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RESEARCH ARTICLE

EVALUATION OF DIFFERENT SWEETENER ON THE PRODUCTION OF KAMIAS PRUNES

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Abstract

The study focused on the development and evaluation of different sweetener on the production of kamias prunes using white sugar, washed sugar, brown sugar, and molasses, to determine their effects on the product characteristics in terms of taste, texture, aroma, and appearance. The research employed experimental design wherein kamias fruits were processed into prunes using the four different sweetener treatments under the same preparation and processing production. Descriptive evaluation was conducted to assess variations in sensory and physical attributes across treatments. Results revealed that the type of sweetener significantly influenced the characteristics of kamias prunes. The findings indicate that each sweetener contributes distinct sensory qualities, confirming its role in product development. It is concluded that sweetener selection is a critical factor in determining the quality of kamias prunes, and it is recommended that further studies be conducted to optimize formulations for possible commercialization.

Keyword: ***kamias, prunes, sweetner, prunes, food processing, product quality, acceptability***

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INTRODUCTION

Background of the Study

Preservation of fruits through drying and sugaring remains a significant practice in many countries due to its role in extending shelf life of the product, lowering food waste, and enhancing high value product. In the study of Smith and Ahmed, in the Global perspective, the development of fruit-based prunes, preserves, and confections has expanded as consumers increasingly seek natural, functional, and minimally processed foods (Smith J. and Ahmed M, 2020). According to Gosh and Ray (2021), sweeteners play an essential role in the processing of fruit products, related not only to flavor but also to taste, texture, aroma, color, and microbial stability. As markets shift toward healthier and more sustainable options, substitute sweeteners have gained attention for their nutrient content and natural composition.

Molasses, a viscous by-product of sugarcane processing, is widely used in food manufacturing all over the world due to its mineral content, antioxidant properties, and strong flavor profile. In the study of Zhou, et.al., (2021) have shown that molasses can add to the sensory and nutritional qualities of various food products, including baked goods, beverages, and preserved fruits. According to Benneth and Kumar, (2020) compared to refined and semi-refined sugars like brown sugar, molasses many present advantages such as lower cost, higher micronutrient concentrations, and lower glycemic impact (Bennet T. and Kumar A., 2020). These attributes position molasses as a feasible alternative sweetener for product innovation in fruit preservation.

In the Philippines, according to Dizon, et.al., (2019) fruit preservation is a long-standing household and commercial utilization. The country is plenty of indigenous fruits that remain underutilized in commercial manufacturing, including *Averrhoa bilimbi* (kamias). Kamias is known for its intense acidity and high vitamin C content, making it appropriate for processing into prunes, jams, pickles, and candies. Regardless of its availability, kamias remains an underdeveloped raw material in food innovation, largely due to its sourness and short shelf life. In the study of Santos and Maloles, (2020) previous local studies have concentrated on its phytochemical properties and potential applications in food and herbal preparations, but limited research has marked its transformation into value-added products using alternative sweeteners.

In the study Pascual and Villanueva, (2022) brown sugar is typically used in producing sweetened dried fruits however, its rising cost and susceptibility to supply changes underscore the need for other sweeteners. Molasses, which is readily available due to the country's powerful sugarcane industry, presents a sustainable option for product development. Moreover, using molasses supports agricultural by-product utilization and offers possible nutritional advantages for consumers.

In spite of the global and local interest in substitute sweeteners and fruit-based product innovation, there remains a gap in studies examining the development and acceptability of kamias prunes using different types of sweeteners.

Current literature presents that while molasses is increasingly accepted internationally for its nutritional value and potential as a natural sweetener, research on its application in fruit-based dried products remains limited. Most studies examine its use in beverages, baked goods, or syrups, leaving a gap in understanding how sweetener performs in the formulation of preserved fruits such as prunes, particularly in terms of flavor, texture, and sensory acceptability. At the same time, kamias (*Averrhoa bilimbi*), an abundant indigenous fruit in the Philippines, has been studied primarily for its phytochemical properties and medicinal applications rather than for product development. Although kamias is highly suitable for processing due to its acidity and nutritional content, there is a clear lack of research exploring its transformation into value-added, shelf-stable products such as prunes. Furthermore, no existing studies investigate different types of sweeteners in the production of kamias.

Another evident gap is the limited number of sensory evaluation studies in the Philippines that center of attention is on consumer acceptability of newly developed food products using indigenous fruits and nontraditional sweeteners. Local product development efforts often lack structured assessments using standardized sensory procedures, which are necessary to figure out consumer preference and market

readiness. In addition, despite the Philippines' strong sugarcane industry remains underutilized in small-scale and community-level food processing, and its potential to reduce production costs and enhance nutritional value has not been sufficiently investigated. Finally, the marketability of kamias prunes as a commercial product remain unstudied, creating a need to determine consumer acceptance of a sour fruit sweetened. These gaps highlight the importance of developing and evaluating kamias prune products using different sweeteners to support sustainable food innovation, promote the utilization of underused fruits, and strengthen local agro-industrial development.

Thus, this study titled "Evaluation of Different Sweetener on the Production of Kamias Prunes" aimed to develop a kamias prune product formulated with different sweetener and evaluate its sensory acceptability. The findings are expected to contribute to food innovation history, strengthen local product development initiatives, and support the utilization kamias fruits in our locality.

OBJECTIVES OF THE STUDY

This study aimed to evaluate the different sweetener on the production of kamias prunes. Specifically, this study aims to answer the following:

1. What is the observable characteristics of kamias prunes?
2. What is the sensory acceptability of the kamias prune using different sweetener in terms of:
   a. taste
   b. texture
   c. aroma
   d. appearance
   e. overall acceptability
3. What is the most acceptable treatment for the Just-About-Right attributes of kamias prunes?
4. What is the economic analysis of sweetened kamias prunes using different sweetener?
5. What is the market turnover of sweetened kamias prunes?

What is the customer's feedback regarding the product's overall acceptability?

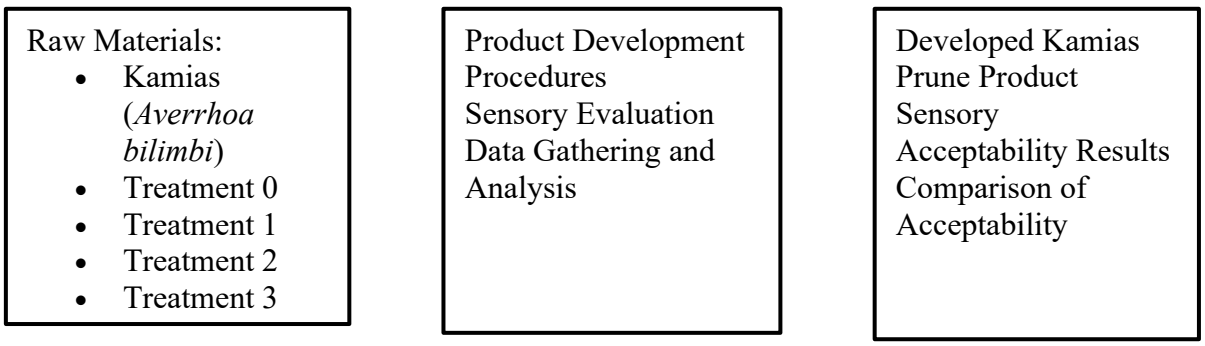
CONCEPTUAL FRAMEWORK

This developed study based on the concept that the type of sweeteners used in the production of kamias prunes significantly influences the product's sensory qualities and level of consumer acceptability. The different sweeteners namely white sugar, washed sugar, brown sugar, and molasses used vary in sweetness level.

These sweeteners expected to influence the sensory attributes and acceptability of the kamias prunes, specifically in terms of taste, texture, aroma, appearance, and general acceptability.

This study also determined which sweetener is most preferred by the respondents for product innovation and local food development.

Research Paradigm



The input of the study consists of the raw materials required for product development of kamias prunes. These include kamias (*Averrhoa bilimbi*), as the main fruit ingredient; using different sweeteners like white sugar, washed sugar, brown sugar, and molasses. The process stage involves procedures to transform the inputs into a ready product kamias prunes in preparing, cleaning, processing kamias, and formulating prune samples. Sensory evaluation is conducted by selected respondents to assess the product's taste, texture, aroma, appearance and overall acceptability. Data gathering and analysis to quantify sensory responses and analyze the statistical differences between the test and control samples. The output of the study shows the results and products derived from the process. These include the developed kamias prune product sweetened, the sensory acceptability results, and the comparison of acceptability between using different treatments.

METHODOLOGY

Research Design

This study engaged in experimental research design focused on product development and sensory evaluation. The design is appropriate because it allows the researcher to develop a product, manipulate the independent variable – different types of sweeteners and systematically measure the dependent variable sensory acceptability.

The study is generally experimental in nature, as it involves the preparation and production of kamias prunes using different sweetener. The research also incorporates a descriptive component through sensory evaluation, where respondents rate the product's attributes including taste, texture, aroma, appearance, and overall acceptability. A Just-About-Right is also used for the kamias prune attributes.

Locale of the Study

The study was conducted at Apayao State College and within the community of Luna. The product preparation and development of the kamias prunes took place in a kitchen facility equipped with the necessary tools for cleaning, processing, drying, and packaging the product. This controlled setting ensures the consistency and quality of the experimental samples.

For the sensory evaluation, the study was utilized a selected group of respondents who are familiar with fruit-based products. The evaluation was conducted in a suitable venue where respondents comfortably assessed the product's sensory attributes, such as taste, texture, aroma, appearance and overall acceptability.

Respondents of the Study

The respondent of this study consists of 45 individuals, divided equally between community experts, ASC employees, and college students to ensure a balanced and credible assessment of the developed kamias prune product.

The first group were 15 experts from the community, composed of individuals with practical experience in food processing, home-based product preparation, local entrepreneurship, or traditional food preservation methods. Their knowledge of locally produced food products and familiarity with kamias-based delicacies contributed very important insights into the acceptability of the product.

The second group were 15 experts from the college setting, specifically faculty members, researchers, and staff with backgrounds in food science, nutrition, or related fields. This group provided scientifically informed evaluations based on established sensory evaluation criteria, product quality standards, and food innovation principles.

The third group were 15 college students, particularly the Bachelor of Science in Hospitality Management students who possessed foundational knowledge in food preparation, taste evaluation, and ingredient functionality. The academic background of these students enabled them to assess the sensory qualities of kamias prunes prepared using different sweeteners.

These three group of respondents assessed the product's sensory attributes, including taste, texture, aroma, appearance and overall acceptability including the Just-About-Right attributes of kamias prunes.

Research Instruments

This study used adopted survey instrument from Emma Ruth Bayogan and Anne Catherine Padilla (2006) in their research study "Quality and Consumer Acceptability of Santol Candy, Kamias and Balimbing Prunes" for sensory evaluation for consumer acceptability tests using hedonic scale. These tools helped gather both numerical ratings and written feedback from the 45 expert respondents.

The Sensory Evaluation Sheet were used by the 45 respondents - 15 experts from the community, 15 from the college employees, and 15 college students. It used the 9-Point Hedonic Scale and Just-About-Right, a common tool for rating food products based on how much the respondents like the samples.

The respondents rated the product acceptability based on taste, texture, aroma, appearance, and overall acceptability. The 9-Point Hedonic Scale includes ratings from 9 (Like Extremely) to 1 (Dislike Extremely), allowing respondents to express their exact level of liking for each attribute.

The 5-point Just-About-right (JAR) scales were used to evaluate intensity relative to an ideal level of the kamias prunes.

This questionnaire helped explain the ratings and provided deeper insights from the respondents.

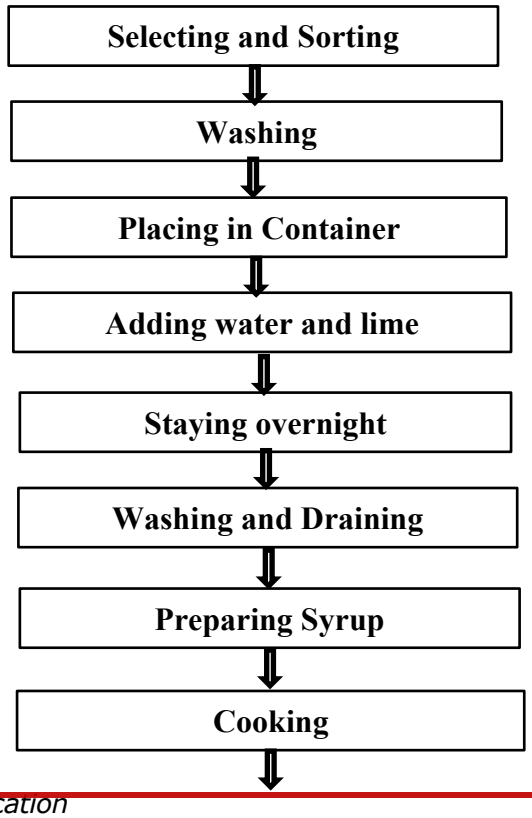
Data Collection Procedure

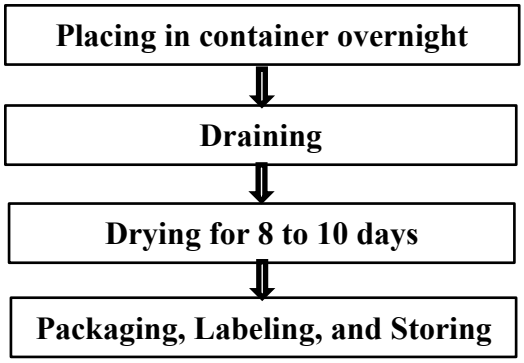
The data collection procedure for this study followed a systematic process to ensure the accurate, reliable, and ethical gathering of information necessary to evaluate the acceptability of the kamias prune product developed using different sweeteners of white sugar, washed sugar, brown sugar, and molasses.

1. Preparation of Raw Materials and Product Formulation

Once the samples were prepared, the researcher ensure standardized taste, texture, aroma, appearance, overall acceptability and packaging for the products. All products were stored properly prior to sensory testing to maintain quality and safety.

Process Flowchart





Procedure:

1. Washing the kamias fruits.
2. Placing in a bucket full of water, add the lime.
3. Staying overnight.
4. Washing and draining the kamias.
5. Cooking the brown sugar with 1 liter water until the brown sugar is melt.
6. Adding the kamias. Again staying overnight.
7. Draining and drying under the sun. Repeating step 6 until 8 to 10 days.
8. Packaging, labeling, and storing.

Treatment 0	Treatment 1	Treatment 2	Treatment 3
1 kilo–white sugar	1 kilo–washed sugar	1 kilo–brown sugar	1 kilo – molasses
1 kilo – kamias	1 kilo – kamias	1 kilo – kamias	1 kilo – kamias
25 grams – lime	25 grams – lime	25 grams – lime	25 grams - lime
25 grams – soy sauce	25 grams – soy sauce	25 grams – soy sauce	25 grams – soy sauce

2. Selection and Orientation of Respondents

A total of 15 community experts, 15 college employees, and 15 BSHM college students were purposively selected based on their experience and familiarity with food evaluation or product development. Respondents were oriented about the purpose of the study, evaluation procedure, the 9-Point Hedonic Scale, Just-About-Right, ethical guidelines, including anonymity and voluntary participation of the respondents.

3. Conduct of Sensory Evaluation

The sensory evaluation was conducted in a clean, well-ventilated, and controlled environment to avoid bias. The treatments were assigned code so that the respondents would not know the actual treatments of the sample product Sample 296 for Treatment 1, Sample 458 for Treatment 2, Sample 731 for Treatment 3, and Sample 842 for Treatment 4, respectively. Evaluations were done individually to prevent influence from other respondents.

Statistical Treatment of Data

The following statistical tools were used to analyze the data gathered from the sensory acceptability evaluation using the 9-point Hedonic Scale:

SCALE	INTERVAL	VERBAL DESCRIPTION
9	8.19 - 9.00	Like Extremely
8	7.29 - 8.18	Like Very Much
7	6.39 – 7.28	Like Moderately
6	5.49 – 6.38	Like Slightly
5	4.59 – 5.48	Neither Like or Dislike
4	2.79 – 3.68	Dislike Slightly
3	2.79 – 3.68	Dislike Moderately
2	1.89 – 2.18	Dislike Very Much

1	1.00 – 1.88	Dislike Extremely

Just-About-Right (JAR) Attribute Intensity using the 5-Point Scales

SCALE	INTERVAL	VERBAL DESCRIPTION
5	4.21 – 5.00	Much too sweet
4	3.41 – 4.20	Slightly too sweet
3	2.61 – 3.40	Just About Right
2	1.81 – 2.60	Slightly not sweet enough
1	1.00 – 1.88	Much not sweet enough

Mean. Scores were computed to analyze the average level of acceptability of the kamias prunes for each sensory attribute (appearance, color, texture, taste, and overall acceptability) for both treatments.

Ethical Considerations

This study adhered to established ethical standards to ensure the protection and rights of all participants involved in the sensory evaluation process. All respondents—comprising 15 from community, 15 from college employees, and 15 college students were provided with clear information regarding the nature, objectives, and procedures of the study. Participation was voluntary, and informed consent was secured before they joined the sensory evaluation. The identity of all the respondents was kept strictly confidential. Respondents were screened to confirm that they had no allergies or sensitivities to the ingredients used in the kamias prune samples. They were participated willingly and without pressure and were assured that their involvement or decision not to participate would not affect their standing in their community or institution. All data collected were used solely for academic and research purposes. The researcher ensures that results were reported honestly, accurately, and objectively. No manipulation of data was done to favor any expected outcome.

RESULTS AND FINDINGS

Table 1. Observable Characteristics of Kamias Prunes

Parameters	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Appearance	Glossy	Golden brown	Brown	Dark
Taste	Sweet	Balanced	Flavorful	Rich
Texture	Firm	Chewy	Soft	Moist
Aroma	Mild	Pleasant	Aromatic	Strong Aroma

Table 1 presents the observable characteristics of kamias prunes using the four different sweeteners, namely: white sugar, washed sugar, brown sugar, and molasses in terms of appearance, taste, texture, and aroma.

Treatment 1 described as glossy in appearance, sweet in taste, firm in texture, and mild in aroma. The appearance may be attributed to the clear syrup produced by white sugar. The sweet taste and mild aroma contributed to the sweetness without altering the natural aroma of kamias.

Treatment 2 were observed golden brown in appearance, balanced in taste, chewy in texture, and pleasant in aroma. The golden-brown color is due to the slightly refined nature of washed sugar. The balanced taste indicates blend of sweetness and natural sourness of kamias. The chewy texture and pleasant aroma suggest improving moisture retention.

Treatment 3 were characterized as brown in appearance, flavorful in taste, soft in texture, and aromatic in terms of smell. The brown color and aromatic may be associated with caramelized components present in brown sugar. The soft texture indicates higher moisture retention, and the flavorful taste enhanced both sweetness.

Treatment 4 were dark in appearance, rich in taste, moist in texture, and strong in aroma. The dark color directly effects the pigmentation of molasses. The rich taste reflects the concentrated sweetness of

molasses. The moist texture may be due to the hygroscopic properties of molasses, while the strong aroma suggests a more scent profile.

Overall, it indicates that different use of sweeteners significantly influenced the physical characteristics of kamias prunes.

In the study of (Kabuo et al., 2024), different sugar treatments used in dried fruits significantly affected their color, aroma, taste, and chewiness. Their study on locally dried fruits revealed that sugar concentration and type influence moisture loss and sensory acceptability, resulting in observable differences in the physical quality of dried fruit products. Fruits treated with sugar solutions showed improved sweetness, texture, and consumer acceptability compared with untreated samples.

According to the study of (Asikin, et al., 2016) found that brown sugar processing methods affect important quality traits such as physical appearance, aroma compounds, and flavorful characteristics. Brown sugar products developed through different drying methods exhibited varying levels of color intensity, aroma, and sweetness due to differences in caramelization and volatile compound formation. The study further explained that brown sugar contains compounds responsible for sweet caramel, roasted, and acidic aroma characteristics, which contribute to richer flavor profiles in food products.

Table 2. Acceptability mean distribution according to taste.

Samples	Mean	Description
Treatment 1	7.05	Like Moderately
Treatment 2	7.49	Like Very Much
Treatment 3	7.85	Like Very Much
Treatment 4	8.30	Like Extremely

Treatment 1 indicates that respondents did not dislike the taste, however, there may be minor development needed to enhance its taste. Sensory research often uses "like moderately" to indicate a satisfactory but not outstanding level of taste appeal.

Treatments 2 and 3 received "like very much" referring that respondents were highly satisfied in terms of taste. Hedonic sensory evaluation studies frequently used this category to identify products with strong consumer appeal (Karbak G. and Bora B., 2020).

Treatment 4 achieved the highest level of taste acceptability, with respondents rating it "like extremely". Product in this category are often considered highly in demand and likely to be chosen by consumers (Huey SL, et al., 2023)

Table 3. Acceptability mean distribution according to texture.

Samples		Mean	Description
Treatment 1		7.60	Like Very Much
Treatment 2		7.58	Like Very Much
Treatment 3		7.60	Like Very Much
Treatment 4		7.86	Like Very Much

The texture of all treatments was "like very much" which shows that the respondents were highly acceptable with the texture of each treatment. It further shows that there were only minimal differences in texture among treatments.

Research on sensory acceptability reinforces that favorable texture ratings are important for consumer satisfaction. Studies using hedonic scales often report textural attributes in terms of liking, where scores "like very much" are interpreted as positive responses toward mouthfeel and consistency of products. These findings demonstrate that texture, as a sensory property, significantly contributes to overall product acceptance, often equal in importance to taste and aroma (Zhang X, et al., 2020).

Table 4. Acceptability mean distribution according to aroma.

Samples	Mean	Description
Treatment 1	7.28	Like Very Much
Treatment 2	7.47	Like Very Much
Treatment 3	7.63	Like Very Much
Treatment 4	8.09	Like Very Much

All treatments in terms of aroma were "like very much" this indicates that respondents were highly acceptable in terms of aroma. It shows that all treatments produced an appealing aroma. Hedonic ratings such as "like very much" indicate that the aroma met the respondent's expectation.

In sensory evaluation, aroma is an important quality attribute because it strongly influences the perception of flavor and overall acceptability. A pleasant aroma creates a positive first impression and increase the likelihood that consumers will enjoy the product.

Based on the 9-point hedonic scale, a rating of "like very much" corresponds to a high level of consumer preference and acceptability. This indicates that the respondents generally found the aroma of all treatments highly pleasant and acceptable. The 9-point hedonic scale is widely used in sensory evaluation because it effectively measures the degree of liking of specific sensory attributes such as aroma (Johnson M., 2021).

Table 5. Acceptability mean distribution according to appearance.

	Mean	Description
Treatment 1	7.77	Like Very Much
Treatment 2	7.74	Like Very Much
Treatment 3	7.74	Like Very Much
Treatment 4	8.07	Like Very Much

In terms of appearance, all treatments "like very much" indicating that respondents were highly accepted. The result shows minimal differences among treatments since all of them obtained the same descriptive rating.

According to sensory evaluation literature, appearance plays a critical role in shaping initial consumer perception and can bias subsequent evaluations of aroma, taste, and texture. Consumers tend to associate visually appealing products with higher quality and better flavor, which can enhance overall acceptability (Zhang X., 2020).

Table 6. Mean distribution according to general acceptability.

	Mean	Description
Treatment 1	7.63	Like Very Much
Treatment 2	7.63	Like Very Much
Treatment 3	7.87	Like Very Much
Treatment 4	8.13	Like Very Much

The general acceptability rated "like very much" in all treatments indicating that all treatments were highly accepted. It shows that all treatments were generally acceptable by the respondents since all obtained the same descriptive rating.

In sensory science, general acceptability is often considered the final indicator of a product's success, as it integrates multiple sensory dimensions into one overarching measure of consumer satisfaction. A high overall acceptability score signifies that respondents not only liked individual attributes but also found the product enjoyable as a whole. Studies in food sensory evaluation show that products rated highly on general acceptability are more likely to be purchased and recommended by consumers, as they satisfy expected quality standards across sensory dimensions (Zhang X., 2020)

Table 7. Just-about-right attributes according to sweetness level.

Samples	Mean	Description
Treatment 1	2.65	Just About Right
Treatment 2	2.81	Just About Right
Treatment 3	3.15	Just About Right
Treatment 4	3.46	Much Too Sweet

Treatments 1, 2, and 3 attributes according to sweetness level are just-about-right. The volume of sweetness of these treatments to be balanced and acceptable. Treatment 4 rated "much too sweet" in terms of sweetness level indicates that respondents perceived the sweetness as higher than preferred.

A Just-About-Right rating follow an optimal balance where sweetness is neither excessive nor insufficient, resulting in greater sensory satisfaction. This result recommend that these treatments achieved appropriate sweetness intensities that matched the sensory anticipation of the respondents. Sensory research implies that products assess as just-about-right for key attributes like sweetness are often perceived as well-proportioned and enjoyable, as they avoid extremes that might detract from general acceptability (Johnson M., 2021).

Table 8. Just-about-right attributes according to sourness level.

	Mean	Description
Treatment 1	2.69	Just About Right
Treatment 2	2.69	Just About Right
Treatment 3	2.83	Just About Right
Treatment 4	2.79	Just About Right

All treatments were rated "just-about-right" in terms of sourness level indicating that the respondents found the sourness of each treatment are well-balanced. This implies consistency across all treatments in terms of sourness.

Research further describe that sensory attributes rated as "Just-About-Right" are firmly associated with higher liking and better overall consumer preference. When consumers perceive an attribute as balanced, they are more likely to rate the product positively and accept it as a whole (Li B., et al., 2014).

Table 9. Just-about-right attributes according to chewiness level.

	Mean	Description
Treatment 1	3.17	Just About Right
Treatment 2	3.21	Just About Right
Treatment 3	3.28	Just About Right
Treatment 4	3.28	Just About Right

All treatments were rated "just-about-right" in terms of chewiness level this shows that respondents found the chewiness of all the treatments perfect. This also means that all treatments neither too hard not too soft.

Chewiness is a significant sensory attribute because it affects the mouthfeel and eating experience of a product. Obtaining a "Just-About-Right rating means that all the treatments achieved the ideal degree of firmness during chewing (Acadofchoc-admin., 2026).

Table 10. Economic analysis of sweetened kamias prunes using different sweetener

Quantity	Description	Price
Treatment 1		
1 kilo	White sugar	₱86.00
1 kilo	Kamias	10.00
2 tsp.	Lime	2.00
2 tsp.	Soy	.50
	Total	**₱98.50**
Treatment 2		
1 kilo	Washed sugar	₱79.00
1 kilo	Kamias	10.00
2 tsp.	Lime	2.00

2 tsp.	Soy	.50
	Total	**₱91.50**
Treatment 3		
1 kilo	Brown sugar	₱76.00
1 kilo	Kamias	10.00
2 tsp.	Lime	2.00
2 tsp.	Soy	.50
	Total	**₱88.50**
Treatment 4		
1 kilo	Molasses	₱75.00
1 kilo	Kamias	10.00
2 tsp.	Lime	2.00
2 tsp.	Soy	.50
	Total	**₱87.50**

For the economic analysis of kamias prunes using different sweetener per treatment. In treatment 1, the total cost of ingredients is ₱98.50, with white sugar as the most expensive component at ₱86.00. This treatment has the highest production cost among all treatments. Economically, this implies that using white sugar may result in lower profit margins.

In treatment 2, the total cost is ₱91.50 which is lower than Treatment 1. The use of washed sugar reduces the cost of sweetener while maintaining similar ingredient composition. This recommends a moderate-cost alternative, offering potential for better profitability compared to white sugar.

For treatment 3, the total cost is ₱88.50, making it more economical than treatment 1 and treatment 2. Brown sugar is cheaper and may also contribute to enhanced flavor and color. This treatment presents a cost-efficient option with feasible added sensory benefits.

For treatment 4, the total cost is ₱87.50, the lowest among all treatments. Molasses is the least expensive sweetener used, making this treatment the most economically favorable in terms of production cost. This suggests the highest potential profit margin.

Overall, it shows that as the cost of sweetener decreases, the total of production cost also decreases. Studies indicates that raw material cost particularly sweeteners significantly affect the total production cost and profitability of food products. For instance, a techno-economic study on sugar-based production revealed that feedstock cost is a major contributor to total production cost, and any increase in sweetener priced directly increases the overall production cost (Salatein NM, et al., 2025).

Table 11. Market turnover and ROI of sweetened kamias prunes per treatment

Treatment	No. of Packs	Selling Price/Pack (₱)	Market Turnover (₱)	Total Cost (₱)	Profit (₱)	ROI (%)
T1 – White Sugar	12	30.00	360.00	98.50	261.50	265.48%
T2 – Washed Sugar	12	30.00	360.00	91.50	268.50	293.44%
T3 – Brown Sugar	12	30.00	360.00	88.50	271.50	306.78%
T4 – Molasses	12	30.00	360.00	87.50	272.50	311.43%
Total	**48**	**—**	**1,440.00**	**—**	**—**	**—**

All the treatments produce the same market turnover (₱360.00), differences in return on investment (ROI) are due to difference in production cost. Treatment 4 (Molasses) yielded the highest ROI (311.43%), indicating the most efficient use of resources, while Treatment 1 (while sugar) has the lowest ROI due to higher cost.

Table 12. Respondent's feedback regarding the product's overall acceptability.

Like most about the product

Taste	Balanced sweet and sour
	Unique and pleasant flavor
Texture	Chewiness/Mouthfeel
	Complementary to taste
Aroma	Pleasant and mild
Overall Acceptability	General liking
	Innovative
Dislike about the product	
Taste	Strong sourness
	Lack of sweetness
Texture	Hard / Difficult to chew
	Sticky texture
Sugar Content	High sweetness
Positive Feedback	Well-developed product
Overall Preference	Sample comparison
Improvement Suggest for the product	
Packaging	Attractive and informative packaging
Taste	Sugar adjustment
Texture	Dryness/Chewiness/Smoothness
Appearance	Logo, label, product size
Innovation	New variants
Overall Sensory Attributes	Taste, texture, aroma
Recommend Kamias Prunes to Others	
Likelihood to Recommend	High willingness to recommend
Nutritional Benefits	Natural, Organic, Vitamins
Taste	Sweet and Sour balance
Market Potential	Dessert, Snack, Commercial Use
Comparison	Comparable to dates

The comments recommend that respondents highly valued the balance of sweetness and sourness, appropriate chewiness, and mild aroma. Treatment 1 and Treatment 2 were the most preferred or favorite. The product's unique flavor and innovative use of kamias fruit also contributed to overall acceptability.

In the texture issues, most negative comments relate to hardness or chewability, especially for Treatment 3 and Treatment 4. A few noted stickiness, which may influence some consumer's preference. As to taste or flavor concerns, some respondents noted strong sourness in certain samples or insufficient sweetness in Treatment 3. In Treatment 2 was noted for having the best balance of sweet and sour. For sugar content, one respondent mentioned high sugar, suggesting potential for adjustment depending on target consumers. For overall, while a few issues were noted, some respondents did not report any negative understanding, indicating that the product is largely acceptable but could benefit from minor adjustments in texture and taste balance.

For packaging improvements, most respondents give priority to the need for attractive, protective, and informative packaging, including logos, labels, and nutrient and shelf-life information. Taste adjustments, some respondents suggested balancing sweetness by either increasing or decreasing sugar depending on the sample treatment. Texture comments indicate a preference for more dried, smooth, and not overly chewy products. Appearance including kamias size and presentation, is significant for consumer's acceptability. Innovation, a few suggestions included developing new product variants, referring market expansion opportunities. Overall sensory quality, respondents suggested improvements should continue the balance of taste, texture, and aroma.

Strong recommendation nearly all respondents expressed willingness to recommend the product to others, indicating high overall acceptability. Health benefits recognized, the product is valued for being natural, organic, and vitamin-rich, which adds to its appeal. In taste, balanced sweet-sour flavor and acceptable texture were repeatedly mentioned as reasons for recommending product. Commercial or snack potential, respondents

suggested the product could be sold as a dessert or snack. Comparison to familiar product, some respondents compared it to dates, suggesting familiarity helps acceptance.

SUMMARY OF FINDINGS, CONCLUTIONS, AND RECOMMENDATIONS

Findings

1. The different sweeteners significantly influenced the observable characteristics of kamias prunes in terms of appearance, taste, texture, and aroma, resulting in distinct product qualities for each treatment.
2. All treatments were rated "Like Very Much" in terms of aroma, texture, appearance, and general acceptability, referring that the respondents were highly satisfied with the sensory qualities of kamias prunes.
3. In terms of taste, the treatments received varying levels of acceptability. Treatment 1 was rated "Like Moderately," Treatments 2 and 3 were rated "Like Very Much," and Treatment 4 was rated "Like Extremely." This indicates that Treatment 4 had the highest level of taste acceptability among the treatments.
4. For the Just-About-Right (JAR) evaluation of sweetness, Treatments 1, 2, and 3 were rated "Just-About-Right," while Treatment 4 was rated "Much Too Sweet," suggesting that the sweetness level of Treatment 4 exceeded the preferred level of the respondents.
5. In terms of chewiness, all treatments were rated "Just-About-Right," indicating that the products had a perfect level of chewiness that matched the preference of the respondents.
6. Overall, the treatments were found to be highly acceptable in most sensory attributes, with only slight difference in taste and sweetness levels.
7. The economic analysis revealed that Treatment 4 was the most cost-e4fficient with the lowest production cost of ₱87.50, indicating the highest potential profitability, while Treatment 1 had the highest cost at ₱98.50, making it the least economical option.
8. All treatments generated the same market turnover of ₱360.00, but differed in return on investment due to variations in production cost, with Treatment 4 obtaining the highest return on investment of ₱311.43 as the most cost-efficient, while Treatment 1 recorded the lowest return on investment because of its higher production cost.
9. Respondents highly valued the kamias prunes for their balanced sweet-sour taste, appropriate chewiness, mild aroma, and overall innovative appeal, with Treatments 1 and 2 being the most preferred due to better sensory balance. Although minor issues such as hardness, stickiness, and sweetness imbalance were noted in some treatments, the product was generally considered acceptable and highly recommended for its health benefits and strong potential as a marketable snack.

Conclusions

The findings of the study revealed that the type of sweetener used plays a significant role in determining the overall physical quality of kamias prunes, influencing important product characteristics such as texture, appearance, and sweetness balance. The kamias prune products were generally well accepted by the respondents based on the evaluated sensory attributes, indicating favorable consumer perception of the developed products. Results further showed that the kamias prune treatments demonstrated acceptable sensory qualities in terms of aroma, texture, appearance, chewiness, and overall acceptability across all formulations. Although Treatment 4 emerged as the most preferred in terms of taste, respondents perceived its sweetness level to be relatively high, whereas Treatments 1, 2, and 3 achieved a more desirable sweetness balance. Moreover, all treatments met the preferred chewiness level, suggesting that kamias prunes possess strong potential for consumer acceptance when sweetness is appropriately optimized. In terms of economic viability, Treatment 4 proved to be the most cost-efficient formulation, having the lowest

production cost and the highest return on investment, while Treatment 1 was identified as the least cost-efficient despite all treatments generating equal market turnover. Regarding sensory acceptability, all treatments were generally acceptable, with Treatments 1 and 2 being the most preferred due to their balanced sweetness, sourness, and texture. Overall, the results indicate that kamias prunes have strong potential for commercialization, particularly when the type of sweetener and product formulation are carefully optimized to enhance both sensory quality and economic efficiency.

Recommendations

1. The appropriate sweeteners should be selected on desired product attributes and that further studies be conducted to optimize processing conditions and assess consumer acceptability for potential commercialization.
2. Reduce the sweetness level of Treatment 4 to improve its Just-About-Right rating maintaining its highly preferred taste.
3. Maintain the chewiness level of all treatments since the respondents found it to be ideal.
4. Maintain the aroma, appearance, and texture of the treatments because these attributes contributed positively to the overall acceptability of the kamias prunes.
5. Improve the taste of Treatment 1 to increase its acceptability from "Like Moderately" to a higher level of preference.
6. It is recommended that molasses be utilized as the primary sweetener in kamias prune production due to its lower production cost and higher return on investment, ensuring better economic efficiency for small-scale or commercial production.
7. Product formulation should be further optimized in terms of sweetness, sourness, and texture, particularly for treatments with higher acceptability to enhance consumer satisfaction and consistency of product quality.
8. The developed kamis prunes be considered for commercialization or livelihood products, with improvements in processing and packaging to strengthen market appeal and support sustainable enterprise development.
9. Conduct further studies with a larger number of respondents to validate the findings and determine whether similar results will be obtained in the different consumer groups.

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