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Processing techniques of dragon fruit into ice cream and the development of instructional techno-guide

Belly Jane P. Camasura*
Faculty of the Graduate School
Sultan Kudarat State University
Tacurong City, Sultan Kudarat, Philippines
Email: camasurabellyjane@gmail.com

Marites B. Java
Faculty of the Graduate School
Sultan Kudarat State University
Tacurong City, Sultan Kudarat, Philippines

Abstract: This study examined the potential of dragon fruit as a key ingredient in ice cream production, utilizing various processing methods—pureed and powdered forms—while also developing an instructional techno-guide for teaching food processing and preservation. The research aimed to evaluate the sensory qualities of the ice cream (color, odor, taste, texture, and overall acceptability), its nutritional value, and its return on investment. It also assessed the effectiveness of the techno-guide based on content quality, instructional value, technical aspects, and overall usefulness. Using an experimental research design, eight treatments were formulated by varying the amount of dragon fruit while keeping other ingredients constant. Sensory evaluations were conducted by sixty food-specialized teachers and students from Lambayong National High School, selected through purposive sampling. An additional thirty food-specialized teachers evaluated the techno-guide. Data were analyzed using two-way ANOVA to determine significant differences among the treatments and processing techniques. Results showed that Treatment 4, using the pureeing method, received the highest ratings for color, odor, texture, and overall acceptability. Treatment 2, using powdered dragon fruit, was also highly rated, particularly in terms of color, texture, and general acceptability. Significant differences were observed in color, texture, and overall acceptability. Cost analysis revealed that Treatment 4 offered the highest return on investment. Nutritional analysis confirmed the safety and health benefits of the product. Respondents rated the instructional techno-guide as highly effective and suitable for educational use. The study recommends exploring other local fruits for similar applications in future research.

Keywords: Dragon Fruit Ice Cream, Food Processing Techniques, Instructional Techno-Guide Development

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INTRODUCTION

People enjoy eating a lot of food, especially if it is a dessert that has a remarkable taste or improves on the existing products in the market to make it unique. According to Merriam-Webster (n.d.), a dessert is usually a sweet course or dish, like ice cream, served at the end of a meal. Ice cream is a frozen dessert crafted from dairy ingredients like milk and cream, blended with flavorings and fresh fruits. Over time, we have observed and tasted that most ice creams we consume are fruit-flavored, such as mango, strawberry, and other varieties.

Ice cream is one of the most loved desserts by Filipinos, especially kids. In some instances, artificial flavorings and colorings replace natural ingredients, making ice cream a type of junk

food that children enjoy. To promote a healthier alternative, the researcher chose to study the production of nutritious ice cream using powdered and pureed dragon fruit.

In the Philippines, dragon fruit has gained popularity due to its numerous health benefits. Many Filipinos now prefer this fruit not only for its taste but also for its nutritional value. With proper cultivation knowledge and government support, dragon fruit farming has the potential to become a new source of income in various regions of Mindanao. The practice could help boost the economy and improve the livelihood of people, particularly in poor rural areas. (Eusebio & Alaban, 2018)

In addition, developing the dragon fruit into ice cream is also beneficial for the community where dragon fruits thrive. This can be a potential income-generating project. The researcher will present the two techniques for processing and developing ice cream made from dragon fruit and help interested individuals in the locality produce the product. This could provide additional income or become a primary source of income for many families who cultivate dragon fruits on their farms and in their backyards.

The processing techniques used by the researcher are pureeing and powdering. Pureeing is a technique that involves blending or pulverizing ingredients into a smooth, creamy, and often uniform consistency. This can be achieved using various tools and methods, including blenders, food processors, immersion blenders, and even manual mashing. Powdering is a common food processing technique where solid foods or ingredients are ground or crushed into fine particles. It is widely used for extending shelf life, improving storage, and facilitating the use of ingredients in various applications, such as flavorings, thickeners, and dietary supplements.

An instructional video teaching guide will be developed to vividly present the process of making dragon fruit ice cream. The instructional technology guide will be uploaded on an online platform for increased visibility among people who are interested in developing a product and for those in the academic community involved in the delivery of instruction in the field of food and nutrition.

Currently, there are several methods for preserving dragon fruit, and it is also processed into various products such as jam, jellies, energy tea, cookies, wine, and soap (The Manila Times, 2019).

The researcher thought of a healthier ice cream using dragon fruit in order to increase nutritional value and taste and also to minimize the making of commercialized powdered flavorings.

Given the points mentioned above, the researcher believes that this study is both timely and relevant.

Problem statement

This study sought to find out ifdragon fruit can be utilizedinice creamusing pureeing and powdering techniques and determine the acceptability of its developed instructional techno-guide. Specifically, it aims to answer the following questions:

1) What are the sensory qualities of the dragon fruit ice creamusing pureeing and powdering processing techniquesin terms of color, odor, texture, taste; and general acceptability?

2) Is there a significant difference in the sensory qualities of dragon fruit ice cream using pureeing and powdering processing techniquesamong different treatments?

3) What are the qualitative attributes of dragon fruit ice cream using pureeing and powdering processing techniquesin terms of nutrient content, total Sugar, and Vitamin C?

4. What is the return on investment of the developed dragon fruit ice creamusing pureeing and powdering processing techniques?

5. What is the level of acceptability of the developed instructionaltechno-guide in terms of content; instructional qualities, technical Qualities, and over-all quality?

Conceptual framework

In this study, the researcher aims to make people familiar with dragon fruit by developing the fruit into ice cream using pureeing and powdering techniques. Converting dragon fruit into ice cream could help in preventing wastage of this fruit, besides the economic benefits it can give to the farmers in the locality. The development of ice cream out of dragon fruit was applied with different treatments.

The input covers the list and preparation of ingredients, materials, and equipment for easy use and the evaluation tool that was used to find out the product's sensory and instructional techno-guide assessment.

The process involves developing a formulation for ice cream made with dragon fruit, which will come in different treatments by varying the amount of pureed and powdered dragon fruit. This part included the analysis of sensory quality and nutrient content, as well as the computation of its return on investment. The process encompassed the development of the instructional techno-guide. This section concluded the evaluation of the instructional-techno guide.

The dragon fruit ice cream that was developed and the instructional techno-guide in video form served as an output of the study.

LITERATURE REVIEW

Food Processing

Food processing involves converting raw ingredients into finished food products, primarily to extend shelf life, enhance safety, and improve taste. The techniques used in food processing range from basic methods like drying and freezing to more complex ones such as fermentation, canning, and pasteurization. This process helps preserve nutrients, extend food storage, and increase the availability of certain foods. However, the impact offood processing on the nutritional value of the final product should also be considered. Some processing techniques, especially when overused, can lower the levels of vitamins, minerals, and other beneficial compounds, potentially diminishing the health benefits of the food. Research indicates that although food processing offers convenience, there is an increasing focus on maintaining the nutritional value of processed foods to ensure a balance between convenience and health (Tran, 2021).

Pureeing is a key culinary technique that transforms solid foods into a smooth, creamy consistency, offering several advantages. It improves flavor by breaking down ingredients and releasing their natural tastes, resulting in a more intense and refined profile. This method improves texture, allowing chefs to create anything from silky smooth to slightly chunky consistencies to suit specific preferences. In addition, pureeing increases nutrient availability, making food easier to digest and absorb. Its flexibility is evident in its use across various dishes, including soups, sauces, desserts, and baby food ("The Art of Pureeing: Unlocking Flavors and Textures in Cooking" on Kitchen Journal, 2024).

Selecting the right equipment is crucial for successful pureeing. The selection of a blender or food processor should be based on the type and amount of ingredients being processed. High-powered blenders are best suited for creating a smooth, refined texture, while food processors are more effective for producing coarser purees (McGee, 2004).

Powdering is a common food processing technique that reduces food materials into fine particles using techniques such as grinding, milling, or other mechanical processes. This approach enhances various food characteristics, including rehydration, solubility, shelf stability, and ease of integration into different food formulations (Barbosa-Cánovas et al., 2005).

The drying process significantly reduces moisture content while retaining essential nutrients and pigments, supporting the idea that red pitaya puree can be efficiently converted into powder for food product development. Dehydration also retains the vibrant color and antioxidant properties, making powdered red pitaya an attractive natural food colorant (Jamilah et al., 2011).

Various mechanical techniques are applied for powdering food materials, with grinding and milling being the most frequently used, particularly for grains, spices, and dried fruits. For heat-sensitive ingredients, freeze-drying followed by milling is a preferred method, as it helps maintain both nutrients and flavors more productively (Kumar et al., 2014).

A key benefit of powdered food is its extended shelf life. The elimination of moisture inhibits microbial growth and spoilage, making powdered products well-suited for long-term storage (Sablani, 2006).

Although powdered food offers numerous benefits, it also has certain disadvantages. Powders with a high-fat content generally have a shorter shelf life, as the fat can decline over time. However, this concern can be minimized by choosing powders with a fat content below 10%. Moreover, some commercially available powdered foods can be pricey, making them less cheap for budget-conscious consumers (Whittington, 2025).

Powdered varieties of functional foods, including spices, herbs, and dairy products, are used for their health benefits, such as aiding digestion and enhancing nutrient bioavailability. Patil et al. (2014) studied the powdering process of spices like turmeric and ginger, highlighting its role in maintaining active compounds. Their findings revealed that employing precise grinding techniques helps retain the medicinal qualities of these spices.

Ice Cream

The mass production of ice cream began in the 18th century, with its introduction to the United States in 1777. The 19th century saw significant advancements with the invention of mechanical refrigeration, making ice cream more affordable. By the 20th century, industrialization enabled mass production, leading to the rise of major brands like Baskin-Robbins and Häagen-Dazs. Modern innovations, such as plant-based alternatives and nitrogen-frozen varieties, continue to shape the industry, reflecting changing consumer preferences (Smith, 2018).

The first ice cream shop in the United States was introduced located in New York City in 1776.The first to do so were American coloniststo introduce the term "ice cream," which derived from the phrase "iced cream," similar to how "iced tea" was named. Over time, the term was simplified to "ice cream," the name still used today (Bellis, 2020). The soft-serve industry has been progressively moving away from the term "Ice Milk" as it is not an enticing descriptor and has contributed to the misconception that soft-serve is inferior to traditional ice cream. Both ice cream and soft-serve are nutritively complete, containing fat, protein, carbohydrates, minerals, and vitamins. However, soft-serve is often considered aexcellent food option because it contains lower amounts of fat and sugar while being higher in milk solids non-fat, which are almost

entirely protein. Since "Ice Milk" is not a marketable term for this lower-fat product, it has become standard practice to refer to any semi-frozen dairy dessert, regardless of fat content, as "soft ice cream" or simply "soft serve" (Gatchalian & De Guzman, 2000).

Numerous factors contribute to the overall consumer acceptance of ice cream, including its flavor, texture, melting properties, color, packaging, and visual appeal. The first element that captures a consumer’s attention is appearance, whether it be the packaging on store shelves or the presentation of the ice cream when served. If the packaging fails to attract potential buyers, they may ignore the product entirely, preventing them from experiencing its quality.

Color also holds a significantpsychological part in the appeal of food, such as ice cream. In addition, the way ice cream melts can affect consumer perception. While usually a minor detail, adispleasing meltdown can result in a separated consistency, whereas a smooth and creamy melting process improves the product’s visual appeal.

Texture is another critical attribute influenced by multiple factors. If two identical ice cream mixtures undergo different handling processes, leading one to develop a coarser, icier texture, consumers may perceive the smoother sample as having a superior flavor. Since the sensory experience of eating ice cream blends texture and taste, an unappealing texture can negatively impact the perception of flavor.

For years, the industry has sustained that the ideal sweetness level is around 15%, based on consumer desires. This is particularly relevant for fruit-flavored ice creams, as fruit acids tend to suppress observed sweetness, and the added bulk of fruit may dilute the mixture, affecting both texture and body. Expanding sugar levels helps enhance fruit flavors while simultaneously improving the consistency of the ice cream. Recent industry trends lean toward incorporating higher amounts of corn syrup or corn solids and blending sweeteners. While these adjustments help lower production costs, they also upgrade the overall quality of the product, making the changes beneficial beyond just economic reasons (Bruhn, 2017).

Dragon Fruit

Dragon fruitderived from the climbing cactus known as Hylocereus, which thrives in warm climate areasworldwide. The name of the plant is derived from the Greek word"hyle,"which means"woody," and from the Latin term "cereus," meaning "waxen." Externally, the fruits exhibit a vibrant pink or yellow bulbous shape, adorned with green, flame-like spikes. Upon slicing it open, the interior reveals white flesh speckled with edible black seeds. Dragon fruit is available in red- and yellow-skinned varieties. Native to southern Mexico and parts of Central and South America, the cactus was brought to Southeast Asia by the French in the early years 19th century. It is referred to as "pitaya" in Central America and "strawberry pear" in some Asian regions. Today, dragon fruit is widely available across the United States. Its texture is juicy with a mildly sweet flavor, often likened to a blend of kiwi, pear, and watermelon, while its seeds impart a nutty taste (Watson, 2022).

The dragon fruitplant is a vine-like climbing cactus thatthrives in arid regions.Due to its epiphytic nature, it thrives best in soilrich in organic matter. Its flowers, which only bloom at night, have earned it the nicknames “moonflower” and “Lady of the Night.” These large, bell-shaped white flowers, measuring over 30 cm in length, emit a sweet fragrance. The pitahaya plant typically undergoes four to six fruiting cycles annually and can be grown from seeds or propagated through stem cuttings (Wikifarmer, n.d.).

The fruits themselves are striking, with vibrant pink or yellow skin and distinct scales. It comes in oval, elliptical, or pear shapes, with flesh that can be white or red in color, speckled

with edible black seeds similar to those found in kiwis. The taste is mildly sweet, sometimes with a slight tang. Closely related to orchid cacti (epiphyllum), which are known for their large, showy flowers, the pitahaya can also be cross-pollinated with epiphyllum species (Thulaja & Rahman, 2018).

The dragon fruit, also known as pitaya, comes in various varieties that differ in appearance, taste, and nutritional content. These varieties are primarily categorized by their skin and flesh colors.

Hylocereus undatus is the most common variety of dragon fruit. It has pink or red skin with white flesh inside. The flavor is mildly sweet, with a slight tanginess. This variety is rich in vitamin C and fiber but is generally less sweet compared to the others. It is often considered the least sweet of all dragon fruit types.

Hylocereus polyrhizus features pink skin and bright red flesh. Its flavor is sweeter than the white flesh variety, with a slightly more intense taste. The red flesh is packed with antioxidants, especially betalains, that are responsible for the deep red color. It also contains higher levels of vitamin C, making it a great immune booster.

Selenicereus megalanthus has a distinctive yellow skin with white flesh inside. It is generally the sweetest variety of dragon fruit, with a smoother texture. This variety is rich in fiber, vitamins, and antioxidants. Its taste is often described as more pleasant and sugar-like, making it a favorite in desserts and smoothies.

Hylocereus guatemalensis has pink skin and a vibrant purple interior. The flavor is sweet and mildly tangy. Similar to the red-flesh variety, it is rich in antioxidants.This variety is often grown in Central and South America and is known for its rich nutritional profile.

These different types of dragon fruit can be distinguished by their colors, and while they share many common health benefits, they offer varying tastes and textures(Schmidt 2022).

Frey (2022) explains that dragon fruit, also known as pitaya, pitahaya, or strawberry pear, belongs to the Cactaceae family. This vibrant, bulb-shaped fruit is known for its sweet flavor and unique spiky appearance.Its flesh can be either pink or white and is mainly grown in tropical and subtropical regions around the world.Although dragon fruit is popular in Asia and Central America, it is not as commonly eaten in the United States.On the other hand, it offers various health benefits as it is rich in vitamins, fiber, iron, and healthy fats—an uncommon feature in fruits.

Dragon fruit is inherently low in calories, with the majority of its calories derived from carbohydrates. Each 6-ounce serving contains approximately 13 grams of naturally occurring sugars and 5 grams of fiber, which accounts for approximately 18% of the recommended daily intake. Although the fruit has minimal fat, its edible seeds contain beneficial omega-3 and omega-6 fatty acids, along with polyunsaturated fats. Additionally, dragon fruit contains a modest amount of protein, approximately 2 grams per serving, andessential nutrients such as vitamin C, riboflavin, niacin, calcium, iron, and magnesium—contributing to vital biochemical processes in the body. Similar to many other fruits and vegetables, dragon fruit is rich in fiber, vitamins, minerals, and antioxidants that support overall health.

Nutrient Analysis

Nutrient analysis in the laboratory focuses on measuring the nutritional composition of foods, particularly the levels of sugars and vitamin C. To determine total sugar content, methods like high-performance liquid chromatography (HPLC) or enzymatic assays are frequently employed.These methods enable precise measurement of both naturally occurring sugars in

foods like fruits and vegetables, and added sugars introduced during food processing. This analysis helps determine the carbohydrate content and overall nutritional value of food products.

Vitamin C, known for its antioxidant properties and role in immune health, is also frequently measured in food. Iodine titration or HPLC are commonly used methods to assess vitamin C levels. Because vitamin C is vulnerable to light, heat, and oxygen, these tests also provide insight into how the nutrient's stability is affected by food processing and storage.

Laboratory testing of total sugars and vitamin C is essential for nutrition labeling, ensuring food quality, and understanding the relationship between diet and health. This analysis enables manufacturers to meet nutritional standards and helps consumers make informed choices about their sugar and vitamin C intake (Johnson, 2020).

In 1990, the United States government passed the Nutritional Labeling and Education Act (NLEA), revising regulations on nutritional labeling for food products, and making standardized labels mandatory for nearly all food items. This legislation aimed to help consumers make informed dietary choices. Nutritional labels provide details on the total caloric content of food, along with the quantities of total fat, saturated fat, cholesterol, sodium, carbohydrates, dietary fiber, sugars, protein, vitamins, calcium, and iron. Additionally, labels might include nutrient content claims (such as "low fat," "low sodium," "high fiber," or "fat-free"), with specific regulations dictating the required levels of certain nutrients for these claims to apply. The label might also display FDA-approved health claims, such as those linking calcium to bone health or sodium to high blood pressure. The information on these labels serves as a tool for consumers to plan a nutritious diet, avoid overconsumption of harmful components, and encourage the intake of foods that contribute to better health (McClements, 2015).

METHODOLOGY

Research design and treatments

The study adopted an experimental product development research approach using a Completely Randomized Design (CRD) with four treatments under each processing technique (pureeing and powdering), each replicated three times. Data analysis employed Two-Way ANOVA to identify significant differences among treatments.

In the pureeing technique, four treatments were formulated by varying the amount of dragon fruit puree combined with a constant amount of other ingredients: Treatment 1 used 4 cups of puree, Treatment 2 used 3 cups, Treatment 3 used 2 cups, and Treatment 4 used 1 cup, each mixed with four boxes of all-purpose cream and two cans of condensed milk. Similarly, for the powdering technique, four treatments were created: Treatment 1 used 1 cup of dragon fruit powder, Treatment 2 used ¾ cup, Treatment 3 used ½ cup, and Treatment 4 used ⅛ cup, maintaining the same amounts of all-purpose cream and condensed milk. All treatments followed identical procedures for consistency in preparation.

Respondents of the study

The respondents of the study included a total of ninety participants. Sixty respondents evaluated the sensory qualities of the dragon fruit ice cream; these comprised twenty Senior High School students enrolled in the Technical-Vocational-Livelihood (TVL) Home Economics strand, twenty Junior High School students enrolled in Food Processing classes, and twenty teachers specializing in TVL and Technology and Livelihood Education (TLE) from Lambayong National

High School. Thirty additional teachers were tasked to evaluate the instructional techno-guide. The sample sizes aligned with the Central Limit Theorem and best practices in sensory evaluation, requiring a minimum of thirty to sixty respondents for reliability.

Research instruments

Two primary research instruments were used in this study. The Sensory Evaluation Tool used a 7-point hedonic scale to measure the acceptability of the dragon fruit ice cream in terms of color, odor, texture, taste, and overall preference. Another instrument, the Techno-Guide Evaluation Sheet, utilized a 5-point Likert scale to assess the techno-guide's acceptability based on content quality, instructional value, technical aspects, and overall quality. Both instruments were adapted from standard evaluation tools and validated by a panel of experts, thus no additional reliability testing was conducted.

Data gathering procedure

In gathering the data, the researcher first obtained approval from relevant authorities, including the College Dean, Schools Division Superintendent, and School Principal of Lambayong National High School. Following this, the researcher prepared the dragon fruit ice cream using both pureeing and powdering processing techniques, generating eight treatments in total. During data collection, respondents were presented with one treatment at a time to taste, followed by completing an evaluation sheet based on their sensory perceptions. A glass of water was provided between tastings to cleanse the palate. Along with sensory evaluation, data on production costs were gathered to compute the return on investment for each treatment. Respondents also evaluated the developed instructional techno-guide to determine its content quality, instructional value, technical accuracy, and overall usefulness.

Nutrien analysis

Samples of the most acceptable products—one from the pureeing method and one from the powdering method—were submitted to the Department of Science and Technology (DOST XII) for laboratory testing, focusing on vitamin C and total sugar content to verify their nutritional benefits.

DISCUSSION OF FINDINGS

Sensory qualities

The study assessed the sensory qualities of dragon fruit ice cream using pureeing and powdering techniques across various treatments. Data were collected and analyzed to determine significant differences in color, odor, texture, taste, and overall acceptability, as evaluated by respondents.

In terms of color, the descriptive analysis showed that Treatment 4 using the pureeing technique achieved the highest mean rating of 6.37, interpreted as "highly acceptable." Treatments 1, 2, and 3 under pureeing were rated "moderately acceptable," with mean scores of 6.07, 6.10, and 6.05, respectively. For the powdering technique, Treatment 2 received the highest mean score of 6.66, also rated as "highly acceptable," while Treatments 1, 3, and 4 also scored within the "highly acceptable" range. A two-way ANOVA confirmed that processing technique significantly influenced color ($p = 0.000$), and significant differences were found among

treatments ($p = 0.035$) and the interaction between processing technique and treatment ($p = 0.033$). However, the model explained only a small portion of the variance, suggesting other factors may also impact color perception. These results are supported by previous studies, such as Shankar et al. (2010) and AP News (2024), emphasizing the crucial role of color in shaping flavor perception and consumer appeal.

Regarding odor, descriptive analysis indicated that for the pureeing method, Treatment 4 again achieved the highest rating of 6.30, classified as "very much acceptable," while the other treatments were "moderately acceptable." Under the powdering method, Treatments 2, 3, and 4 were all rated "very much acceptable," with Treatment 4 achieving the highest score of 6.28. The ANOVA results revealed significant differences attributed to the processing technique ($p = 0.005$) and among treatments ($p = 0.000$), but no significant interaction between processing method and treatment ($p = 0.249$). These findings align with research emphasizing the importance of olfactory cues in shaping flavor perception, as explored by Herz (2005) and Mennella (2007).

In terms of texture, the sensory evaluation showed that all treatments under pureeing were rated as "moderately acceptable." For the powdering technique, Treatment 2 achieved the highest mean score of 6.63, classified as "very much acceptable," with Treatments 1 and 4 also highly rated. Treatment 3 under powdering obtained the lowest texture rating. The ANOVA analysis showed significant differences due to processing techniques ($p = 0.000$), treatments ($p = 0.000$), and the interaction between technique and treatment ($p = 0.001$), with the model explaining a moderate amount of the variance ($R^2 = 0.126$). These results support prior studies (Sternquist, 2025; Hort, 2001) that highlight how texture, influenced by ingredient composition and fat content, greatly affects food acceptability.

Taste evaluation revealed that Treatment 4 using the pureeing method received the highest mean score of 6.12, while for the powdering method, Treatment 4 also received the highest rating of 6.66, interpreted as "very much acceptable." Other treatments were generally rated as "moderately acceptable." The two-way ANOVA indicated significant differences for processing techniques ($p = 0.000$) and treatments ($p = 0.000$), while the interaction between processing technique and treatment approached significance ($p = 0.057$). Although the model explained a modest variance ($R^2 = 0.110$), these findings align with research by López-Alt (2025) and Singh-Ackbarali and Maharaj (2014), who emphasized that factors like temperature, aroma, and texture significantly influence taste perception.

Finally, in terms of general acceptability, descriptive analysis showed that Treatment 4 under the pureeing method and Treatment 2 under the powdering method were the most preferred by respondents. Treatment 4 using pureeing scored 6.37 ("very much acceptable"), while Treatment 2 using powdering scored 6.66 ("very much acceptable"). Treatments 1, 2, and 3 under pureeing were classified as "moderately acceptable." ANOVA results revealed significant differences for processing technique ($p = 0.000$), treatments ($p = 0.035$), and their interaction ($p = 0.033$), though the model accounted for only a small amount of variance ($R^2 = 0.064$). These outcomes are consistent with previous findings by Mosca et al. (2015) and Fiorentini et al. (2020), who highlighted that food acceptability is influenced not only by sensory attributes but also by consumer needs, preferences, and experiences.

Overall, the findings indicated that both the method of dragon fruit processing and the specific formulation significantly affect the sensory qualities of dragon fruit ice cream. Among the treatments, Treatment 4 for pureeing and Treatment 2 for powdering emerged as the most preferred in terms of color, odor, texture, taste, and general acceptability.

Nutrient analysis

The nutritional analysis of dragon fruit ice cream, prepared using pureeing and powdering techniques, focused on two key parameters: total sugar content and vitamin C content. Based on laboratory testing conducted by the Chemical and Microbial Testing Laboratories of DOST Region XII in Koronadal City, the ice cream produced through the pureeing method contained 11.72% total sugar and 70.92 mg/100g vitamin C. In comparison, the product using the powdering method exhibited a higher total sugar content of 15.55% but a significantly lower vitamin C content of 21.80 mg/100g.

The higher sugar concentration observed in the powdered form can be attributed to moisture loss during the drying process, which concentrates the sugars. Conversely, the notable reduction in vitamin C during powdering is likely due to the degradation caused by heat and air exposure during drying. These findings suggest that while both versions of the product are nutritious and safe for consumption, their nutritional benefits vary depending on the processing technique. The pureed version is more advantageous for vitamin C intake, while the powdered version offers greater stability for long-term storage.

The total sugar content values align with typical ranges found in traditional frozen desserts, as traditional ice creams generally contain 14–20% total sugar, and frozen yogurts range from 12–18% (Marshall et al., 2017). The total sugar measurement was conducted through titrimetric methods, such as Fehling's solution titration or the Lane-Eynon method, which accurately assess reducing sugars (Horwitz & Latimer, 2016). Meanwhile, the vitamin C content in the pureed dragon fruit ice cream, at 70.92 mg/100g, is considerably higher than that typically found in fruit sorbets, which generally retain 10–40 mg/100g depending on the fruit type and processing conditions (Burdurlu et al., 2006). This finding highlights the superior nutritional profile of the pureed dragon fruit ice cream compared to conventional frozen desserts, where vitamin C levels are often negligible due to the absence of fruit-based ingredients (Dairy Research Institute, 2015).

Acceptability of the developed instructional techno-guide

In terms of content, the mean rating of 4.51 of the instructional techno-guide of dragon fruit ice cream is interpreted as excellent. On the other hand, the table further reveals that the content, instructional, technical, and overall qualities of the techno-guide were also excellent with average ratings of 4.51, 4.48, 4.53, and 4.52 respectively.

Generally, the results show that the grand mean rating of the developed instructional techno-guide through video was excellent with a mean of 4.51. It implies that the techno-guide exceeds expected standards and has a very high level of acceptability; hence, it has nothing to revise.

Instructional materials refer to any resources provided to students in both public and private schools, regardless of their format. These materials include but are not limited to, written or visual content, audiovisual resources, and electronic or digital materials, such as those accessible online. Non-printed materials are those that require electronic equipment to be used as learning tools(Law Insider, n.d.)

CONCLUSION

Based on the findings of this study, several conclusions can be drawn. First, the dragon fruit ice cream produced using both pureeing and powdering techniques was found to be highly acceptable in terms of quality. The sensory evaluation revealed a significant difference in the sensory qualities of dragon fruit ice cream across processing techniques and treatments, particularly in terms of color, texture, and general acceptability.

The nutrient analysis further showed that the product is nutritious and safe for consumption, although its nutritional value depends on the processing technique used. The pureed form was found to be more beneficial for vitamin C intake, whereas the powdered form was noted to be more stable for long-term storage. Furthermore, the study suggests that dragon fruit growers and families engaged in dragon fruit cultivation may find value in turning their harvests into ice cream products through pureeing and powdering, providing them with a potential source of income.

Lastly, it was concluded that the developed instructional techno-guide, presented through video format for making dragon fruit ice cream using pureeing and powdering techniques, achieved a very high level of acceptability and can be effectively utilized as instructional material in teaching food preservation.

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