy, coconut, or compound milk on the rheology and the physical and sensory properties of probiotic ice cream fermented and reported that the combination of soy milk with cow and coconut milk decreases its hysteresis values and increases the total acceptability of ice cream containing soy milk. Sensorially, soy when applied to frozen desserts such as ice cream, has some disadvantages, by decreasing the total acceptability (body texture, color, and flavor) of ice cream in comparison with dairy products.

Chandrapala & Zisu (2016) explored the new trends engineered dairy products and found that there are significant changes in the quality of products, many of them resulting from better knowledge of the functional properties of the ingredients and their impact on the structure and texture. Besides, other improvements focused on energy efficiency and environmental sustainability have been made and will be needed in the future.

Fuangpaiboon & Kijroongrojana (2017) investigated the impact of various substitutes for fat on the sensory properties and modified coconut milk ice cream physical and inferred having anode are the fat substitutes used tend to increase the freezing point and the temperature glass transition, as well as the rate of melting of the ice cream. Besides, it was found that regardless of which fat substitute was used, the low-fat ice cream had greater mouth coverage and coconut flavor, but less ice and less skimmed-milk powder flavor than skimmed ice cream ($p < 0.05$). Low-fat ice creams with Simplese®100 added showed the most similar sensory characteristics to the control. However, the results of the acceptance test showed that low-fat ice cream with the addition of inulin, maltodextrin, and Simplese®100 did not differ significantly from the control in any of its attributes ($p > 0.05$). For low-fat ice cream, there were no significant differences in flavor scores, except for odor, between the addition of inulin and the control ($p > 0.05$).

According to Góral et al. (2018), the addition of inulin in ice cream with coconut milk implies an increase in the dry matter when compared to the addition of the same amount of locust bean gum. The addition of stabilizers like these results in small changes in the content of matter, ash, water, and carbohydrates. Another very important parameter in the quality of the ice cream matrix and ice cream desserts are the melting time and the first drop time. Increasing the content of inulin in the mixture reduces the time of the first drop during melting, but increases the melt resistance of the ice cream after 45 minutes. According to the

authors, locust bean gum ice cream does not melt in the same amount of time, which is probably due to the very high concentration of stabilizer combined with coconut milk rich in polysaccharides. Regarding texture, it was observed that the addition of inulin and locust bean gum in coconut milk-based ice cream significantly alters the product's hardness.

It is possible to see that when replacing cow's milk with soy-based vegetable milk, coconut, and various combinations of coconut or soy milk with cow's milk, the particle size and the apparent viscosity of fermented ice creams are improved. However, soy milk increases the area of hysteresis resulting in a firmer product.

Norouzi et al. (2019) evaluated the survival rate of *Lactobacillus paracasei* in fermented and unfermented frozen soy dessert, as well as the physical-chemical, rheological, and sensory properties of the products. For this purpose, the viable cell count of *L. paracasei* was monitored during 180 days of storage at -24°C . A significant increase ($p < 0.05$) was observed in the exceedance values (42.57 ± 8.5) in the fermented probiotic frozen soy dessert compared to other samples. The viscosity of the control sample and dessert unfermented after 50 min cuts was higher than the viscosity of the fermented soy frozen dessert (966 cp). The sensory properties of the frozen probiotic fermented soy dessert were significantly improved by fermentation. In contrast to the frozen unfermented probiotic soy dessert, there was no significant decrease ($p < 0.05$) in viable *L. paracasei* cell counts during storage. Both probiotic frozen soy desserts have promising potential for use as functional products. But, fermentation can increase the stability of probiotic bacteria, especially *L. paracasei* in frozen soy dessert. Besides, the physical-chemical and sensory properties of the frozen soy dessert were improved by fermentation.

Therefore, there is a growing trend in the sector of edible ice cream since much has been studied the development of non-dairy desserts, as possible products with substitutes for cow's milk.

4. Final Considerations

The market for frozen desserts without lactose is a macro trend that is emerging from its specialty and increasingly increasing its appeal to a broader mass audience. Thus, it gains notoriety and success due to improved and better-tasting products, as well as an increase in the general interest in vegan and dairy-free options and growing awareness of the problems associated with lactose intolerance. Therefore, although the use of cow's milk substitutes has been explored by the dessert industry, there is still much to explore about the alternatives

available to innovate in the design of non-dairy based desserts and thus, as a suggestion for future work, the authors suggest research with vegetable raw materials that can replace cow's milk in frozen desserts.

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