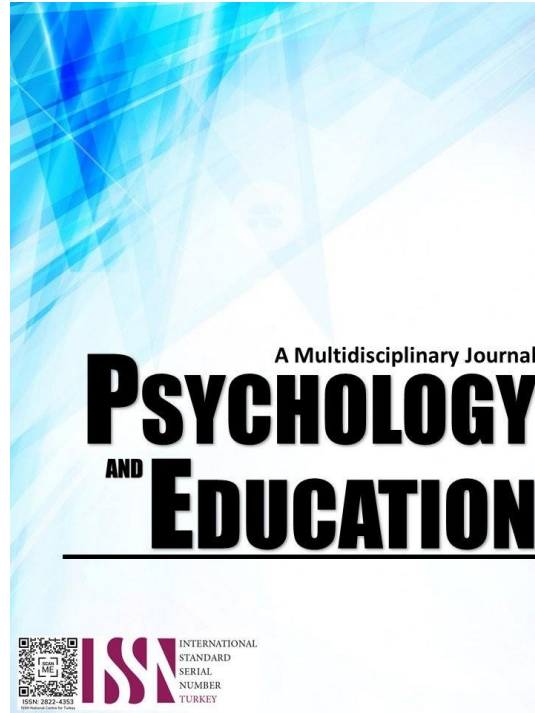


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Exploring the Students' Level of Satisfaction: The Use of Fern Fiddlehead as an Ice Cream Flavor

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Abstract

This research aims to determine the students' level of satisfaction with the use of fern fiddlehead as an ice cream flavor. The researchers used purposive sampling, surveying, and interviewing twenty (20) participants from 2nd and 3rd year HRM students. The study explored their overall experiences, and recommendations for product improvement. In terms of taste, texture, aroma/fragrance, flavor, and appearance/visual presentation, the product received a satisfactory interpretation. The identified positive experiences included similar to matcha, good taste, creamy texture, and unique texture. Conversely, the negative experiences included are not good, rough texture, unpleasant, and unappealing. For recommendations, the participants suggest removing the sour aftertaste, pulverizing the fern, improving the smell, and making it appealing. Overall, the use of fern fiddlehead as an ice cream flavor can represent culinary creativity and be a distinct addition to the world of gourmet dessert.

Keywords: *fern fiddlehead, ice cream, product, students' satisfaction*

Introduction

Ice cream, a popular treat enjoyed by many, provides a refreshing source of enjoyment during the summer months. It offers a wide variety of flavors, affordability and ease of preparation. However, according to Mellor (2023) it is important to note that consuming ice cream can have potential health implications due to its high fat and calorie content. Ice cream is often regarded as an unhealthy indulgence. Furthermore, the significant sugar content in ice cream is a key ingredient in its production. In the Philippines, consuming of ice cream is higher among females than males, as mentioned by Global Food Industry News (2020). Furthermore, children aged up to 15 accounted for the highest consumption of ice cream in 2018, with a 40.9% volume share. Ice cream sales in the Philippines stood at PHP 12 billion (252.7 million USD) in 2018- and are forecasted to rise to PHP 17.1 billion by 2023. In volume terms, the sector is expected to grow from 67.8million kg in 2018 to 88.6m kg by 2023.

A study conducted by Naelga & Estillora (2018) indicates that people nowadays are becoming more health conscious and prefer foods that grown naturally from seeds that have not been genetically modified. Consumers are looking for foods which offer health and nutrition benefits, that is why many researchers nowadays continued innovating food products that provide nourishment in the body. Nutritionally, fiddleheads contain potassium, magnesium, phosphorous, iron, calcium, and many other nutrients.

According to the International Journal of Agricultural Technology (2021) ferns are commonly used not only maintaining biodiversity but also as a source of medicine, food, ornamentals, fiber, bioremediation, and organic material. It is therefore crucial to conduct inventory studies on the various fern species thriving in the province and determine their local utilization to establish a baseline data for future studies. Collected ferns and fern allies are primarily used as food, sold in markets, used in medicine, as needed materials for making handicrafts and valued for their aesthetic qualities.

Taculao (2020) emphasized that ferns are commonly used for ornamental purposes or as feed for livestock. It is a fascinating indigenous plant with versatile culinary uses. Its adaptability to shaded areas near water sources makes it a resilient vegetable. Even without proper farming, the plant can grow and survive. The vegetable can be prepared in traditional ways, from steaming to coconut milk-based dishes, which highlight its culinary flexibility, making it a unique and flavorful addition to local cuisines.

While the culinary industry has witnessed a surge in the popularity of unconventional or exotic ice cream flavors, there remains a notable gap in research pertaining to the utilization of fern fiddlehead as an ice cream flavor. Singh (2018) while some fern is valued for their culinary uses among tribal communities, there is a lack of attention towards the nutraceutical and bioactive potential of ferns in the food industry. This study aims to address this gap by utilizing the fern fiddlehead as flavor in ice cream.

Research Questions

This study aimed to determine the level of satisfaction of students regarding the use of fern fiddlehead as ice cream flavor. Specifically, it sought to answer the following questions:

1. What is the level of satisfaction of students with fern fiddlehead as ice cream flavor, in terms of:
 - 1.1. Taste;
 - 1.2. Texture;
 - 1.3. Aroma/Fragrance;
 - 1.4. Flavor; and
 - 1.5. Appearance/Visual Presentation?

2. What are the overall experiences of the participants with the product?
3. What are the recommendations do the participants have for product improvement?

Literature Review

Fiddlehead Ferns: Nutritional Insights from USDA and Alaska Plant Profiles

According to findings from the United States Department of Agriculture and Alaska Plant profiles by Donald R. Ross, fiddlehead ferns are the young, tender, tightly furled new-growth shoots of fern family plants, typically the ostrich fern. They derive their name from their resemblance to the head of a fiddle.

These ferns boast a unique sweet taste due to their high vitamin C content. For instance, 100g of fresh fronds contain 26.6mg or 44 % of daily-required levels of vitamin C, a moderately potent water-soluble anti-oxidant, along with flavonoid compounds like carotenes, scavenges harmful free radicals, offering protection against cancer, inflammation, and viral illness by (Rudrappa 2024.)

Health Benefits of Fern Fiddlehead

Fern fiddleheads have been recognized for their significant nutritional benefits. Naelga and Estillore (2018) note that fiddleheads also contain carotenoids and ascorbic acid, comparable to other leafy vegetables. Carotenoids, fat-soluble compounds are best absorbed with fat and are beneficial for those people have healthy diet. Ascorbic acid, crucial for treating and preventing vitamin C deficiency, supports antioxidant activity and boosts the immune system's ability to work against diseases. Through their combined effects, these components make the plant notable as a source of good energy.

According to Greeshma et al. (2018), fiddleheads have a high amount of essential omega-3 and omega-6 polyunsaturated fatty acids, with a desirable n-6/n-3 ratio. Omega 3 are typically found in fish. As human being cannot produce them on their own. Therefore, people should seek these nutrients to maintain their health. Omega-3 fatty acids are crucial for the proper functioning of all cells in the body playing a vital role in cell membrane, and supporting interactions between cells. They are particularly concentrated in high levels in cells in the eyes and brain. Fiddleheads from the fern *Diplazium esculentum* contain moderate quantities of proteins, lipids, carbohydrates, minerals, and essential amino acids, making them a potentially nutritious food source for humans (Sridhar & Pavithra 2018). These nutrients are essential for energy production in the human body.

Culinary Uses of Fern Fiddlehead

Singla et al., (2022) state that fern fiddleheads are used as a vegetable in cooking. They can be boiled or steamed and served as a hot vegetable, harvested before they unfurl. In addition to their culinary uses, fiddleheads are recognized for their nutritional potential. Possessing essential amino acids and high protein digestibility, which makes them suitable for human consumption.

Ferns have made significant contributions to the culinary world. This vegetable can be prepared in the simplest ways, yet provides considerable benefits. Ferns are easy to find and grow naturally requiring without proper farming.

Fern fiddlehead have various culinary uses. They are highly flavorful and nutritious, containing antioxidants, iron, potassium, and even omega-3 fatty acid. Their rich and distinctive flavors enhance dishes, allowing for creative experimentation in the kitchen. They can be preserved by pickling to extend their shelf life. Fiddlehead can be paired with omelets and bacon for adventurous basic breakfast options or used to top in pasta, called as fern fiddlehead pasta adding new dimension to the dish. Additionally, ferns are popular in Korean cuisine, since the plant is used in many delicious Korean meals stated by Moulton (2020).

Fern Fiddlehead as Flavor

Peijian (2014) highlighted the potential of fern fiddlehead as a flavouring agent. It is suggested that incorporating fern fiddleheads into dried meat floss could yield a product with a nutritious profile and appealing taste. The presence of dietary fiber from fiddleheads may contribute to a softer texture, reduced fat content, and potential health benefits, such as improved digestion and enhanced human resistance.

People describe the flavor and texture of fern as a blend of asparagus, green beans, spinach, and broccoli stem. Mattison (2023) this plant is not available in all seasons and becomes inedible once it sprouts and unfurls. Ferns can be used in a wide variety of cooking styles beyond sautéing and salads. They are versatile and enhance whether serve on a salad, baked into quiches, sautéed in butter, tossed with pasta, added to pizza, or even tempura battered and deep-fried.

Innovation in ice cream industry

The ice cream industry is continuously evolving, with flavor innovation at its core. As consumer preferences shift towards more unique and exotic tastes, ice cream manufacturers face the challenge of not only creating these new flavors but also ensuring their consistent quality and production efficiency.

As mentioned by Shaunak (2020) modern day ice cream has evolved significantly over 2000 years. On the other hand, efforts are also underway to create even more luxurious ice creams with new inventive flavours. This culinary evolution showcases the intersection of

tradition and experimentation in the world of frozen treats.

In recent years, there has been a notable increase in the demand for innovative ice cream flavors. This trend offers a wide range of options including gourmet creations and globally-inspired tastes, healthier, plant-based alternatives, presenting ample with opportunities for brands willing to experiment.

As the plant-based ice cream market expands with various of flavors and formats, innovation in the space will need to better recreate the taste and texture as stated by Daily (2023). In the growing plant-based ice cream market, replicating the taste and texture of traditional dairy ice cream remains a key challenge for innovation. Balancing flavor complexity and mimicking the creamy texture remains pivotal for the continued success of plant-based alternatives in the ice cream industry.

The plant based ice cream market also inhibits the "biggest gap among plant-based dairy categories...between penetration and the desire for it," as noted by Usmen said. According to Olam Food Ingredients research. Over 50% of consumers expressed willingness that they would be more willing to try plant-based ice cream if more options were readily available,

A study conducted by Naelga et al., (2018) suggested that people nowadays are increasingly health conscious and seek foods grown naturally from seeds that have not been genetically modified. They are looking for foods that offer health and nutrition benefits, which is why many researchers are innovating food products that can give nourishment to the body. From nutritional standpoint, fiddleheads contain potassium, magnesium, phosphorous, iron, calcium, and many other nutrients.

Undoubtedly, while ice cream remains palatable and emotionally satisfying, it proves to be an exceedingly suboptimal choice for health. Laden with high sugar, fat, and calories, ice cream contributes weight gain, compounded by its propensity to be easily over consumed. In contrast, plant-based ice cream offers a commendable alternative. These products not only completely avoid dairy but also often enhanced natural ingredients and reduced caloric density relative to traditional ice cream formulations.

Methodology

Research Design

This study employed descriptive mixed-method design, to assess the level of satisfaction of students regarding the use of fern fiddlehead as an ice cream flavor. Descriptive mixed-method design combines qualitative and quantitative data collection and analysis methods. To provide a comprehensive understanding of a phenomenon (Maggetti 2018).

Respondents

The study included twenty (20) randomly chosen participants from 2nd or 3rd year Hotel and Restaurant Management (HRM) students. Convenience sampling was used, allowing students to voluntarily participate. Out of twenty (20) respondents, seven (7) with (35%) were aged 21 -23 and five (5) with (25%) were age ranges from 21 – 23 and 27- 29, and three (3) with (15) were 24 – 26, indicating that the majority of the group respondents were aged 21 – 23. Fourteen (14) or seventy percent (70%) were male and six (6) or thirty percent (30%) were female.

Purposive sampling was employed, where participants were selected based on specific characteristics required for this study. The participants are chosen from 2nd or 3rd year Hotel and Restaurant Management (HRM) students. In other words, units are selected "on purpose" in purposive sampling. Purposive sampling, also known as judgemental sampling, relies on the researchers' judgement to select individuals, cases or events that can best provide the needed information (Nikolopoulou 2022).

Instrument

Quantitative research instruments are used to gather numerical data for statistical analysis. These instruments include surveys questionnaires and tests. Researchers utilize this instrument to measure variables, and identify pattern. The study used qualitative research instruments to gather descriptive and in-depth information about the research study. These instruments include interviews, observations open-ended survey to explore phenomena, understand experiences and uncover meanings embedded in data.

Procedure

This study outlines the step-by-step methods that researchers follow to create the fern fiddlehead ice cream;

Gather and prepare Nestlé all-purpose cream, condensed milk, and fern, (pako pako).

Cut the needed part of the fern, to obtain the fiddlehead. Wash it thoroughly until the water runs clean.

Boil the fern fiddlehead for five (5) minutes to ensure cleanliness and eliminate any pathogens or food-borne illnesses. Let it rest for another five (5) minutes.

Blend the fern fiddlehead into a fine paste using a food processor.

Place 250 ml of all-purpose cream into a mixing bowl and beat it with an electric mixer until it increase in volume. Gradually, add the condensed milk and continuing to beat until the mixture is well-combined.

Slowly incorporate the blended fern fiddlehead mixture into the mixing bowl. Mix for at least two (2) minutes to ensure thorough blending.

Pour the mixture into a container with a lid and chill in the freezer overnight.

Data Analysis

To analyze the quantitative data, the mean, overall means, and standard deviation were computed using the descriptive statistics. These will provide basic information about variables in data best and highlight potential relationships between variables. Thematic analysis was used to identify recurring themes in qualitative data obtained from participants' interviews, capturing their overall experiences and recommendation on the incorporation of fern fiddlehead as an ice cream flavor.

Ethical Considerations

Ethical considerations were strictly followed throughout the research process to ensure integrity and respect.

Researchers obtained permission from students before conducting a survey.

Participants were informed that the ice cream contained fern fiddlehead (pako pako) a vegetable to check for allergies. Safety precautions, including glove use, hand washing, and wearing hair nets or hijab, were observed during the product-making process.

Study objectives and participants rights emphasized during on orientation session. A consent form outlining confidentiality assurance was provided to participants.

Informed consent was obtained from all participants, ensuring they understood the study's purpose and potential consequences, and freely chose to participate without coercion.

Participants were allowed to respond in either Filipino or English during the interviews.

The interviews were conducted in a respectful manner, free from derogatory or discriminatory language.

Interview schedule were mutually agreed upon to ensure convenience for all participants and researches.

Results and Discussion

This section presents the quantitative and qualitative results derive from the collected data and the students' level of satisfaction on the use of fern fiddlehead as an ice cream flavor. It encompasses data analysis, display, and interpretation guided by the survey questionnaire and research questions.

This chapter contains two (2) parts. The first part consists of the results conducted using survey questionnaire among the respondents. The second part is the gather experiences and recommendation of the participants.

I. The Levels of Satisfaction on the Use of Fern Fiddlehead as an Ice Cream Flavor in terms of Taste, Texture, Aroma, Flavor, and Appearance

Table 1. *Level of Satisfaction in terms of Taste*

	<i>Item</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>Interpretation</i>
1.	The ice cream tastes like the main ingredient, which is the fern.	4.05	0.69	Satisfied
2.	The sweetness level of the fern ice cream is just right.	4.05	0.76	Satisfied
3.	The bitterness of the fern balance the flavor to the ice cream.	3.45	1.00	Moderately Satisfied
4.	The bitterness of the fern adds flavor to the ice cream.	3.55	1.10	Satisfied
5.	The product leaves behind a pleasant aftertaste.	3.95	0.69	Satisfied
Overall Mean		3.81		Satisfied

Legend: 4.50-5.00, Strongly Satisfied; 3.50-4.49, Satisfied; 2.50-3.49, Moderately Satisfied; 1.50-2.49, Dissatisfied; 1.00-1.49, Strongly Dissatisfied

Table 1 shows that the students' level of satisfaction on the use of fern fiddlehead as an ice cream flavor in terms of Taste is Satisfied. This indicates that the majority of the participants likely satisfied on the product with the mean of 3.81 and the standard deviation of 0.19.

As presented in Table 1, Items 1 and 2 received the highest weighted mean of 4.05, interpreted as "satisfied." These items state, "The ice cream tastes like the main ingredient, which is the fern," and "The sweetness level of the fern ice cream is just right." This result implies that fern fiddlehead can be effectively used as a flavor for ice cream.

Moreover, item 3, which states, "the bitterness of the fern balance the flavor to the ice cream" got the lowest mean of 3.45.

Table 2 demonstrates that students are generally satisfied with the use of fern fiddlehead as an ice cream flavor in terms of texture, with an overall mean satisfaction score of 4.15 and standard deviation of 0.13.

Item 2, which states, "The integration of fern into the ice cream results in a seamless blend of flavors," received the highest mean score of 4.45. This indicates that the fern, or pako pako, is well-blended and fully integrated into the ice cream, contributing positively to its texture.

Table 2. *Level of Satisfaction in terms of Texture*

	<i>Item</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>Interpretation</i>
1.	The fern enhances the overall flavor profile of the ice cream.	4.00	0.92	Satisfied
2.	The integration of fern into the ice cream results in a seamless blend of flavors.	4.45	0.60	Satisfied
3.	The product boasts a smooth and creamy texture.	4.15	0.75	Satisfied
4.	The fern ice cream delicately melts in one's mouth, offering a luxurious sensation.	4.05	0.83	Satisfied
5.	The fern ice cream achieves the perfect consistency, neither too soft nor too firm.	4.1	0.91	Satisfied
Overall Mean		4.15		Satisfied

Legend: 4.50-5.00, Strongly Satisfied; 3.50-4.49, Satisfied; 2.50-3.49, Moderately Satisfied; 1.50-2.49, Dissatisfied; 1.00-1.49, Strongly Dissatisfied

However, statement number 4, "The fern ice cream delicately melts in one's mouth, offering a luxurious sensation," received the lowest mean score of 4.05 but was still interpreted as satisfied. This suggests that while the fern ice cream is generally well-received, there is room for improvement in enhancing its melting quality to further elevate the overall luxurious sensation.

Table 3. *Level of Satisfaction in terms of Aroma*

	<i>Item</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>Interpretation</i>
1.	The aroma of the ice cream perfectly complements its flavor.	3.75	0.97	Satisfied
2.	The ice cream emits an inviting and delightful aroma.	3.6	1.14	Satisfied
3.	Despite the fern's bitterness, its scent doesn't transfer to the ice cream.	4.25	0.85	Satisfied
4.	The ice cream's aroma is subtle yet captivating, enticing the senses.	3.7	1.03	Satisfied
5.	The aroma of the ice cream is reminiscent of those found in the market, familiar and desirable.	3.7	0.92	Satisfied
Overall Mean		3.8		Satisfied

Legend: 4.50-5.00, Strongly Satisfied; 3.50-4.49, Satisfied; 2.50-3.49, Moderately Satisfied; 1.50-2.49, Dissatisfied; 1.00-1.49, Strongly Dissatisfied

As presented in Table 3, Item 3, which states, "Despite the fern's bitterness, its scent doesn't transfer to the ice cream," got the highest weighted mean of 4.25, interpreted as "satisfied." This result implies that the fern fiddlehead smell doesn't ruin or transfer the ice cream's aroma or fragrance.

However, statement number 2, "The ice cream emits an inviting and delightful aroma," got the lowest mean of 3.6 but was still interpreted as satisfied. This result implies that the product needs to improve the aroma of the ice cream when it comes to attractiveness to attract potential consumers.

Table 3 shows that students are generally satisfied with the use of fern fiddlehead as an ice cream flavor in terms of aroma, with an overall mean satisfaction score of 3.8 and standard deviation of 0.11.

Table 4. *Level of Satisfaction in terms of Flavor*

	<i>Item</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>Interpretation</i>
1.	Fern Fiddlehead ice cream's unique flavor is appealing and enjoyable.	4.45	0.60	Satisfied
2.	I prefer Fern Fiddlehead ice cream's distinct flavor profile over traditional options.	4.00	0.86	Satisfied
3.	The combination of fern fiddlehead flavor and the ice cream base creates a satisfying taste experience.	4.35	0.59	Satisfied
4.	The herbal and earthy notes of Fern Fiddlehead ice cream make it stand out from other flavors.	4.4	0.60	Satisfied
5.	The balance between sweetness and the subtle bitterness of fern fiddlehead in the ice cream enhances its flavor profile, resulting in a satisfying taste.	4.15	0.67	Satisfied
Overall Mean		4.27		Satisfied

Legend: 4.50-5.00, Strongly Satisfied; 3.50-4.49, Satisfied; 2.50-3.49, Moderately Satisfied; 1.50-2.49, Dissatisfied; 1.00-1.49, Strongly Dissatisfied

Table 4 shows that the students' level of satisfaction with the use of fern fiddlehead as an ice cream flavor is high, with an overall mean score of 4.27 and standard deviation of 0.11, indicating that the majority of participants are satisfied with the product.

Item 1, which states, "Fern Fiddlehead ice cream's unique taste is appealing and enjoyable," received the highest mean score of 4.45, suggesting that the fern ice cream's unique flavor differentiates it from other market options.

Lastly, statement number 5, "The balance between sweetness and the subtle bitterness of fern fiddlehead in the ice cream enhances its flavor profile, resulting in a satisfying taste," received the lowest mean score of 4.15 but was still interpreted as satisfied. This indicates that while the flavor is generally well-received, there is room for improvement in balancing the flavors to enhance overall satisfaction.

Table 5. *Level of Satisfaction in terms of Appearance*

Item	Mean	Standard Deviation	Interpretation
1. The ice cream's appearance is visually desirable and appealing.	4.3	0.73	Satisfied
2. The presentation of the ice cream is both attractive and appetizing.	4.15	0.93	Satisfied
3. The color of the ice cream harmoniously corresponds to its flavor.	4.35	0.67	Satisfied
4. It is neatly presented and visually pleasing.	4.35	0.75	Satisfied
5. The packaging complements the allure of the ice cream.	3.85	0.75	Satisfied
Overall Mean	4.2		Satisfied

Legend: 4.50-5.00, Strongly Satisfied; 3.50-4.49, Satisfied; 2.50-3.49, Moderately Satisfied; 1.50-2.49, Dissatisfied; 1.00-1.49, Strongly Dissatisfied

As presented in Table 1, Items 3 and 4, which state, "The color of the ice cream harmoniously corresponds to its flavor" and "It is neatly presented and visually pleasing," received the highest weighted mean of 4.35, interpreted as "satisfied." This indicates that the ice cream's color aligns well with its flavor, and the overall presentation of the ice cream is inviting.

However, statement number 5, which states, "The packaging complements the allure of the ice cream," received the lowest mean of 3.85 but was still interpreted as satisfied.

Table 5 shows that the students' level of satisfaction with the use of fern fiddlehead as an ice cream flavor is high, with an overall mean score of 4.2 and standard deviation of 0.10, indicating that the majority of participants are satisfied with the product appearance.

II – Experience of the Participants

The research question 1 which is the overall experiences of students on the use of fern fiddlehead as an ice cream flavor. Table 6 is about the experiences, the research question 2 which are the recommendation/s of students for product betterment.

Overall Experiences of Students on the product.

Table 6 showed the themes as well as the responses for the experience of students.

Table 6. *Experiences of Student on the Use of Fern Fiddlehead as an Ice Cream Flavor*

Themes	Contextualized Responses
Similar to Matcha	<ul style="list-style-type: none"> The product has a fresh taste. Similar to matcha ice cream. The fern has an effect similar to that of consuming tea, specifically matcha. The product is a task like matcha.
Good Taste	<ul style="list-style-type: none"> The product has a good taste, but the "pako pako" leaves are still visible. The product is good. This is highly recommended for healthy conscious people. The ice cream tastes good, you can taste it properly. But it does not have the potential to get into the market. It's delicious, and it can apply to the restaurant when serving dessert. The food is good; you achieved the ice cream texture.
Creamy	<ul style="list-style-type: none"> The food is good; you achieved the ice cream texture. I like the creamy texture and how it melts in my mouth.
Unique Texture	<ul style="list-style-type: none"> The texture is different from other ice cream.
Not Good	<ul style="list-style-type: none"> The taste is not good, maybe I am not familiar with the taste of the product..
Rough Texture	<ul style="list-style-type: none"> The "pako pako" leaves are still visible.
Unpleasant	<ul style="list-style-type: none"> The smell is a bit of an ick. It's like sweetened grass with milk.
Unappealing	<ul style="list-style-type: none"> The appearance is not good. It's the number one to be improved.

Based on the themes presented in the table, the overall experiences of the students with the use of fern fiddlehead as an ice cream flavor were positive. Respondents 2, 4, and 12 appreciated the taste of the product; the same was true of the matcha; respondents 5, 6, 10, 13, 14, 16, 18, and 19 found the product to be tasty.

Respondents 1 and 8 generally agreed on the creaminess of the ice cream, and having a unique texture was observed by respondents 7 and 17. Having a mild aroma was appreciated by respondent 17, and respondent 7 saw the product as having the same matcha appearance.

Also, respondent 9 disapproved of the taste of the ice cream. Its rough texture was observed by respondents 2, 3, 5, 6, and 7, and respondent 17 saw the unpleasant aroma of the ice cream. Lastly, respondent 11 points out the appearance of the product as unappealing.



III. Recommendation of the participants on the product.

The recommendations of participants on the product. Table 7 showed the themes as well as the response for recommendations of students for the betterment of the product.

Table 7. *Students Recommendation on the Use of Fern Fiddlehead as an Ice Cream Flavor*

Themes	Contextualized Responses
Sour after taste	• Lower the sourness.
Pulverized the fern	• The vegetable must be pulverized to achieve a smooth texture.
Improved the aroma	• It should have smell like the main ingredient rather than milk.
Make it appetizing	• It needs to be appetizing and needs to add up food color and vanilla extract.

The study findings suggest that there are four (4) main areas for improvement identified by the students: respondent 13 suggests reducing the sour content of the product, and respondents 1, 3, 5, 10, 12, and 20 pulverized the fern fiddlehead to achieve the smooth texture of the ice cream. Respondents 8, 17, and 19 suggested enhancing the product aroma to make a pleasant aroma, and respondents 11 and 18 said to improve the appearance by adding additional flavoring or food coloring to achieve a good appearance. These recommendations aim to balance overall sensory experiences.

I. The level of satisfaction of the students on the fern fiddlehead as an ice cream flavor

Taste

Taste plays a crucial role in the enjoyment and selection of food and it can heavily influence their decision to purchase or continue using a product.

As presented in Table 1, Items 1 and 2 received the highest weighted mean of 4.05, interpreted as "satisfied." These items state, "The ice cream tastes like the main ingredient, which is the fern," and "The sweetness level of the fern ice cream is just right." This result implies that fern fiddlehead can be effectively used as a flavor for ice cream.

Ice cream flavors are critical for consumer satisfaction and enjoyment. Different types of ice creams with distinct flavors have been developed, such as original-flavor ice creams, humulus rice wine-flavored ice creams, and apple-flavor ice creams, each offering unique sensory experiences and health benefits as mentioned by Jen et al. (2016).

Item 4, which states, "The bitterness of the fern adds flavor to the ice cream," received the second highest mean of 3.95. This result shows that the natural taste of fern, which is bitter, does add flavor to the ice cream, making it delicious and suitable for flavor.

According to Tuwani et al. (2020) the balance between bitterness and sweetness is an important aspect of taste perception, influenced by genetic, evolutionary, and environmental factors. Studies have highlighted the evolutionary significance of the human gustatory system's innate attraction to sweet tastes and aversion to bitterness.

On the other hand, item 5, which states, "The product leaves behind a pleasant aftertaste," got the lowest mean of 3.55. This result implies that the use of fern fiddlehead has a pleasant aftertaste that makes the product unique.

Additionally, as stated by Simons et al. (2008) studies on artificial sweeteners have highlighted the importance of understanding consumer sensitivity to aftertastes, with genetic variability playing a role in bitterness sensitivity

In summary, the overall positive ratings suggest that fern fiddlehead is a viable and appealing flavor for ice cream, balancing sweetness and bitterness while providing a unique and pleasant aftertaste.

Texture

Table 2 demonstrates that students are generally satisfied with the use of fern fiddlehead as an ice cream flavor in terms of texture, with an overall mean satisfaction score of 4.15.

Item 2, which states, "The integration of fern into the ice cream results in a seamless blend of flavors," received the highest mean score of 4.45. This indicates that the fern, or pako pako, is well-blended and fully integrated into the ice cream, contributing positively to its texture.

Moreover, the statement "The product boasts a smooth and creamy texture" received the second-highest mean score of 4.15, indicating a very high level of satisfaction. This suggests that the ice cream achieves the desired smoothness and creaminess.

Syed (2018) ice cream is a popular dairy product among consumers of all ages. Textural attributes of ice are the key factors determining the market success of the product. Ice cream is a dairy aerated dessert that is frozen prior to consumption

Item 5, which states, "The fern ice cream achieves the perfect consistency, neither too soft nor too firm," received a mean score of 4.1, the third-highest. This result implies that the ice cream has the appropriate consistency for an enjoyable texture.

When ice cream melts in the tongue, several elements influence the customer experience. The textural characteristics of ice cream, such as viscosity, fat instability, and form retention during melting, determine how it feels during melting according to Amir (2023).

However, statement number 4, "The fern ice cream delicately melts in one's mouth, offering a luxurious sensation," received the lowest mean score of 4.05 but was still interpreted as satisfied. This suggests that while the fern ice cream is generally well-received, there is room for improvement in enhancing its melting quality to further elevate the overall luxurious sensation.

According to Abbas et al. (2018) excessive consumption of luxury ice cream might have a harmful impact on health due to its high sugar and fat content. Ice cream, a popular dairy food, contains components including stabilizers, emulsifiers, sugar, and fat, which, when taken in excess, can contribute to obesity, diabetes, and other health concerns.

Overall, these results indicate that the fern fiddlehead ice cream is well-received in terms of texture, achieving high satisfaction ratings across various aspects of its texture.

Aroma

As presented in Table 3, Item 3, which states, "Despite the fern's bitterness, its scent doesn't transfer to the ice cream," got the highest weighted mean of 4.25, interpreted as "satisfied.". This result implies that the fern fiddlehead smell doesn't ruin or transfer the ice cream's aroma or fragrance.

Non-bitter scents have a considerable impact on consumers' taste perception, palatability, and food consumption. Aromas play an important function in establishing taste sensations even in the absence of a true taste stimulation, enriching the whole experience and raising appetites for specific foods as mentioned by (Eleuch and Koubaa, 2023)

In addition, item 1, which states, "The aroma of the ice cream perfectly complements its flavor," got the second highest mean of 3.75. This result shows that the smell of the ice cream doesn't smell bitter and has a mild aroma that is suitable for ice cream.

On the other hand, items 4 and 5, which state that "the ice cream's aroma is subtle yet captivating, enticing the senses," and "the aroma of the ice cream is reminiscent of those found in the market, familiar and desirable," got the third highest mean of 3.7. This result implies that the use of fern fiddlehead has a pleasant aroma that reminds the participants of the ice cream that exists in the market.

According to David and Simon (2004) aromas have a major impact on customer emotions and behaviors in retail contexts, affecting decision-making and purchase outcomes. Scent is a potent marketing tool that may create sensory experiences, impact consumer associations with brands, and increase profitability.

However, statement number 2, "The ice cream emits an inviting and delightful aroma," got the lowest mean of 3.6 but was still interpreted as satisfied. This result implies that the product needs to improve the aroma of the ice cream when it comes to attractiveness to attract potential consumers.

Flavor

Table 4 shows that the students' level of satisfaction with the use of fern fiddlehead as an ice cream flavor is high, with an overall mean score of 4.27, indicating that the majority of participants are satisfied with the product.

Item 1, which states, "Fern Fiddlehead ice cream's unique flavor is appealing and enjoyable," received the highest mean score of 4.45, suggesting that the fern ice cream's unique flavor differentiates it from other market options.

As stated by Parker (2003) the flavor of ice cream has a considerable impact on consumer perception. According to research, marking the type of flavoring on ice cream influences consumer preferences, with naturally flavored ice cream being favored when labeled as such.

Moreover, statement 4, which states, "The herbal and earthy notes of Fern Fiddlehead ice cream make it stand out from other flavors," received the second-highest mean score of 4.4, interpreted as very satisfied. This implies significant market potential for vegetable-based ice cream flavors.

Item 3, which states, "The combination of fern fiddlehead flavor and the ice cream base creates a satisfying taste experience," received the third-highest mean score of 4.35. The novelty of the fern fiddlehead flavor enhanced the participants' experience. Item 2, which states, "I prefer Fern Fiddlehead ice cream's distinct flavor profile over traditional options," received a mean score of 4.00, indicating that the unique flavor gives the ice cream an edge over traditional options.

The sort of flavoring in ice cream has a considerable impact on consumer perception. Studies have demonstrated that labeling ice cream with certain flavor kinds, such as natural or artificial vanilla, increases customer like and acceptability. Furthermore, distinguishing between 'home-made' and commercial ice creams based on characteristics such as look, aroma, and texture influences consumer preference and product identification. Overall, the distinct flavor profiles of ice creams have a substantial impact on customer perception and liking, emphasizing the relevance of flavor labeling and ingredient choices in the ice cream as said by Parker and Penfield (2005).

Lastly, statement number 5, "The balance between sweetness and the subtle bitterness of fern fiddlehead in the ice cream enhances its flavor profile, resulting in a satisfying taste," received the lowest mean score of 4.15 but was still interpreted as satisfied. This indicates that while the flavor is generally well-received, there is room for improvement in balancing the flavors to enhance overall satisfaction.

Appearance

As presented in Table 1, Items 3 and 4, which state, "The color of the ice cream harmoniously corresponds to its flavor" and "It is neatly presented and visually pleasing," received the highest weighted mean of 4.35, interpreted as "satisfied." This indicates that the ice cream's color aligns well with its flavor, and the overall presentation of the ice cream is inviting.

As mentioned by Phillips (2024) ice cream's color is important since it determines how people perceive its flavor. Various natural colorants are used in ice cream making to improve its visual appeal and create a distinct sensory experience. As the public has become more health conscious and concerned with food supply and quality, ice cream manufacturers have forced to reconsider their production and marketing techniques. For some, this has meant transitioning to more natural ingredients, free of the artificial colors and flavors that many large ice cream manufacturers have relied on for years

In addition, Item 1, which states, "The ice cream's appearance is visually desirable and appealing," received the second-highest mean of 4.3. This result indicates that participants find the presentation of the ice cream pleasing.

Matcha powder is a vibrant dark green in color. In recent years, there has been a growing trend among consumers for foods that are perceived as being more natural. This has led to a corresponding increase in the popularity of natural food colors and clean-label colors, which are added to foods to give them a more appealing appearance. ROHA (2022) offers a brilliant range of exceptional natural food colors and clean-label colors that fully accommodate the requirements of the product at hand. Pink, green, orange or black – natural colors are of utter importance to convey the right look and feel.

On the other hand, Item 2, which states that "the presentation of the ice cream is both attractive and appetizing," received the third-highest mean of 4.15. This suggests that the ice cream visually entices consumers.

However, statement number 5, which states, "The packaging complements the allure of the ice cream," received the lowest mean of 3.85 but was still interpreted as satisfied.

The positive experiences of participants on the product

Similar to Matcha

Matcha flavor has been popular these days, and although some don't like its taste, many find it good and unique.

Based on the combined responses of participants 2, 4, and 12, they said, "I guess the flavor tastes like match. Since the main flavor of ice cream is vegetable, that may be the reason why it has a similar taste to matcha. You can also actually taste malunggay and avocado."

It's bitter in the beginning, but after it settles down, the bitterness fades and you get a smooth, sweet finish. It has an earthy flavour and grassy aroma, but no bitterness compared to black or oolong teas according to Vahdam (2023).

Good Taste

The use of all-purpose cream and condensed milk balanced the bitterness that came from the main flavor of ice cream, which is the fern, or "pako pako." According to the combined responses of participants 5, 6, 10, 13, 14, 16, 18, and 19, they said, "The product actually tastes good. The use of fern fiddlehead or pako pako is not noticeable unless someone seeks to see what flavor is used. The uniqueness of its flavor is good and new."

Unsurprisingly, taste is often the most important factor in customers deciding whether or not they like a product. Fancy labels and ethical claims can only do so much in drawing in and keeping customers – how the product tastes will ultimately be the deciding factor for many consumers, according to Lewis 2022. Sensory pleasures from the taste of foods is a major determinant of food intake: Foods that satisfy the taste may contribute not only to greater eating experience, but also to a sense of satiation and satiety.

Creamy

The use of all-purpose cream and condensed milk helps achieve the right creaminess needed for ice cream. According to the combined responses of participants 1 and 8, they said, "Because of the creaminess of ice cream, it melts on the mouth. When it comes to the desired creaminess of texture, it is achieved."

Ice cream is a beloved treat enjoyed by people of all ages across the globe. Its creamy texture and rich flavor are what make it so irresistible. According to Simpson (2012) creaminess is a popular sensory feature of many fat-containing foods, particularly dairy foods such as ice creams, yoghurts and sauces and has an important influence on consumers' preferences.

Unique texture

The fern, or "pako pako," was not in its smallest form; many find it a problem, but according to the combined responses of participants

7 and 17, “the texture of the ice cream is different from the rest of the usual ice cream on the market. He loves the roughness of its texture.”

Creating unique textural experiences in ice cream products can signal indulgence, a premium experience and decadence for consumers. In Mintel (2019) US Ice Cream and Frozen Treat Report consumers were asked: “Which of the following would encourage you to try a new frozen treat product?” 34% of respondents say that they would like to see new textures in frozen treats.

The negative experiences of the participants on the product.

Taste bad

The use of fern fiddlehead, or “pako pako,” which is unfamiliar to the public, is a disadvantage for ice cream flavor. According to participant 9, “because she is unfamiliar with the main ingredient, the fern fiddlehead, it makes it harder for her to like the taste.” Since the usual taste of ice cream is mostly sweet, it makes the participant assume that the product is mostly sweet.

According to Nunez (2019) taste is one of your basic senses. It helps you evaluate food and drinks so you can determine what’s safe to eat. It also prepares your body to digest food. Bitterness is due to many different molecules. These molecules are usually found in plants. Not all bitterness is bad, though. We can typically tolerate bitterness at low amounts or when they’re combined with other tastes.

Rough Texture

In terms of the product texture, it faces a problem. According to the combined responses of participants 2, 3, 5, 6, 7, and 18, they said that “the used fern fiddlehead was not pulverized or grinded into its smallest form, leading to a rough texture of the ice cream. There is an uneven or bumpy feeling when eating the ice cream.” This judgment led to participants being moderately satisfied with the ice cream..

Ice cream is a popular dairy product among consumers of all ages. Textural attributes of ice are the key factors determining the market success of the product according to Syed (2018). A coarse texture is due to comparatively large particles of frozen water; each ice crystal is sufficiently large that the coarseness is obvious. When extremely coarse, grainy textures are noted, the product is criticized as being icy or spiny.

Unpleasant

The smell of the product plays an important role, since the impression sets how it smells. Sometimes the smell defines its taste. According to the response of participant 17, “it smells like sweetened grass mixed with milk. However, the smell is only noticed when someone seeks to smell it.”

The smell of freshly cut grass is a distinct aroma that often associated with warm weather, outdoor activities, and the onset of spring or summer. Food odors have been shown to influence food choices, portion selection, and can promote a specific desire to consume certain foods (Ferriday and Brunstrom, 2008).

Unappealing

The appearance of the product sets the appetite. According to the response of participant 11, “the product looks unappealing; if there is a part of the product that needs improvement, that would be the appearance.”

The first thing to attract customers is appearance. The appearance of ice cream also includes the ice cream’s color. It has a marked psychological effect on acceptability of foods of all types, and ice cream is no exception. Making our ice creams look delicious, it’s a good start stated by Wang (2015).

Recommendations of participants on the product improvement

Initially, participant 13 suggests removing the sourness that the participant tastes. The ice cream should taste sweet, but the product has a touch of sourness that needs to be removed. The sourness is not ideal for ice cream taste. Since all of us know that ice cream tastes sweet and not sour.

Unsurprisingly, taste is often the most important factor in customers deciding whether or not they like a product. Fancy labels and ethical claims can only do so much in drawing in and keeping customers – how the product tastes will ultimately be the deciding factor for many consumers, according to Lewis 2022. Sensory pleasures from the taste of foods is a major determinant of food intake: Foods that satisfy the taste may contribute not only to greater eating experience, but also to a sense of satiation and satiety.

Additionally, most of the participants faced a problem with the texture of the ice cream. For a better experience of the ice cream, it must have a good texture to maintain consumer interest.

Pulverized the fern, or “pako pako,” so that the ice cream texture would be creamy and wouldn’t have the feeling of eating a vegetable. Since the product is made of vegetables, it is important that the product have a good taste while avoiding a rough texture. Pulverize the fern, or “pako pako,” to avoid roughness.

In fact, these claims are supported by different authors and studies. According to Beckley and Vahalik (2015) lays out a model that categorize people into four different mouth behaviour groups: crunchers, chewers, smoothers, and suckers.

Thirdly, sometimes people try to smell the product before eating. If the smell is not good, it will not set an appetite. Participants 8, 17, and 19 suggested that ice cream should smell like fern, or “pako pako,” but in moderation and make it smell like the main ingredients. Add some vanilla extract or sesame seeds to improve the smell and make it more appealing.

In fact, these claims are supported by different authors. The aroma (smell, odor, fragrance) of food is one of the most important sensory impressions and in most cases determines the choice and acceptance of the product by consumers. (Bothnowska 2018).

Lastly, the appearance of the product does influence a quick judgment about whether it is appealing or not. Participants 11 and 18 suggested that the product should look appetizing to be attractive to potential consumers. Add some artificial coloring to uplift the look and make it look vibrant and pleasurable.

Indeed, this claims are supported by different authors. Visualization of food appearance has become an important factor influencing customer satisfaction which is creating an unforgettable experience when people visit to the restaurant. (Putra et al., 2018).

Conclusions

Based on the findings of the study, the following conclusions are drawn.

The level of satisfaction of students on the use of fern fiddlehead as an ice cream flavor in terms of taste, texture, aroma or fragrance, and appearance or visual presentation are satisfied.

The researchers concluded that the participants have enjoyed the taste of another form of ice cream flavor that made out of vegetable. The main objective of this study is to identify the level of satisfaction of student on the use of fern fiddlehead as an ice cream flavor, the results in survey shows the meeting of the objective.

Overall, the students' level of satisfaction on the use of fern fiddlehead as an ice cream flavor is satisfied or can be another plant-based ice cream flavor to introduce into food industry.

In view of the findings of this study, the following were recommended:

The new flavor of ice cream that made out of vegetable can be great alternative for health-conscious people that want to eat ice cream.

Children who dislike vegetable, the fern ice cream can be an alternative for them to consume since the product is sweet.

Entrepreneurs can explore the business potential of fern fiddlehead ice cream, a unique product that merges culinary innovation with health-conscious consumer trends. This thesis proposes that fern fiddlehead ice cream presents a promising opportunity in the food industry due to its: Unique Selling Proposition and Market Demand.

Nutritionist can use the product as alternative and innovative product within the food industry. This study suggests that fern fiddlehead ice cream presents a unique business opportunity for nutritionists due to its health benefits, and nutritional profile.

For future researchers, they can also further study about the vegetable plant fern or “pako pako” regarding its possible product that can contribute to the food industry.

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