Journal homepage: www.fia.usv.ro/fiajournal
Journal of Faculty of Food Engineering,
Ştefan cel Mare University of Suceava, Romania
Volume XXIV, Issue 1 - 2025, pag. 65-79

FOOD AND ENVIRONMENT SAFETY

PLANT-BASED DRINK ALTERNATIVES OF MILK ON A SEGMENT OF FUNCTIONAL ICE CREAM – A REVIEW

Ionela IACOBAN [1], Adriana DABIJA [1], Ancuța CHETRARIU [1*]
[1]*Faculty of Food Engineering, Stefan cel Mare University of Suceava, Romania*
*Corresponding author: ancuta.chetrariu@fia.usv.ro
Received 17 February 2025, accepted 30 March 2025

Abstract: *Ice cream is a frozen dessert that is very well known and appreciated all over the world. The main components of conventional ice cream are sugar, fat, skimmed milk solids and stabilizers. However, the ice cream industry is looking for new ways to improve existing products by adding healthy, additive-free, delicately processed ingredients with a clean label. The purpose of this paper is to provide information about plant-based drink alternatives, food products with specific characteristics created through unique technologies and conditions. These foods differ from regular one due to their unique composition or manufacturing process, which meets specific nutritional requirements. The industry is also exploring using dairy-free drinks, such as soy, almond, coconut, sesame, oat drink to produce new lactose-free products that provide plant-based protein and fat. These plant compounds' nutritional values and health-promoting effects make them attractive and practical for consumers. While the industry strives to reduce fats in dairy products, it is essential to maintain the quality of these products. This is especially difficult for light ice creams, as reducing fat can lead to a deficiency in the flavor profile and a poor texture. As consumer demand for light and low-fat ice cream continues to grow, the quality of these products must not be compromised. Therefore, the choice and quality of plant-based drink and bioactive compounds used in ice cream production are essential for the properties of the final product.*

Keywords*: milk substitutes, grain-based plant drink, nut-based plant drink, seed-based plant drink, pseudo-grains-based plant drink, vegetables-based plant drink*

1. Introduction

The increasing prevalence of lifestyle-related diseases such as heart disorders and depression has caused health-conscious consumers to reconsider their food choices. Consequently, the market has witnessed the emergence of new functional foods and products [1]. The global population is expected to grow by two to four billion by 2050 [2]. Ensuring a sustainable supply of protein for this growing population is set to become one of the most important challenges facing our societies in the coming decades [3]. The growing population is expected to need twice as much protein as is consumed. The growing demand for protein ingredients in recent years underlines the magnitude of this need, requiring multiple approaches to be pursued simultaneously to address it [4]. Consumers have elevated expectations and are eager to discover innovative and delicious food options in the modern age [5]. At the same time, they are increasingly aware of the link between food and health, which drives a desire to make safer and healthier choices [6]. Different definitions of functional foods and nutraceutical products have been developed over time, with one definition defining functional food as a food capable of bringing health benefits and reducing disease risk [7]. Ice cream is a dessert with a unique structure comprising solid, liquid, and gaseous components, a colloidal food with a complex structure of particles like fat droplets, air bubbles, and ice crystals in a freeze-concentrated aqueous solution. It is often made by combining milk, nonfat milk solids, supplementary fat (such cream or other fats), emulsifiers, hydrocolloids,

DOI: https://doi.org/10.4316/fens.2025.007

flavoring agents, and other ingredients [8]. Food products that are entirely free of diary, eggs and other animal-derived ingredients are named "plant-based or nondairy" [8]. Given the important levels of cholesterol in milk fat and the substantial sugar content in conventional ice cream recipes, is not recommended for people with diabetes or prediabetes or for children [9]. Therefore, it would be advantageous to investigate alternative options for replacing milk fat in traditional ice cream formulas [10,11].

Plant-based milk alternatives are water-soluble extracts that resemble milk in appearance and are produced by reducing the size of the raw material, extracting it in water with homogenization, separating the solid phase from the liquid phase and formulating the final product [12,13]. There are a various types of plant-based milk substitutes, such as:

- Grain-based plant drinks (oat, rice, corn, teff, and spelt drink);
- Vegetable-based plant drinks (soy, lupine, and pea drink);
- Nut-based plant drink (almond, coconut, hazelnut, pistachio, peanuts, pecans, brazil nuts and walnut drink);
- Seed-based plant drink (sesame, flaxseed, hemp, sunflower drink);
- Pseudo-grains-based plant drink (quinoa, amaranth, and buckwheat drink).

This paper provides a comprehensive overview of plant-based drink alternatives, and the technological interventions implemented to improve their quality. It also looks at potential future research avenues that could lead to developing high-quality alternatives to plant-based drink.

2. Functional ice cream

Ice cream is a dessert with a unique structure comprising solid, liquid, and gaseous components [14]. Typical ice cream contains about 30% ice, 50% air, 5% fat, and 15% matrix (sugar solution) by volume, as presented in Figure 1. These components are present in ice cream as small particles, including ice crystals, fat droplets, and air bubbles, dispersed in a continuous phase called a matrix [15,16]. To understand how the microstructure of ice cream is formed during the manufacturing process, it is essential to understand some concepts from the physical chemistry of colloids, freezing, and rheology [17,18]. The definition of functional foods may vary, but functional ice cream should offer healthier properties and potentially reduce the risk of disease compared to regular ice cream [14]. People of all ages and social classes can enjoy the benefits of functional ice cream. Strategies for creating functional ice cream include replacing fats and sugars with beneficial alternatives [19]. For example, sucrose can be replaced with grape molasses, milk fat with protein, and carbohydrate-based fat substitutes or fats with a high content of unsaturated fats. However, removing or replacing an ingredient can impact the physicochemical properties, which in turn can affect sensory characteristics important to consumers [19,20]. The primary nutrients found in ice cream are sugar and fat, which provide the body with energy and essential nutrients. The fat content in ice cream can range from 10% to 16%, while the minimum solids content in milk is set at 20% by weight. The fat and solids in milk contribute to ice cream's rich, creamy texture and mouthfeel [21]. In addition to dairy components, ice cream may contain stabilizers, emulsifiers, and other ingredients that help improve the overall quality and performance of the product. The interesting thing is that ice cream is not only a source of essential nutrients but also contains various vitamins and minerals, including vitamins A, C, D, and E, as well as phosphorus and calcium [15].

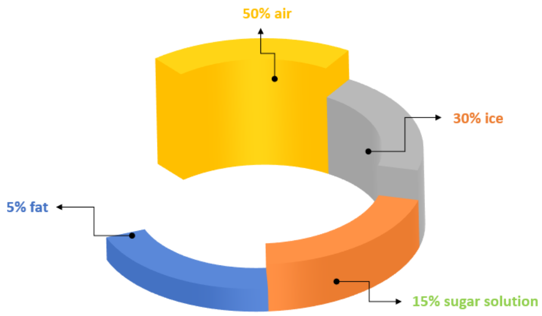

Fig. 1. Composition of ice cream

3. Plant-Based Ice Cream Alternatives: Nutrition, Functionality, and Consumer Appeal

In recent years, there has been a growing demand for innovative, affordable, and safe food products that offer health benefits beyond essential nutrition. This trend has led to the development of new functional foods that can help prevent lifestyle-related diseases, such as heart disorders and depression [22]. The definition of functional foods may vary, but functional ice cream should offer healthier properties and potentially reduce the risk of disease compared to regular ice cream People of all ages and social classes can enjoy the benefits of functional ice cream. Strategies for creating functional ice cream include replacing fats and sugars with beneficial alternatives. Plant-based drinks improves the antioxidant, nutritional and sensory properties of food products [23]. Water-soluble extracts of legumes, oilseeds, cereals, or pseudocereals that have a similar look to milk are known as plant extracts or plant-based milk alternatives. Including plant-based drinks in dairy foods seems to be a promising strategy for producing functional foods [24]. According to the World Cancer Research Fund and the American Institute for Cancer Research, most individual epidemiological studies have shown an increased risk of prostate cancer associated with increased consumption of milk or dairy products. The available evidence is limited but suggests a potential link between milk and dairy products and the development of prostate cancer [25]. Diet ice cream is made from plant-based drink substitutes such as soy, cashew, hazelnut, coconut, hemp, or almond and is enriched with various flavors [26]. It is an excellent option for vegetarians, raw vegans, lactose-intolerant people, and those who prefer a healthy lifestyle. Plant-based drink substitutes and dietary fiber make possible to obtain finished products with a texture, hardness, and firmness like ice cream obtained with milk [5]. A plant-based drink is a functional and nutraceutical food since it is cholesterol-free and contains unsaturated fats, vitamins, minerals, and antioxidants [27–29]. Studies have shown that completely replacing fats in ice cream can negatively affect various physical properties (thermal, rheological or structural) and flavor profiles, including the intensity and release of aromatic compounds [14]. Balancing fat and fat substitutes in low-fat ice cream is crucial to achieving the desired physical and sensory properties. The fat acts as an insulator with low thermal diffusivity, which slows down the rate of heat transfer in ice cream. This, in turn, slows down the rate of melting. In addition, non-polar fats do not affect the freezing point, while skimmed dairy solids used as fat substitutes can lower the freezing point [14]. The impact of whey protein particle size distribution on light ice cream was examined. Ice cream containing whey protein with a particle diameter greater than 5 µm showed greater firmness and 10% lower overshot than ice cream with microparticulate whey protein. Smaller particle sizes (0.1-2 µm) contribute to a creamy mouthfeel, while larger particles (more significant than 3 µm) can produce a sandy texture. Of the protein-based fat substitutes, micro-particular whey proteins are seen as the most like fat globules on the tongue and provide a creamy texture [14,19,30,31]. Indeed, consumers tend to associate creaminess with a perception of high quality. Therefore, the particle size distribution of fat substitutes can significantly influence sensory attributes in the mouth. Technologies such as high-pressure homogenization have been explored to improve the consistency of low-fat ice cream. These techniques can help to achieve a desirable texture and improve the overall consumer experience [30,18]. High sugar and saturated fat content can pose health problems when consumed regularly and in large quantities. While several non-dairy alternatives also boast elevated levels of sugar and saturated fat, there are superior options that offer lower levels of saturated fat and sugar and a protein content like that of traditional ice cream [19,30,33,34]. Plant-based drink are liquids that result from the breakdown (reduction in size) of plant material, such as grains, pseudo-grains, oilseeds, and nuts. When mixed with water, these fluids can be homogenized to mimic the appearance and consistency of milk by achieving the desired particle size distribution [5]. A classification [35] of plant-based milk alternatives is showed in Figure 2.

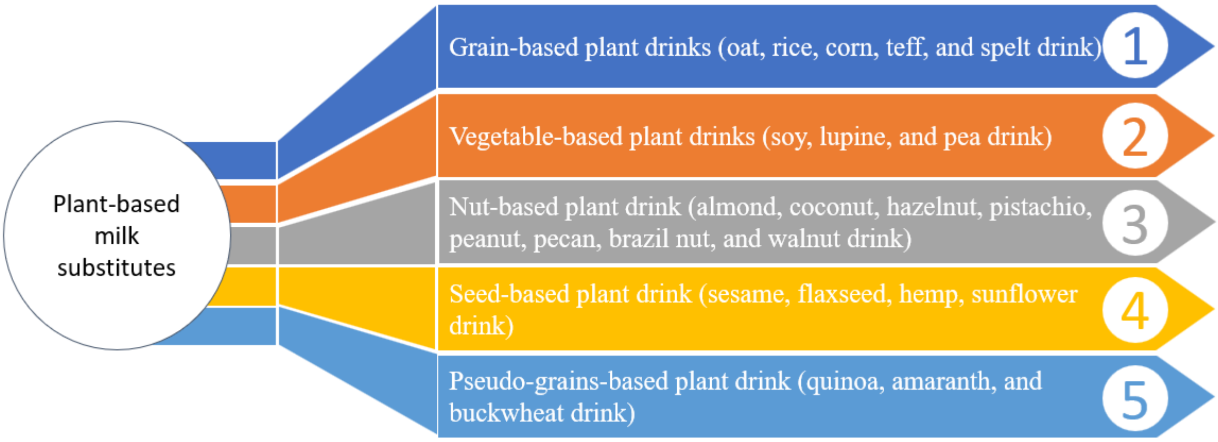

Fig. 2. Plant-based milk substitutes

Ice cream manufacturers are increasingly looking for alternatives to milk due to issues related to its fat, cholesterol and lactose content and the growing demand for plant-based drink ice cream [35].

4. Plant-based drink alternatives

Functional ice cream products can be developed with unique nutritional profiles and sensory characteristics using plant-based drink alternatives [21]. Incorporating plant-based drink alternatives into ice cream formulas can significantly impact the final product's textural, rheological, and chemical properties [36,37]. The different compositional profiles of plant-based drink alternatives can also influence ice cream's melting behavior, overrun, and overall stability.

Plant-based drink alternatives tend to have higher viscosity and different flow behaviors than milk, which can affect the ice cream's overall quality and sensory attributes [36].

4.1. Grain-based plant drinks for ice cream

Grain-based plant drinks, such as oat, rice, corn, teff, and spelt offer unique properties that can be leveraged in the ice cream industry. Oat drink, for instance is known for its creamy texture and mild flavor, making it a suitable ingredient for ice cream production [38]. Rice drink, on the other hand, is often used as a lactose-free and gluten-free alternative, providing a light and refreshing base for ice cream.

Corn drink, with its sweet and slightly nutty taste can contribute to the overall flavor profile of ice cream, while teff and spelt drinks offer additional nutritional benefits due to their high mineral and protein content. It can be used to create a smooth and indulgent ice cream with a velvety mouthfeel [39]. For instance, corn drink-based ice cream can be paired with caramel or chocolate flavors, creating a delightful balance of sweetness and richness. Teff and spelt drinks due to their high mineral and protein content can contribute to the nutritional profile of ice cream, making them appealing options for health-conscious consumer. These drinks can be used to obtain ice cream with a more well-rounded nutritional value, offering a healthier alternative to traditional dairy-based ice cream [38]. Teff drink, derived from the ancient grain teff is a nutrient-dense option for ice cream. It is rich in minerals like iron, calcium, and magnesium, as well as protein compound, making it a nutritious addition to ice cream formulation [40]. Spelt drink, another ancient grain-based drink offers a unique flavor and texture that can be leveraged in ice cream production. It is known for its creamy consistency and slightly nutty taste, which can complement a variety of ice cream flavors [39].

4.2. Vegetable-based plant drink for ice cream

Vegetable-based plant drinks including soy, lupine, and pea drink offer diverse properties that can be advantageous in the ice cream industry [38]. Lupine drink, derived from the lupine bean, is a relatively new player in the plant drink market, but its potential as an ice cream ingredient is worth exploring [41]. Pea drink with its high protein content and subtle flavor can be an excellent choice for individuals seeking a more nutritious ice cream option [42].

Soy drink, for instance, is a popular choice due to its neutral flavor and ability to mimic the creaminess of milk, being a reliable source of protein, containing all the essential amino acids, and being rich in various vitamins and minerals, such as calcium, iron, and vitamin B [43]. The protein content in soy drink may help improve the texture and mouthfeel of ice cream, while the lipid content may contribute to the overall creaminess of ice cream [35,44]. Regular consumption of soy products can provide health benefits, such as reducing the risk of cancer and cardiovascular disease, diabetic diseases, and improving bone and kidney health [45,46]. Soy drink is an economical source of high-quality plant protein. Compared to milk, soy drink contains a similar amount of protein but only one-fifth of the calcium [47].

4.3. Nut-based plant drinks for ice cream

Nut-based plant drinks, such as almond, coconut, hazelnut, pistachio, peanut, and walnut drink offer a range of flavors and textures that can be leveraged in the ice cream industry.

Almond drink with its delicate flavor and creamy texture can be used to create a light and refreshing ice cream. Almond drink is known for its subtle nutty flavor and low-calorie content compared to milk [48]. It is also a reliable source of vitamin E, an excellent source of dietary fiber, monounsaturated fatty acids, protein, essential minerals, riboflavin, and antioxidants and can contribute to the nutritional profile of ice cream products [44]. Almond drink's lower protein and fat content than milk may require additional stabilizers and emulsifiers in ice cream formulas to achieve a similar creamy texture and mouthfeel [49]. The low-fat content of almond drink may also result in a lighter ice cream texture, which may be desirable for specific consumer preferences [44,50]. Almond drink is beneficial for coronary heart disease, as it lowers LDL cholesterol in plasma. This non-dairy drink is an excellent alternative to milk for the hypersensitive and lactose-intolerant population [50,51].

Walnut drink, with its nutty and slightly astringent notes of walnut drink can provide a pleasant counterpoint to the sweetness of the ice cream, resulting in a more sophisticated and well-rounded flavor experience. This drink can be particularly effective in pairing with richer, more refinement ice cream flavors, such as chocolate or caramel, to help cut through the sweetness and add depth to the overall taste [21]. Hazelnut drink, with its distinctive nutty flavor, can be used to create unique and sophisticated ice cream varieties, while pistachio drink can add a vibrant green color and distinctive taste to ice cream [52]. Coconut drink is another popular plant-based alternative used in ice cream production and can impart a rich taste and mouthfeel to ice cream, being a popular choice for tropical-inspired flavors [21,50]. It is high in saturated fat, which can contribute to ice cream's rich and creamy texture [53], but also is a source of various nutrients, including potassium, magnesium, and vitamin C [54].

The distinct flavor of coconut drink may be desirable in certain ice cream products, lending a tropical flair to the sensory experience [55,56]. However, it is important to note that coconut drink is higher fat content may require formulation adjustments to achieve the ice cream's desired texture [44]. The high oleic and lauric acid content in coconut drink also helps prevent arteriosclerosis and associated diseases. Confectioners, bakeries, biscuits and ice cream industries widely use coconut drink to enhance the aroma and taste of various products [29].

Peanut drink with its rich and nutty flavor can be used to create unique ice cream varieties, such as peanut butter-flavored ice cream [57,58].

4.4. Seed-based plant drink for ice cream

Seed-based plant drinks, including sesame, flaxseed, hemp, and sunflower drink, offer a range of nutritional benefits and unique flavor profiles that can be advantageous in ice cream production.

Sesame drink can be used to create ice cream with a unique and distinctive flavor and contain many active compounds with antioxidant properties [59,60].

Flaxseed drink, rich in omega-3 fatty acids, can provide a nutritional boost to ice cream, catering to health-conscious consumers. Because of its extraordinarily high levels of phytoestrogens, dietary fiber, alpha-linolenic acid (ALA), and high-quality protein flaxseed is an attractive food product [61].

Hemp drink can be a versatile option for ice cream formulations [62], with a low content of saturated fats and a high nutritional value [63,64]. Hemp seeds have been shown to contain all nine essential amino acids, the most abundant being cysteine and methionine [65].

Sunflower drink, with its light and slightly grassy taste, can be used to create refreshing and delicate ice cream varieties [66].

4.5. Pseudo-grains-based plant drink for ice cream

Pseudo-grain-based plant drinks can offer a range of health benefits and distinctive flavor profiles that can be leveraged in the ice cream industry, catering to consumers seeking more nutritious and innovative ice cream options [57].

Quinoa drink, derived from the ancient superfood quinoa, is another option for ice cream production. Quinoa is a gluten-free pseudo-grain that is high in protein, fiber, and various vitamins and minerals, making it a nutritious addition to ice cream [38]. Amaranth drink, made from the nutrient-dense amaranth grain, can also be used in ice cream formulations [65]. Buckwheat drink, despite its name, is derived from the buckwheat plant, a gluten-free pseudo-grain, and can contribute to a unique and earthy flavor to ice cream [67]. With the growing consumer demand for plant-based and healthier alternatives, the use of diverse plant-based drinks in ice cream production can provide a wide range of opportunities for manufacturers.

The nutritional composition of milk and milk alternatives is a key factor to consider in the formulation of ice cream. A comparison of the nutritional properties of soy, almond and coconut drink is presented in Table 1:

Table 1.

Nutritional properties of soy, almond and coconut drink

Nutrients	Protein content	Fat content	Carbohydrate content	Calorie content	Additional nutrients	Study
Soy drink	High content	Moderate content	Moderate content	Moderate content	Rich in vitamins and minerals	[50]
Almond drink	Low content	Low content	Low content	Low content	Rich in vitamin E	[26]
Coconut drink	Moderate content	High content	High content	High content	Moderate vitamins and minerals	[68]

5. Plant-Based milk alternatives: benefits, challenges, and innovations

Milk has been an essential human food source since the seventh-millennium BCE. Milk is a complex, highly nutritious food that provides the necessary proteins, lipids, vitamins, and minerals, especially calcium. However, only some people respond well to milk consumption. Lactose intolerance (which affects about 75% of the world's population) and allergy to cow's milk proteins are the main disadvantages of milk consumption. The vegan diet is becoming increasingly popular due to concerns about environmental pollution and animal welfare. Additionally, although many people are lactose intolerant, lactose has been shown to improve the bioavailability of calcium and other minerals, so this should be considered when choosing between milk and plant-based drinks. Plant-based drink have fewer minerals and vitamins, and their absorption is less consistent than milk [69]. However, plant-based drinks are usually fortified with vitamins, especially calcium, to improve its nutritional value. On the other hand, plant-based drink alternatives contain some antinutrients that can interfere with mineral absorption and reduce protein digestibility [70]. These antinutrients include phytic acid, trypsin inhibitors, and inositol phosphates. Despite this, plant-based drink alternatives, especially soy-based drink substitutes, contain other vital components who are not present in milk, such as dietary fiber and isoflavones [71]. Therefore, plant-based drink alternatives have emerged as promising substitutes for mammalian milk in daily diets [70], and lately there is an increase in the production of plant-based foods in the food sector. The production of alternatives to plant-based drink involves several steps, which can vary depending on the type of raw material used. Typical steps include wet grinding, filtering, adding additional ingredients (such as gums, salt, sugar, oils, minerals, and vitamins), sterilization, homogenization, aseptic packaging, and cold storage [70,72].

Alternatives to plant-based drink comprise the breakdown of plant materials such as cereals, legumes, oilseeds, nuts, water extraction and subsequent homogenization of these fluids. The size of their particles is distributed in the range of 5-20 µm, so plant-based drink is like milk in terms of appearance and consistency [46,73]. Plant-based drinks do not contain lactose and cholesterol and have a higher content of unsaturated fatty acids. However, some plant-based drinks contain refined sugars with a higher glycemic index than cow's milk, which is essential to consider. On the other hand, plant-based drinks contain micronutrients that are not present in milk and have valuable bioactivity [72]. Fresh plant-based drink alternatives have a short shelf life and are limited in consumption. To increase shelf life, heat treatment, in particular pasteurization and ultra-high temperature (UHT), is standard in producing alternatives plant drink. However, heat treatment can alter the properties of proteins, vitamins, and minerals, affecting the stability and sensory properties of the final product [70]. Non-thermal techniques are being researched to increase the shelf life of plant-based drink alternatives without compromising their stability, nutritional value, or sensory profile. Ultrasound method, pulsating electric fields method, ohmic heating method, and high- and ultra-high-pressure homogenization are sustainable techniques that preserve plant-based drink alternatives and enhance a large-scale production [72]. Another challenge for plant-based drink alternatives is their higher cost of production, a key factor in food choice decisions. In one region of Canada, many consumers found these products expensive [74]. Despite the price, manufacturing plant-based drink alternatives has positive environmental effects, such as reduced water use and the potential to reduce climate change and ecotoxicity [69]. Plant-based drink alternatives can be used as a beverage or as an ingredient in cheese, cream, yoghurt, butter, ice cream, and other desserts [74]. The nutritional profile of plant-based drink alternatives is essential when comparing them to dairy products [75].

Plant-based drink alternatives have a different nutritional profile than milk, which is influenced by the plant's source, how it is processed, and whether it has been enriched with additional ingredients [76]. Animal proteins provide unique sensory and textural properties to foods that cannot be easily reproduced with plant-based meat alternatives. However, the industry has seen two challenges regarding sensory acceptability for consumers. First, a finished product may have a "spicy" or "chalky" mouthfeel caused by large insoluble particles. Second, consumers identify the different flavors of plant-based drinks and their textural attributes and appearance, affecting purchasing decisions and conceptualization. To make plant-based drinks tastier and more appealing from a organoleptic point of view, flavors are often added, and different raw materials are mixed [72,77]. Due to its multiphasic nature, achieving the desired texture and sensory qualities in plant-based *ice cream* requires a robust protein structure. Therefore, the quality and quantity of protein in the milk or milk alternatives used for production of ice cream are essential. Replacing skimmed milk powder with soy protein isolate increases ice cream samples' viscosity, melting time, and hardness [46]. Soy-based drink has a protein content comparable to milk and fortifying ice cream with soy protein improves the product's texture, firmness, and viscosity [50]. Soy lecithin also emulsifies, increase viscosity, stability, and texture, prolonging ice cream's melting time [43,78]. Coconut drink increases the viscosity of the ice cream mix, reduces the ice cream's melting time and improves the nutritional content of ice cream [28,29]. The main challenge in using coconut or soy drink in ice cream is achieving a stable colloidal system. The lecithin in soy drink creates a hard ice cream that must soak at room temperature for 15 minutes before serving [29].

5.1. Functional and rheological properties of plant-based ice cream alternatives: Impact on texture and sensory quality in ice cream formulation

The functional properties of milk and milk alternatives play a crucial role in ice cream's texture, mouthfeel, and stability [44]. The natural composition of milk contributes to its creamy texture and emulsifying properties, providing a familiar flavor and mouthfeel [33], while plant-based alternatives drink may require additional stabilizers and emulsifiers to achieve similar results [36].

Soy drink's protein content and emulsifying properties make it a valuable alternative, while coconut drink's high-fat content and distinct flavor add a more intense flavor to ice cream products [79].

Almond drink, with its lower fat and protein content, presents unique formulation challenges and provides opportunities to create lighter textures in ice cream [39]. A comparative table is shown below (Table 2) to highlight the textural properties of soy, almond, and coconut drink in ice cream formulas:

Table 2

Textural properties of soy, almond and coconut drink in ice cream

Property	Soy drink	Almond drink	Coconut drink
Creaminess	Creamy texture with moderate density	Light and airy texture	Rich and dense texture
Sensation in the mouth	Smooth and velvety	Light and gentle	Creamy and luxurious
Melting resistance	Moderate melting resistance	Faster melting rate	Slower melting rate
Study	[50]	[26]	[55]

The tropical flair of coconut drink and the subtle nuts of almond drink provides opportunities to create unique flavor profiles in ice cream. Understanding and capitalizing on these sensory characteristics can drive innovation and meet various consumer preferences in the ice cream market [55]. These differences in texture can be attributed to the various compositions and functional properties of plant-based drinks, which ice cream producers can use to create a diverse palette of textures and sensory experiences.

Rheological properties, such as viscosity and shear behavior are critical in determining ice cream's textural properties and mouthfeel [80]. Understanding plant-based drinks rheological properties becomes essential in formulating ice cream with the desired sensory attributes [74]. For example, the high-fat content of coconut drink contributes to a creamier and denser ice cream texture, while the lower fat content of almond drink can lead to a lighter and airier feel [81]. Those milk alternatives' different viscosity and flow behaviors directly impact the ice cream product's overall quality and sensory experience [82], and the most challenging aspect of plant-based ice cream alternative technology is the rheological properties, particularly the viscosity of the cream mixtures. Ice cream's ability to return to a static state after freezing is crucial in determining the structure formation patterns. Ice cream comprises various mixtures that require specific rheological properties to ensure a perfect texture. These properties are obtained with the help of inulin, maltodextrin, gum, polydextrose and pectin, which bind water and structure mixtures with several components [28,83,84].

5.2. Physico-chemical and sensorial properties of plant-based drink alternatives in ice cream formulation

Plant-based ice cream alternatives are becoming increasingly popular due to milk's high fat, cholesterol, and allergenicity content. Chemical composition of plant-based drink affects the interactions between the ingredients in the ice cream formulation [70]. This, in turn, influences factors such as emulsion stability, fat crystallization, and ice crystal formation [68]. A point worth noting is that the chemical composition of plant-based drinks also influences the flavor profiles of ice cream. Capitalizing on distinct flavors, such as the nutty hues of almond drink or the tropical notes of coconut drink, creates unique and appealing ice cream products that align with evolving consumer preferences for healthier and more sustainable food options. Plant-based drinks offer several opportunities and challenges for developing functional ice cream products [54]. The protein content and emulsification capabilities of soy drink, the richness of coconut drink, and the unique textural properties of almond drink provide ice cream producers with diverse tools to create innovative and appealing products that cater to evolving consumer preferences [44]. Dietary fiber (psyllium and pectin) has been added to almond and hemp drink (0-10%) to improve plant-based ice cream alternatives' rheological, textural, and sensory properties. Technologically, to achieve specific consistency and sensory characteristics, it is recommended to add a maximum of 6% psyllium fiber and 8% pectin. Regarding organoleptic evaluation, the plant-based ice cream alternative with almond drink was preferred for its sweet flavor. In contrast, the plant-based ice cream alternative with hemp drink was valued only for its improved physicochemical and rheological properties [63]. Aboulfazli et al. [83] compared fermented ice cream prepared with various alternatives to cow's, soy and coconut drink and combinations of these alternatives (25%, 50% and 75%). When a mixture of 75% soy and 25% alternative coconut drink was used instead of milk, the probiotic development of *L. acidophilus* and *B. bifidum* in fermented ice cream was significantly increased compared to when milk was used [29]. Diniz et al. [85] conducted a study to develop and investigate the feasibility of integrating water-soluble plant extracts from baru nuts and cashew nuts to produce peanut-flavored and cocoa-flavored vegan ice creams. The peanut-flavored ice cream had higher lipids and proteins levels, but lower moisture and carbohydrates. The cocoa-flavored ice cream had higher melting rates and overruns. Consequently, both variants showed potential for commercial viability and consumer acceptance, providing an alternative for people with dietary restrictions or as a general food option [85]. Matabura [86] conducted a study to examine the melting characteristics of dairy-free ice cream that uses cashews drink and coconut cream as the main ingredients. Those ingredients were prepared separately and combined in different proportions to create the milk-free ice cream. The content of protein, fiber, fat, and ash increases with the addition of coconut cream, while the moisture decreases. The melting properties of ice cream changed with the increase of coconut cream [86]. In formulating functional ice cream, it is reasonable to use combinations of ingredients to achieve both health benefits and optimal sensory quality, finding the right balance between the two of them.

6. Conclusions

The consumers are becoming more concerned about sustainable living, food security, and environmental issues and this is also reflected in the growing demand for vegan ice cream, based on plant-based alternative drinks. Both allergies or intolerances to lactose, as well as the desire to have a healthier diet, with reduced fat or sugar consumption, the segment of alternative drinks to milk is growing more and more. In the ice cream sector, grain-based plant drinks, vegetable-based plant drinks, nut-based plant drink, seed-based plant drink, and pseudo-grains-based plant drink are mainly used. The most widely used vegetable drinks are obtained from soy, oat, coconut, almond or hemp for their functionally active components. Milk substitutes are used to formulation of ice cream-like characteristic, but depending on the nature of the vegetable drink used, various quality parameters are influenced, including viscosity, melting resistance, overrun, and the texture. Plant-based drink has proven to be an effective alternative to produce vegan ice cream with high acceptability from consumers, but also with a balanced composition.

7. References

[1]. CHUGHTAI, M.F.J., PASHA, I., ZAHOOR, T., KHALIQ, A., AHSAN, S., WU, Z., NADEEM, M., MEHMOOD, T., AMIR, R.M., YASMIN, I., LIAQAT, A., TANWEER, S., Nutritional and Therapeutic Perspectives of *Stevia Rebaudiana* as Emerging Sweetener; a Way Forward for Sweetener Industry. CyTA - *Journal of Food*, 18, 164–177, (2020).

[2]. SIKORA, R.A., TERRY, E.R., VLEK, P.L.G., CHITJA, J., Transforming Agriculture in Southern Africa: Constraints, Technologies, *Policies and Processes*, Routledge, New York, US, (2019).

[3]. LONNIE, M., HOOKER, E., BRUNSTROM, J.M., CORFE, B.M., GREEN, M.A., WATSON, A.W., WILLIAMS, E.A., STEVENSON, E.J., PENSON, S., JOHNSTONE, A.M., Protein for Life: Review of Optimal Protein Intake, Sustainable Dietary Sources and the Effect on Appetite in Ageing Adults, *Nutrients*, 10, 1–18, (2018).

[4]. VILLARÓ, S., ACIÉN, G., FERNÁNDEZ-SEVILLA, J.M., LAFARGA, T., Future Proteins Sources, Processing, Applications and the Bioeconomy. Microalgal Protein Production: Current Needs and Challenges, *Academic Press*, Cambridge, Massachusetts, (2023).

[5]. ERHARD, A., JAHN, S., BOZTUG, Y., Tasty or Sustainable? Goal Conflict in Plant-Based Food Choice, *Food Quality and Preference*, 120, 105237, (2024).

[6]. CHEN, X., JIANG, X., WU, L., Drivers of Consumers' Intention to Adopt Sustainable Healthy Dietary Patterns: Evidence from China, *Frontiers in Sustainable Food Systems*, 7, 1–12, (2023).

[7]. GENOVESE, A., BALIVO, A., SALVATI, A., SACCHI, R., Functional Ice Cream Health Benefits and Sensory Implications, *Food Research International*, 161, 111858, (2022).

[8]. FREIRE, D.O., ATIK, D.S., GLADEM, P.M., RANKIN, S.A., HARTEL, R.W., Composition, Microstructure, Rheology, and Meltdown Behavior of Commercial Nondairy Frozen Desserts, *Journal of Food Science*, 1–13, (2024).

[9]. KIJTAWEE, J., Developing Healthy Ice Cream Products by Supplementing Vetiver Root and Using Stevia Extract Instead of Sugar, *Journal of Positive School Psychology*, 6(4), 3836–3844, (2022).

[10]. EYLES, H., TRIEU, K., JIANG, Y., MHURCHU, C.N., Reducing Children's Sugar Intake through Food Reformulation: Methods for Estimating Sugar Reduction Program Targets, Using New Zealand as a Case Study, *The American Journal of Clinical Nutrition*, 111, 622–634, (2020).

[11]. ESPINOZA, L.A., PURRIÑOS, L., CENTENO, J.A., CARBALLO, J., Chemical, Microbial and Sensory Properties of a Chestnut and Milk Ice Cream with Improved Healthy Characteristics. *International Journal of Food Properties*, 23, 2271–2294, (2020).

[12]. TSAI, S.Y., TSAY, G.J., LI, C.Y., HUNG, Y.T., LIN, C.P., Assessment of Melting Kinetics of Sugar-Reduced Silver Ear Mushroom Ice Cream under Various Additive Models, *Applied Sciences*, 10(2664), (2020).

[13]. VELOTTO, S., PARAFATI, L., ARIANO, A., PALMERI, R., PESCE, F., PLANETA, D., ALFEO, V., TODARO, A., Use of Stevia and Chia Seeds for the Formulation of Traditional and Vegan Artisanal Ice Cream, International *Journal of Gastronomy and Food Science*, 26, 100441, (2021).

[14]. AKBARI, M., ESKANDARI, M.H., DAVOUDI, Z., Application and Functions of Fat Replacers in Low-Fat Ice Cream: A Review, *Trends in Food Science & Technology*, 86, 34–40, (2019).
[15]. ARSLANER, A., SALIK, M.A., Functional Ice Cream Technology, Akad. Gida, 18, 180–189, (2020).
[16]. SOUKOULIS, C., LEBESI, D., TZIA, C., Enrichment of Ice Cream with Dietary Fibre: Effects on Rheological Properties, Ice Crystallisation and Glass Transition Phenomena, *Food Chemistry*, 115, 665–671, (2009).
[17]. SAMAKRADHAMRONGTHAI, R.S., JANNU, T., SUPAWAN, T., KHAWSUD, A., AUMPA, P., RENALDI, G., Inulin Application on the Optimization of Reduced-Fat Ice Cream Using Response Surface Methodology, *Food Hydrocolloid*, 119, 106873, (2021).
[18]. SOUKOULIS, C., TZIA, C., Grape, Raisin and Sugarcane Molasses as Potential Partial Sucrose Substitutes in Chocolate Ice Cream: A Feasibility Study. *International Dairy Journal*, 76, 18–29, (2018).
[19]. HOSSAIN, M.K., KEIDEL, J., HENSEL, O., DIAKITÉ, M., The Impact of Extruded Microparticulated Whey Proteins in Reduced-Fat, Plain-Type Stirred Yogurt: Characterization of Physicochemical and Sensory Properties, *Lwt*, 134, (2020).
[20]. MUNK, M.B., MUNK, D.M.E., GUSTAVSSON, F., RISBO, J., Using Ethylcellulose to Structure Oil Droplets in Ice Cream Made with High Oleic Sunflower Oil, *Journal of Food Science*, 83, 2520–2526, (2018).
[21]. ABBAS SYED, Q., Effects of Different Ingredients on Texture of Ice Cream, *Journal of Nutritional Health & Food Engineering*, 8(6), 422-435, (2018).
[22]. RANA, J., PAUL, J., Consumer Behavior and Purchase Intention for Organic Food: A Review and Research Agenda, *Journal of Retailing and Consumer Services*, 38, 157–165, (2017).
[23]. GRANATO, D., SANTOS, J.S., SALEM, R.D., MORTAZAVIAN, A.M., ROCHA, R.S., CRUZ, A.G., Effects of Herbal Extracts on Quality Traits of Yogurts, Cheeses, Fermented Milks, and Ice Creams: A Technological Perspective, *Current Opinion in Food Science*, 19, 1–7, (2018).
[24]. ABDOLLAHZADEH, S.M., ZAHEDANI, M.R., RAHMDEL, S., HEMMATI, F., MAZLOOMI, S.M., Development of Lactobacillus Acidophilus-Fermented Milk Fortified with Date Extract, *Lwt*, 98, 577–582, (2018).
[25]. HOQUE, M., MONDAL, S., Safety of Milk and Dairy Products, *Food Safety and Human Health*, Elsevier, Amsterdam, Holland, 127–143, (2019).
[26]. KOT, A., KAMIŃSKA-DWÓRZNICKA, A., GALUS, S., JAKUBCZYK, E., Effects of Different Ingredients and Stabilisers on Properties of Mixes Based on Almond Drink for Vegan Ice Cream Production, *Sustainability*, 13, 12113, (2021).
[27]. LOW, R.H.P., BABA, A.S., ABOULFAZLI, F., Effects of Different Levels of Refined Cane Sugar and Unrefined Coconut Palm Sugar on the Survivability of Lactobacillus acidophilus in Probiotic Ice Cream and Its Sensory and Antioxidant Properties, *Food Science and Technology Research*, 21, 857–862, (2015).
[28]. ABOULFAZLI, F., BABA, A.S., Effect of Vegetable Milk on Survival of Probiotics in Fermented Ice Cream under Gastrointestinal Conditions, *Food Science and Technology Research*, 21(3), 391–397, (2015).
[29]. ABOULFAZLI, F., SHORI, A.B., BABA, A.S., Effects of the Replacement of Cow Milk with Vegetable Milk on Probiotics and Nutritional Profile of Fermented Ice Cream, *Lwt*, 70, 261–270, (2016).
[30]. HOSSAIN, M.K., PETROV, M., HENSEL, O., DIAKITÉ, M., Microstructure and Physicochemical Properties of Light Ice Cream: Effects of Extruded Microparticulated Whey Proteins and Process Design, *Foods*, 10, 1433, (2021).
[31]. CHUNG, S.; AVE, O.S., Release of Artificial Cherry Flavor from Ice cream varying in fat and fat replacers, *Journal of Sensory Studies*, 19, 211–236, (2004).
[32]. YILSAY, T.Ö., YILMAZ, L., BAYIZIT, A.A., The Effect of Using a Whey Protein Fat Replacer on Textural and Sensory Characteristics of Low-Fat Vanilla Ice Cream, *European Food Research and Technology*, 222, 171–175, (2006).
[33]. VARELA, P., PINTOR, A., FISZMAN, S., How Hydrocolloids Affect the Temporal Oral Perception of Ice Cream, *Food Hydrocolloids*, 36, 220–228, (2014).
[34]. CRAIG, W.J., BROTHERS, C.J., Nutritional Content of Non-Dairy Frozen Desserts, *Nutrients*, 14, 1–10, (2022).
[35]. SETHI, S., TYAGI, S.K., ANURAG, R.K., Plant-Based Milk Alternatives an Emerging Segment of Functional Beverages: A Review, *Journal of Food Science and Technology*, 53, 3408–3423, (2016).
[36]. GROSSMANN, L., KINCHLA, A.J., NOLDEN, A., MCCLEMENTS, D.J., Standardized Methods for Testing the Quality Attributes of Plant-Based Foods: Milk and Cream Alternatives, *Comprehensive Reviews in Food Science and Food Safety*, 20, 2206–2233, (2021).
[37]. MCCLEMENTS, D.J., Development of Next-Generation Nutritionally Fortified Plant-Based

Milk Substitutes: Structural Design Principles, *Foods*, 9, 271–314, (2020).
[38]. PINTO, D.d.S., SILVA, S.d.S., FIGUEIREDO, R.W., MENEZES, F.L., CASTRO, J.S., PIMENTA, A.T.Á., SANTOS, J.E.Á., NASCIMENTO, R.F., GABAN, S.V.F., Production of Healthy Mixed Vegetable Beverage: Antioxidant Capacity, Physicochemical and Sensorial Properties, *Food Science and Technology*, 42, e28121, (2022).
[39]. SEONG, G.U., KIM, J.Y., KIM, J.S., JEONG, S.U., CHO, J.H., LEE, J.Y., LEE, S.B., KABANGE, N.R., PARK, D.S., MOON, K.D., KANG, J.W., Quality Characteristics of Rice-Based Ice Creams with Different Amylose Contents, *Foods*, 12, 1518, (2023).
[40]. GEBRU, Y.A., SBHATU, D.B., KIM, K.P., Nutritional Composition and Health Benefits of Teff (Eragrostis Tef (Zucc.) Trotter), *Journal of Food Quality*, 2020, 1-6, (2020).
[41]. ZAOUADI, N., ZIANE-ZAFOUR, A. H., OUAZIB, M., ARAB, Y., HACINI, K., ASLAN, S.S., Formulation and Optimization by Experimental Design of Dairy Dessert Based on Lupinus Albus L. and Stevia Rebaudiana Extracts, *Asian Journal of Dairy and Food Research*, 38(4), 281, 218–287, (2019).
[42]. VEBER, A.L., LEONOVA, S.A., SIMAKOVA, I. V., ESMURZAEVA, Z.B., The Development of a Beverage with a Dispersion Structure from Pea Grains of Domestic Selection, IOP Conference Series: Earth and Environmental Science, 624, (2021).
[43]. OKWUNODULU, N.I., CHIKEZIE, O.S., LINUS-CHIBUEZEH, A., Assessment of Imitation Milk from Sprouted Soybean (*Glycine max*) and Boiled African Breadfruit Seeds (*Treculia africana*) Milk Blends, *Journal of Food Stability*, 3, 70–89, (2020).
[44]. ROMULO, A., MEINDRAWAN, B., Marpietylie Effect of Dairy and Non-Dairy Ingredients on the Physical Characteristic of Ice Cream: Review, IOP Conference Series: Earth and Environmental Science, 794, (2021).
[45]. LACHMAN, J., HEJTMÁNKOVÁ, K., KOTÍKOVÁ, Z., Tocols and Carotenoids of Einkorn, Emmer and Spring Wheat Varieties: Selection for Breeding and Production, *Journal of Cereal Science*, 57, 207–214, (2013).
[46]. GHADERI, S., MAZAHERI TEHRANI, M., HESARINEJAD, M.A., Qualitative Analysis of the Structural, Thermal and Rheological Properties of a Plant Ice Cream Based on Soy and Sesame Milks, *Food Science & Nutrition*, 9, 1289–1298, (2021).
[47]. CHAIWANON, P., PUWASTIEN, P., NITITHAMYONG, A., SIRICHAKWAL, P.P., Calcium Fortification in Soybean Milk and in Vitro Bioavailability, *Journal of Food Composition and Analysis*, 13, 319–327, (2000).
[48]. PRIYA, S.R., RAMASWAMY, L., Preparation and Quality Assessment of Yoghurt Prepared from Dairy Milk and Coconut (Cocos Nucifera, L) Milk, Cord, 32, 10, (2016).
[49]. DOUGLAS, G., Ice Cream and Frozen Desserts, *Sensory Analysis of Dairy Foods*, 281–344, (2023).
[50]. SHRESTHA, M., MASKEY, B., Effects of Soymilk and Milk Solid Not Fat on Soy Ice Cream Quality, *Himalayan Journal of Science and Technology*, 2, 41–47, (2018).
[51]. YADA, S., HUANG, G., LAPSLEY, K., Natural Variability in the Nutrient Composition of California-Grown Almonds, *Journal of Food Composition and Analysis*, 30, 80–85, (2013).
[52]. RENNA, M., LUSSIANA, C., MALFATTO, V., GERBELLE, M., TURILLE, G., MEDANA, C., GHIRARDELLO, D., MIMOSI, A., CORNALE, P., Evaluating the Suitability of Hazelnut Skin as a Feed Ingredient in the Diet of Dairy Cows, *Animals*, 10, 1–23, (2020).
[53]. DEOSARKAR, S.S., KALYANKAR, S.D., PAWSHE, R.D., KHEDKAR, C.D., Ice Cream: Composition and Health Effects, Encyclopedia of Food and Health, 1st edition, Elsevier, Amsterdam, Holland, 385-390, (2015).
[54]. BELTRAN, L.B., RASPE, D.T., CASTILHO, P.A., SOUSA, L.C.S., FIOROTO, C.K.S., VIEIRA, A.M.S., MADRONA, G.S., Desenvolvimento de Sorvete Vegano de Chocolate Formulado Com Batata Doce e Leite de Coco, *Brazilian Journal of Development*, 6, 15274–15284, (2020).
[55]. PERERA, K.D.S.S., PERERA, O.D.A.N., Development of Coconut Milk-Based Spicy Ice Cream as a Nondairy Alternative with Desired Physicochemical and Sensory Attributes, *International Journal of Food Science*, 1-7, 2021, (2021).
[56]. BELEWU, M.A., BELEWU, K.Y., Comparative Physico-Chemical Evaluation of Tiger-Nut, Soybean and Cocnut Milk Sources, *International Journal of Agriculture and Biology*, 9, 5, (2007).
[57]. ARBACH, C.T., ALVES, I.A., SERAFINI, M.R., STEPHANI, R., PERRONE, Í.T., DE CARVALHO DA COSTA, J., Recent Patent Applications in Beverages Enriched with Plant Proteins, *npj Science of Food*, 5, (2021).
[58]. VLASSOPOULOS, A., MASSET, G., CHARLES, V.R., HOOVER, C., CHESNEAU-GUILLEMONT, C., LEROY, F., LEHMANN, U., SPIELDENNER, J., TEE, E.S., GIBNEY, M., DREWNOWSKI, A., A Nutrient Profiling System for the (Re)Formulation of a Global Food and

Beverage Portfolio, *European Journal of Nutrition*, 56, 1105–1122, (2017).
[59]. AFANEH, I., ABU-ALRUZ, K., QUASEM, J.M., Fundamental Elements to Produce Sesame Yoghurt from Sesame Milk, *American Journal of Applied Sciences*, 8, 1086–1092, (2011).
[60]. KEMSAWASD, V., CHAIKHAM, P., Effects of Frozen Storage on Viability of Probiotics and Antioxidant Capacities of Synbiotic Riceberry and Sesame-Riceberry Milk Ice Creams, Current *Research in Nutrition and Food Science Journal*, 8, 107–121, (2020).
[61]. KALAIARASI, R., KALAMANI, R., Formulation and standardisation of functional flaxseed soymilk-shake, *Research Journal of Life Sciences, Bioinformatics, Pharmaceutical and Chemical Sciences*, 10(3), (2024).
[62]. HIDAS, K.I., NYULAS-ZEKE, I.C., SZEPESSY, A., ROMVÁRI, V., GERHART, K., SURÁNYI, J., LACZAY, P., DARNAY, L., Physical Properties of Hemp Drink-Based Ice Cream with Different Plant Proteins Guar Gum and Microbial Transglutaminase, *Lwt*, 182, (2023).
[63]. LEAHU, A., ROPCIUC, S., GHINEA, C., Plant-Based Milks: Alternatives to the Manufacture and Characterization of Ice Cream, *Applied Sciences*, 12, 1754, (2022).
[64]. ROPCIUC, S., GHINEA, C., LEAHU, A., PRISACARU, A. E., OROIAN, M. A., APOSTOL, L. C., DRANCA, F., Development and characterization of new plant-based ice cream assortments using oleogels as fat source, *Gels*, 10(6), 397, (2024).
[65]. BESIR, A., AWAD, N., MORTAS, M., YAZICI, F.A., Plant-Based Milk Type: Hemp Seed Milk, Akad. Gida, 20, 170–184, (2022).
[66]. PETRARU, A., URSACHI, F., AMARIEI, S., Nutritional Characteristics Assessment of Sunflower Seeds, Oil and Cake. Perspective of Using Sunflower Oilcakes as a Functional Ingredient, *Plants*, 10, 2487, (2021).
[67]. YAO, Y., HE, W., CAI, X., BEKHIT, A.E.D.A., XU, B., Sensory, Physicochemical and Rheological Properties of Plant-Based Milk Alternatives Made from Soybean, Peanut, Adlay, Adzuki Bean, Oat and Buckwheat, *International Journal of Food Science & Technology*, 57, 4868–4878, (2022).
[68]. CARLSSON KANYAMA, A., HEDIN, B., KATZEFF, C., Differences in Environmental Impact between Plant-Based Alternatives to Dairy and Dairy Products: A Systematic Literature Review, *Sustainability*, 13, (2021).
[69]. SILVA, A.R.A., SILVA, M.M.N., RIBEIRO, B.D., Health Issues and Technological Aspects of Plant-Based Alternative Milk, *Food Research International*, 131, 108972, (2020).
[70]. BOCKER, R., SILVA, E.K., Innovative Technologies for Manufacturing Plant-Based Non-Dairy Alternative Milk and Their Impact on Nutritional, Sensory and Safety Aspects, *Future Foods*, 5, 100098, (2022).
[71]. AYDAR, E.F., TUTUNCU, S., OZCELIK, B., Plant-Based Milk Substitutes: Bioactive Compounds, Conventional and Novel Processes, Bioavailability Studies, and Health Effects, *Journal of Functional Foods*, 70, 103975, (2020).
[72]. BEKIROGLU, H., GOKTAS, H., KARAIBRAHIM, D., BOZKURT, F., SAGDIC, O., Determination of Rheological, Melting and Sensorial Properties and Volatile Compounds of Vegan Ice Cream Produced with Fresh and Dried Walnut Milk, International *Journal of Gastronomy and Food Science*, 28, 100521, (2022).
[73]. MOSS, R., BARKER, S., FALKEISEN, A., GORMAN, M., KNOWLES, S., MCSWEENEY, M.B., An Investigation into Consumer Perception and Attitudes towards Plant-Based Alternatives to Milk, *Food Research International*, 159, 111648, (2022).
[74]. KÜÇÜKGÖZ, K., TRZĄSKOWSKA, M., Nondairy Probiotic Products: Functional Foods That Require More Attention, *Nutrients*, 14, (2022).
[75]. PLAMADA, D., TELEKY, B.E., NEMES, S.A., MITREA, L., SZABO, K., CĂLINOIU, L.F., PASCUTA, M.S., VARVARA, R.A., CIONT, C., MARTĂU, G.A., SIMON, E., BARTA, G., DULF, F.V., VODNAR, D.C., NITESCU, M., Plant-Based Dairy Alternatives-A Future Direction to the Milky Way, *Foods*, 12, 1883, 1–33, (2023).
[76]. SHORT, E.C., KINCHLA, A.J., NOLDEN, A.A., Plant-Based Cheeses: A Systematic Review of Sensory Consumer Acceptance, *Foods*, 10, 1–12, (2021).
[77]. LIM, T.-J., EASA, A.-M., KARIM, A.-A., BHAT, R., LIONG, M.-T., Development of Soy-Based Cream Cheese via the Addition of Microbial Transglutaminase, Soy Protein Isolate and Maltodextrin, *British Food Journal*, 113, 1147–1172, (2011).
[78]. PAUL, A.A., KUMAR, S., KUMAR, V., SHARMA, R., Milk Analog: Plant Based Alternatives to Conventional Milk, Production, Potential and Health Concerns, *Critical Reviews in Food Science and Nutrition*, 60, 3005–3023, (2020).
[79]. CHOI, M.J., SHIN, K.S., Studies on Physical and Sensory Properties of Premium Vanilla Ice Cream Distributed in Korean Market, *Food Science of Animal Resources*, 34, 757–762, (2014).
[80]. MAURICIO-SANDOVAL, E.A., ESPINOZA-ESPINOZA, L.A., RUIZ-FLORES, L.A., VALDIVIEZO-MARCELO, J., MORENO-QUISPE, L.A., CORNELIO-SANTIAGO, H.P., Influence of the Pulp of Mangifera Indica and

Myrciaria Dubia on the Bioactive and Sensory Properties of Ice Cream, *Frontiers in Sustainable Food Systems*, 7, (2023).
[81]. BLOK, A.E., BOLHUIS, D.P., STIEGER, M., Contributions of Viscosity and Friction Properties to Oral and Haptic Texture Perception of Iced Coffees, *Food & Function*, 11, 6446–6457, (2020).
[82]. SAPIGA, V., POLISCHUK, G., BREUS, N., OSMAK, T., Enzymatic Destruction of Protopectin in Vegetable Raw Materials to Increase Its Structuring Ability in Ice Cream, *Ukrainian Food Journal*, 10, 321–332, (2021).
[83]. ABOULFAZLI, F., BABA, A.S., MISRAN, M., Effect of Vegetable Milks on the Physical and Rheological Properties of Ice Cream, *Food Science and Technology Research*, 20, 987–996, (2014).
[84]. KASAPOGLU, M.Z., SAGDIC, O., AVCI, E., TEKIN-CAKMAK, Z.H., KARASU, S., TURKER, R.S., The Potential Use of Cold-Pressed Coconut Oil By-Product as an Alternative Source in the Production of Plant-Based Drink and Plant-Based Low-Fat Ice Cream: The Rheological, Thermal, and Sensory Properties of Plant-Based Ice Cream, *Foods*, 12, 1–16, (2023).
[85]. DINIZ, L.G.T., JESUS, E.P., FRANCISCO, C.T.P., TORMEN, L., BERTAN, L.C., Mixed Water-Soluble Nut-Based Plant Extracts to Produce Vegan Ice Creams, Research, *Society and Development*, 11, e39011729892, (2022).
[86]. MATABURA, V.V., Plant-Based Ice Cream: Processing, Composition and Meltdown Properties Analysis, *Tanzania Journal of Science*, 49, 446–455, (2023).