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SENSORY CHARACTERISTICS OF JUTE LEAVES *(Corchorus olitorius)* AND LADY FINGER *(Abelmoschus esculentus)* IN MAKING GELATIN-BASED DESSERT

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ABSTRACT
This experimental research aimed to determine the sensory characteristics of gelatin-based desserts enrich with jute leaves (*Corchorus olitorius*) and lady finger (*Abelmoschus esculentus*). Formulation A utilized young variants, while the Formulation B utilized mature variants of dehydrated Jute and Lady Finger and process into powder. All gelatin-based dessert formulations were evaluated for descriptive sensory characteristics (color, aroma, taste, aftertaste, mouthfeel, and texture) and general acceptability using a line-scale test. The most preferred formulation was also determined using a preference test. Findings revealed that that for the sensory attributes, both formulations were perceived by the panelists to have medium olive-green (Formulation A) and medium dark green (Formulation B) colors. The scores for aroma, aftertaste, mouthfeel, and texture showed that both formulations had a perceptible distinct vegetable odor, has no aftertaste, has a soft mouthfeel, and smooth texture. As for flavor, Formulation A was perceived to have a strongly perceptible distinct vegetable flavor while Formulation B had a perceptible distinct vegetable flavor. Formulation A, which were preferred by 65.3 % of the sensory panelists. this study demonstrates the potential utilization of dehydrated *saluyot* and *okra* in the development of innovative gelatin-based desserts with acceptable properties. Based on the study's findings, Formulation A is recommended to be utilized for further research and future commercialization. This shows the possibility of using underutilized plant materials in the food industry and promoting healthier dessert options in the market.

Keywords: Gelatin-based desserts, Dehydrated jute leaves (Saluyot), Okra (Abelmoschus esculentus), Sensory evaluation, Underutilized plant materials

Introduction

Consumer interest in modifying their diets has increased over the last few years. This puts a pressure on food producers to do research, create new food products, and constantly improve the health advantages of already existing ones. However, it is still unavoidable to consume sweets, processed meals, and sugary drinks, which are frequently laced with salt, fats, or artificial sweeteners that offer low nutritional value. As a result, excessive consumption of these food preparations results to ill health, weight gain, and teeth decay.

Desserts made of gelatin are examples of delicacies that most kids like. It is a carrageenan gel mixed with another gum (Montaño, 2004). This jiggly, sweet material is typically associated with hospital and school trays, but it is also well-liked as a low-calorie treat by dieters. Jelly, on the other hand, is a poor dietary choice because of its high sugar content and low levels of protein and fiber. Jelly is similarly lacking in nutrition, offering essentially no vitamins, minerals, or fiber, despite being low in calories (Rowles, 2017).

It is necessary to include more nutrients and less artificial flavors while creating healthy desserts. As a result, adding readily available vegetables to Filipino delicacies like gelatin-based desserts can be a fantastic source of extra vitamins. Utilizing these raw materials has a significant impact on Philippine agriculture by converting raw materials into items that are not readily perishable sources of additional micronutrients for desserts, this could have a significant influence on the sustainability and security of the food supply in industrialized nations like the Philippines.

The Philippines' agricultural industry could be significantly impacted by using these raw materials by transforming them into products that are not *readily* perishable. *Okra* (*Abelmoschus esculentus*) and *saluyot* (*Corchorus olitorius*) are two commonly farmed raw resources in the nation. Jute, also known as *saluyot*, is a common edible leafy vegetable that grows throughout the tropics and subtropics, from Asia to Africa. It is prized as food and for having a lot of fiber. The leaves of *saluyot* are incredibly nutrient-dense and high in calcium, iron, protein, vitamins A, C, and E, as well as thiamin, riboflavin, niacin, folate, and dietary fiber. Jute is usually cooked as stew, forming a thick, slimy syrup similar in consistency to *okra* and usually taken with rice or another starchy staple (Sakee, 2011). On the other hand, the ladyfinger, commonly known as *okra* in the Philippines, is a warm-season vegetable. It is a good source of minerals, vitamins, antioxidants, and fiber. It also contains a sticky juice that people use to thicken sauces (Ware, 2019).

Jute and ladyfingers can be added to desserts to provide nutrition, but proper research on its processing and acceptability is needed to determine its physico-chemical characteristics and sensory perception among target consumers. A diet rich in vegetables can reduce the risk of health conditions such as obesity, diabetes, and cardiovascular diseases.

It is in this premise that the researcher is motivated to explore ladyfinger and jute as a research experiment, hence this study.

Statement of the Problem

1. What are the sensory characteristics of the jute leaves and ladyfinger gelatin-based dessert in terms of color, aroma, flavor, aftertaste, texture, and mouthfeel?
2. What is the most preferred formulation (MPF) of a gelatin-based dessert?

Research Methods

Research Design

This study employed an experimental research design, with each product formulation replicated three times to strengthen the reliability and validity of the results. A Completely Randomized Block Design (CRBD) was applied in the experimentation to ensure objective comparisons among formulations.

Respondents
The panel of evaluators consisted of seventy-five (75) purposively selected participants. These included Food Technology students from the School of Technology, University of the Philippines Visayas–Miagao Campus, and Home Economics faculty members from Iloilo Science and Technology University–Miagao Campus.

Research Instrument
Data were gathered using a researcher-developed questionnaire incorporating a 15-centimeter line scale to measure descriptive sensory characteristics such as color, aroma, taste, aftertaste, mouthfeel, and texture. The instrument was reviewed and validated by four experts in home economics, food technology, and statistics to ensure content validity.

Data Gathering Procedure
The experimentation was conducted in five phases:
Phase I – Preparation of ingredients, tools, utensils, and equipment.
Phase II – Processing of dehydrated jute leaves and lady finger.
Phase III – Try-out of recipes.

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Phase IV – Standardization of recipes.
Phase V – Sensory evaluation of the finished products.

Data Analysis
The sensory evaluation results were analyzed using frequency and percentage distributions to determine acceptability and consumer preference. Reliability testing was performed using Cronbach's alpha, which yielded an overall coefficient of 0.865, indicating high internal consistency.

Sensory Characteristics of Jute Leaves and Ladyfinger Gelatin-based Dessert

Color. Table 1 presents the sensory characteristics of jute leaves and ladyfinger gelatin-based desserts in terms of color.

Table 1

Sensory Characteristics Formulations A and B of the Gelatin-Based Desserts in Terms of Color

Color	Formulations Young (A)		Mature (B)	
	f	%	F	%
Light green	2	2.7	18	24.0
Green	2	2.7	20	26.7
Medium Dark Green[B]	16	21.3	21	28.0
Medium Olive Green[A]	34	45.3	13	17.3
Olive Green	21	28.0	3	4.0
Total	75	100	75	100

Note: [A,B] denotes the highest results for [A] Formulation A and [B] Formulation B.

As shown in table 1, findings revealed that 45.3% (34/75) of the panelists rated Formulation A as having a medium olive-green color while Formulation B was rated by 28.0% (21/75) to have a medium dark green color. Although almost an equal number of panelists perceived the color of the product to be light green to green. This means that the perceived color of the gelatin-based dessert formulations is caused by the incorporation of the powdered vegetables.

The results imply that the maturity of the raw material incorporated in the gelatin-based dessert play a significant role in the final color of the product.

According to Shewfelt (2014), the darker color of mature vegetables compared to young vegetables can be attributed to several factors. As vegetables mature and ripen, their pigments, such as chlorophyll, carotenoids, and anthocyanins, undergo changes that result in a deeper and more intense coloration, mainly due to the accumulation of these pigments.

Chlorophyll is responsible for the green color in many vegetables, becomes more concentrated in mature plants, giving them a richer hue. The breakdown of cell walls in mature vegetables can also contribute to color changes. This breakdown release pigments that were previously trapped within the cells, further enhancing the overall coloration (Solovchenko et al., 2019). Enzymatic reactions and chemical reactions that occur during ripening can also contribute to color development.

Aroma.
Table 2 presents the sensory characteristics of jute leaves and ladyfinger gelatin-based desserts in terms of Aroma.

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Table 2

Sensory Characteristics Formulations A and B of the Gelatin-Based Desserts in Terms of Aroma

Aroma	Formulations Young (A)		Mature (B)	
	f	%	f	%
Absence	4	5.3	13	17.3
Slight	4	5.3	15	20.0
Moderate	8	10.7	15	20.0
Perceptible [A,B]	30	40.0	24	32.0
Strongly detectable	29	38.7	8	10.7
Total	75	100	75	100

Note: [A,B] denotes the highest results for [A] Formulation A and [B] Formulation B.

As shown, in terms of aroma, Formulation A (young) was evaluated by 30 evaluators (40.0 %) as Perceptible while Formulation B (mature) was evaluated by 24 panel of evaluators (32.0 %) as Perceptible. This means that in terms of aroma, both formulations from young and mature vegetables had detectable aroma. Table 11 presents the sensory characteristics of jute leaves and ladyfinger gelatin-based desserts in terms of aroma.

According to Gramza-Michalowska (2007), the incorporation of the dried vegetables can contribute to the overall aroma of the final product since the typical aroma of a gelatin-based dessert can vary depending on the specific flavor and ingredients used. The findings imply that the aroma of the jute and ladyfinger gelatin-based dessert made up of mature vegetables and of the young vegetables have similar aromas.

Singh (2015) stated that the strength of the aroma in mature vegetables compared to young vegetables can be attributed to few factors. Firstly, as vegetables mature and reach their optimal ripeness, their flavors and aromas tend to become more concentrated and pronounced. This is because as the vegetable matures, its cells undergo changes, and various compounds responsible for the aroma developed and accumulated. These compounds, such as volatile organic compounds (VOCs), are responsible for creating the distinct smells human associate with different vegetables. Secondly, the aging process can also cause certain enzymes within the vegetables to break down complex molecules into simpler ones. These simpler compounds are more volatile and easily evaporate, resulting in a stronger aroma.

Flavor. Table 3 presents the sensory characteristics of jute leaves and ladyfinger gelatin-based desserts in terms of flavor.

Table 3

Sensory Characteristics Formulations A and B of the Gelatin-Based Desserts in Terms of Flavor

Flavor	Formulations Young (A)		Mature (B)	
	f	%	f	%
Absence	2	2.7	6	8.0
Slight	4	5.3	13	17.3
Moderate [B]	9	12.0	20	26.7
Perceptible [A,B]	27	36.0	20	26.7

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Strongly detectable [A]	33	44.0	16	21.3
Total	75	100	75	100

Note: [A,B] denotes the highest results for A Formulation A and B Formulation B

As shown on Table 3, in terms of flavor, Formulation A has a perceptible to strongly detectable flavor while Formulation B was perceived to have a moderate to perceptible flavor intensity. This means that in terms of flavor, the formulation from young vegetables were perceived as strongly palatable in taste.

According to Stevens, vegetables harvested at an early stage of development have lower concentrations of compounds responsible for more pronounced tastes, thus yielding to milder flavors as well. On the other hand, as vegetables progress through their growth cycle and reach maturity, their flavor profiles can become more robust and distinctive. This is attributed to the accumulation of various compounds, including sugars, amino acids, and volatile compounds responsible for characteristic tastes (Schwab et al., 2008). A study by Tallei et al. (2023) also showed that mature leaves of microgreens have a more developed flavor, color, and texture. In addition, traditional or unflavored gelatin typically has a neutral flavor which provides a versatile base, thus gelatin-based desserts can be customized to suit your taste preferences and its flavors are often dependent on the ingredients used.

Aftertaste. Table 4 presents the sensory characteristics of jute leaves and ladyfinger gelatin-based desserts in terms of aftertaste.

Table 4

Sensory Characteristics Formulations A and B of the Gelatin-Based Desserts in Terms of Aftertaste

After taste	Formulations Young (A)		Mature (B)	
	f	%	f	%
Absence [A, B]	33	44.0	19	25.3
Slight	12	16.0	13	17.3
Moderate	10	13.3	12	16.0
Perceptible	14	18.7	18	24.0
Strongly detectable	6	8.0	13	17.3
Total	75	100	75	100

Note: [A,B] denotes the highest results for [A] Formulation A and [B] Formulation B.

As shown on the table 4, in terms of aftertaste, perception of both formulations did not indicate a perceptible aftertaste.

In general, gelatin itself does not have a strong taste and aftertaste, so the flavor may come from the other ingredients such as fruit juices, extracts, or sweeteners (Levy, 2023). In this study, the incorporation of dried vegetables did not leave any aftertaste on the produced gelatin-based dessert.

According to Park (2021), as vegetables mature, several factors contribute to changes in their flavor profile. One key factor is the alteration in the concentration of various compounds, such as sugars, organic acids, and volatile compounds. For instance, as a fruit or vegetable ripens, the sugar content generally increases, resulting in a sweeter taste. This increase in sugar levels can contribute to a more pronounced flavor experience. Furthermore, organic acids, which contribute to the overall acidity or tartness of a vegetable, can change as it matures. The balance between sugars and organic acids is crucial in determining the perceived taste (Kader, 2008). As the vegetable matures, the levels of organic acids may decrease, resulting in a milder or less acidic taste. Volatile compounds, responsible for the aroma and fragrance of vegetables, can also vary during maturity. These compounds, such as

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esters, aldehydes, and alcohols, can add complexity to the flavor profile (Kader, 2008). As a vegetable matures, the levels and composition of these volatile compounds may change, influencing the overall sensory experience, including its aftertaste.

Mouthfeel. As shown on the Table 5 below, panelists perceived Formulation A (24.0%) and Formulation B (44.0%) to possess a soft mouthfeel.

Table 5

Sensory Characteristics Formulations A and B of the Gelatin-Based Desserts in Terms of Mouthfeel

Mouthfeel	Formulations Young (A)		Mature (B)	
	f	%	f	%
Soft [A, B]	18	24.0	33	44.0
Slightly Soft	16	21.3	12	16.0
Slightly Firm	13	17.3	10	13.3
Moderately Firm	14	18.7	14	18.7
Firm	14	18.7	6	8.0
Total	75	100	75	100

Note: [A,B] denotes the highest results for [A] Formulation A and [B] Formulation B

As shown in table 5, the mouthfeel of the Gelatin-based desserts possess a distinctive mouthfeel characterized by a combination of textural attributes. These exhibit a soft and jiggly consistency, owing to the gelatin matrix formed during the gelling process. The gelatin matrix imparts a modest firmness, offering a gentle resistance upon mastication. Upon application of forces, the gelatinous structure yields to the pressure, thereby providing a soft, springy bounce (Whitney, 2022). This resilient quality adds to the tactile pleasure experienced while consuming gelatin-based desserts. Furthermore, the gelatin matrix contributes to a slippery sensation that enhances the overall mouth feel, creating a smooth and gliding sensation across the tongue (Shewfelt, 2014).

Texture. Based on Table 6 shown below, panelists perceived both Formulation A (25.3%) and Formulation B (40.0%) to have a smooth texture.

Table 6

Sensory Characteristics Formulations A and B of the Gelatin-Based Desserts in Terms of Texture

Texture	Formulations Young (A)		Mature (B)	
	f	%	f	%
Smooth [A, B]	19	25.3	30	40.0
Slightly Smooth	17	22.7	16	21.3
Slightly Rough	13	17.3	9	12.0
Moderately Rough	16	21.3	14	18.7
Rough	10	13.3	6	8.0
Total	75	100	75	100

Note: [A,B] denotes the highest results for [A] Formulation A and [B] Formulation B

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As shown in Table 6, the texture of the product was rated "smooth" by 19 respondents (25.3%) for Formulation A and by 30 respondents (40%) for Formulation B.

This means that both formulations were generally perceived as having a desirable mouthfeel, with Formulation B receiving higher preference in terms of smoothness.

This result implies that incorporating powdered vegetables into gelatin-based desserts can enhance their texture, making them creamier and smoother as a result of better blending and reduced particle presence.

Gelatin, a protein derived from collagen, plays a pivotal role in transforming liquid mixtures into semi-solid or solid structures. The gelling process occurs when gelatin molecules, which consist of long chains of amino acids, are dispersed in a liquid medium. Upon heating, these chains unwind and separate, allowing them to dissolve and evenly disperse throughout the liquid. As the mixture begins to cool, the gelatin molecules undergo a process called reassociation. This involves the chains reattaching to one another, forming a three-dimensional network known as a gel (Baguley & McDonald, 2015). A higher gelatin-to-liquid ratio leads to a firmer and more solid gel while decreasing the gelatin concentration results in a softer and more delicate texture. A study by Li et al. (2022) showed similar results when the storage modulus and hardness of all gels formed by gelatin and whey protein isolates increased with the increase in gelatin concentration. Cooling the gelatin-based mixture at refrigeration temperatures forms a solid, bouncy texture, while setting it at room temperature yields a softer and delicate consistency (Yusof, 2019).

Preference Test for Gelatin-based Dessert Formulations

Table 7 presents the findings on the preference test between Formulations A and B of the gelatin-based dessert.

Table 7
Preference Test for Gelatin-Based Dessert Formulations

	Scores	
Formulations	Frequency count (f)	Percentage (%)
Young (A)	49	65.3
Mature (B)	26	34.7
Total	**75**	**100.0**

As shown in the table, Formulation A with powdered young jute leaves and lady fingers, were preferred by 49 or 65.3 % of the panel of evaluators while Formulation B with powdered mature jute leaves and lady fingers, were preferred by 26 or 34.9 % of the panel of evaluators. This indicates that majority of the panel of evaluators preferred the gelatin-based dessert with powdered young jute leaves and lady fingers.

In this preference test, the panel of evaluators were asked to choose their preferred product based on the following attributes: appearance (color), aroma, flavor, after taste, mouth feel and texture. This result implies that the panel of evaluators preferred a gelatin-based dessert with a medium olive-green color, perceptible aroma, perceptible flavor, no aftertaste, soft mouthfeel, and smooth texture, which are characteristics of Formulation A.

The above findings were consistent with the study of Lee et al. (2018) emphasized the importance of these attributes in their study, suggesting that they play a crucial role in shaping consumer perception and choice. By incorporating these attributes into their evaluation criteria, the panel of evaluators in the current study was able to discern preferences between Formulation A and Formulation B effectively. Additionally, the notion that characteristics such as medium olive-green color, perceptible aroma, perceptible flavor, absence of aftertaste, soft mouthfeel, and smooth texture, which were exhibited by Formulation A, are generally favored by consumers in gelatin-based desserts.

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Conclusions

Recommendations

Based on the foregoing conclusions, the following recommendations were advanced:

1. The result of this study should be disseminated to the general public through lectures, seminars, workshops, demonstrations and publications.
2. Jute and ladyfinger vegetable powder should be utilized by homemakers in preparing gelatin-based desserts due to each high fiber content, unique flavors and textures.
3. HE Teachers may be encouraged to incorporate jute leaves and ladyfinger in their laboratory activities, and provide hands-on experience in working with natural and nutritious ingredients.
4. Students should be taught about the health benefits and sustainability of jute leaves and ladyfinger gelatin-based desserts by showcasing their versatility in the kitchen and promoting their nutritional and eco-friendly benefits.
5. Farmers should be encouraged to consider diversifying crop production by cultivating jute leaves and ladyfinger, which can serve as additional revenue streams and contribute to crop rotation practices for soil health.
6. A further study should be conducted by future researchers to validate the results of the present investigation and the shelf-life and packaging of the products.

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