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FORMULATION, ANALYSES AND ACCEPTABILITY OF FRUIT SOURING PASTE

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Abstract: Food innovation has always played a crucial role in human development, providing solutions to enhance flavor, prolong shelf life, and reduce food waste. This study explored the use of cucumber tree, batuan, and green mango as alternative souring agents in *sinigang*, aiming to reduce food waste and promote culinary innovation. It focused on evaluating the sensory qualities, such as appearance, aroma, sourness, and texture, and the overall acceptability of fruit pastes derived from these indigenous ingredients.Using an experimental-developmental research design, this employed a Completely Randomized Design (CRD) with three replications. Sensory data were gathered from 110 evaluators using the 9-Point Hedonic Scale, with results analyzed through arithmetic mean and ANOVA. The result revealed that all three pastes received favorable evaluations. Cucumber tree paste was rated very much appealing and extremely sour, while batuan paste was described similarly but with slightly less sourness. Green mango paste received the highest overall ratings for all attributes. In terms of consumer acceptability, evaluators showed strong preference across all samples, with green mango paste being the most liked followed by batuan paste and lastly, the cucumber tree paste. Statistical analysis indicated significant differences in appearance and aroma among the treatments, but no notable differences in sourness and texture. Consumer acceptability showed significant differences in appearance only. These results supported the potential of cucumber tree, batuan, and green mango as viable, natural souring agents. Among the three, green mango paste was selected for further testing. Microbial and proximate analyses confirmed its safety, nutritional value, and potential for longer shelf life, reinforcing its suitability for commercialization and use in sustainable food product development.

Keywords: Fruit Souring Paste, Microbial and Proximate Analyses, Cucumber Tree, Batuan, Green Mango

I. INTRODUCTION

Food innovation has always played a crucial role in human development, providing solutions to enhance flavor, prolong shelf life, and reduce food waste. In tropical regions like the Philippines, a variety of seasonal fruits are often underutilized despite their rich flavors and nutritional benefits. Among these are cucumber tree (*Averrhoa bilimbi*), batuan (*Garcinia binucao*), and green mango (*Mangifera indica*). Traditionally, these fruits serve as souring agents in dishes, such as *sinigang* and *paksiw*, but their potential in processed forms, particularly as pastes, remains largely unexplored. Cucumber tree, commonly known as *kamias*, is rich in vitamin C and has been traditionally used for souring soups, as well as in pickles and jams (Torres, 2019).

Juanda et al. (2023) investigated the sensory characteristics of cucumber tree jam, demonstrating that attributes, like color, aroma, taste, and texture, significantly influence consumer preferences. This insight is particularly relevant for cucumber tree-based pastes, where optimizing these sensory factors could improve market acceptance and popularity. According to Dinakaran et al. (2022), cucumber tree is rich in ascorbic acid and essential minerals, making it a highly nutritious option for consumers seeking healthy food alternatives. As an alternative paste, cucumber tree's nutritional profile could provide a health-conscious option for those looking to improve their diet, increasing its potential to be a popular product in the health food market. Incorporating these nutritional benefits into cucumber tree-based products could significantly contribute to the growing demand for functional food ingredients.

Batuan, a regional delicacy in Visayas and Mindanao, is highly regarded for its unique balance of tanginess and subtle sweetness. Green mango, prized for its tartness, is a versatile fruit with broad culinary applications. Their high acidity and natural flavor profiles make these fruits promising candidates for innovative food processing techniques, including the production of alternative pastes (Fernandez et al., 2021).

The Negrense Volunteers for Change Foundation (2024) showcased batuan as a symbol of sustainable agricultural practices and cultural preservation. Through their initiative to process batuan into powder and paste, they created

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livelihoods for local farmers while expanding its market reach. The production of batuan as an alternative paste not only supports rural economies but also reinforces its significance as a heritage ingredient. This effort illustrates the impact of combining tradition with innovation in food systems. Ping et al. (2018) stressed that sensory attributes, such as taste, texture, and aroma, play a vital role in consumer acceptance of food products. Using Quantitative Descriptive Analysis (QDA), they assessed flavor intensity, texture, and overall acceptability. Their findings suggest that sensory evaluation tools are essential in refining product formulations, particularly in introducing batuan paste as an alternative ingredient in the market.

The acceptability of green mango paste is gaining attention, particularly in terms of consumer preferences and market trends. Green mangoes, renowned for their rich flavor and diverse varieties, play a crucial role in the global fruit market. Kiloes et al. (2021) emphasized that sensory attributes, such as taste, aroma, and texture are fundamental to consumer acceptance. Retaining the natural sweetness and aroma of fresh mangoes enhances marketability and fosters brand loyalty, ensuring a competitive edge for green mango paste globally.

Fruit pastes are concentrated forms of fruit used as condiments and flavor enhancers. They are valued for their convenience, extended shelf life, and intensified taste. However, the acceptability of fruit pastes depends on factors such as appearance, aroma, sourness, and texture. Consumer perception is a pivotal factor in determining the commercial viability of such products. While cucumber tree, batuan, and green mango are widely used in traditional culinary practices as natural souring agents, limited research exists on their potential in paste formulations. These fruits offer distinct sourness, flavor, and nutritional benefits, making them ideal candidates for innovative food products. However, the lack of comprehensive studies on the optimal formulation of pastes, incorporating these ingredients presents a challenge. Determining the right ratios to achieve desirable sensory characteristics is essential in ensuring the success of these products in the market.

This study focused on the acceptability of a paste derived from cucumber tree, batuan, and green mango, aiming to introduce a novel product that highlights local ingredients while catering to the modern palate. By evaluating consumer preferences and perceptions, the research sought to provide valuable insights into the potential marketability of these alternative pastes. Promoting the utilization of these fruits aligned with sustainability efforts by reducing food wastage and maximizing the agricultural value of indigenous fruits. As food innovation continues to evolve, the development of natural, versatile, and culturally relevant products would play a key role in shaping the future of the food industry.

Generally, the objective of this study was to develop and find out the formulation, analyses, and acceptability of paste using cucumber tree, batuan, and green mango. Specifically, it aimed to:determine the sensory qualities of the fruit souring paste in terms of appearance, aroma, sourness, and texture; determine the sensory qualities of the fruit souring paste in terms of appearance, aroma, sourness, and texture when applied to sour fish soup “fish *sinigang*”; determine the general acceptability of the fruit souring paste in terms of appearance, aroma, sourness, and texture when applied to sour fish soup “fish *sinigang*”; determine if there is a significant difference in the sensory qualities of the fruit souring paste, considering the different treatments; determine if there is a significant difference in the general acceptability of fruit souring paste when applied to when applied to sour fish soup “fish *sinigang*”, considering the different treatments; determine the shelf life of the fruit souring paste in room and chilling temperatures; and submit the best product for microbial test and proximate analysis.

II. METHODOLOGY

Methods of Research

This study used the experimental-developmental method. According to Llego, 2017), it is a research approach that involves the creation or improvement of a product or process through systematic experimentation and iterative development. It integrates experimental procedures to test hypotheses and developmental techniques to refine outcomes based on findings. In the developmental research, the product developed was the paste from cucumber tree, batuan, and green mango, which composed of three treatments to find out the appearance, aroma, sourness and texture of the paste.

Research Design

The study employed a Completely Randomized Design (CRD) to evaluate the sensory qualities of three different fruit souring pastes. The experimentation consisted of three treatments: Treatment A (cucumber tree paste), Treatment B (batuan paste), and Treatment C (green mango paste). Each paste was assessed based on five sensory attributes: appearance, aroma, sourness, texture, and overall acceptability, using standardized evaluation procedures. This design

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ensured that each treatment had an equal chance of being assigned, minimizing bias and allowing for an objective comparison of the sensory characteristics across the three fruit-based pastes.

Materials, Tools and Equipment

The materials, tools, and equipment used in this study were the following: one gas stove; one blender; three bowls; one chopping board; three glass jars; one knife; one ladle; one measuring glass; one pan; three spoons; one rubber scraper; and one weighing scale.

Treatments Used in the Study

The experiment was carried out in three treatments with the same amount of cucumber tree, batuan, and green mango with 250 grams, 250 ml of water, and 2.5 grams of salt. The treatments were as follows: Treatment A (cucumber tree paste), Treatment B (batuan paste), and Treatment C (green mango paste). To obtain the desired result and product, the process of experimental trial and error was done.

The purpose of the treatments in this study was to find out the formulation, analyses, and acceptability of fruit souring paste from cucumber tree, batuan, and green mango. This study followed a developmental approach to achieve the desired result for the products.

Table 1. Proportion of ingredients used in making cucumber tree, batuan and green mango paste.

Ingredients	Treatment A	Treatment B	Treatment B
Cucumber tree	250g	-	-
Batuan	-	250g	-
Green mango	-	-	250g
Water	250ml	250ml	250ml
Salt	2.5g	2.5g	2.5g

Experimental Procedure

Procedures in Making Cucumber Tree, Batuan, and Green Mango Paste

In making cucumber tree, batuan, and green mango paste, the fruits were selected and sorted for quality to avoid contamination. Then, the fruits were washed and drained separately. Afterwards, all the fruits were weighed. Subsequently, the fruits were cut and transferred to the blender. Next, the fruits were blended. Then, the fruit purees were transferred in a pan. After that, the fruit purees were cooked to make a paste. Finally, the paste was set aside to cool down and ready for packaging.

Collection of Data

The instrument used in this study was an evaluation sheet. It dealt with the quality attributes of the product, as evaluated by experts in each sensory qualities of the cucumber tree, batuan, and green mango paste in terms of appearance, aroma, sourness, and texture, while the general acceptability of the finished product, considering the different treatments when applied to sour fish soup "fish *sinigang"*, was evaluated by the consumers.

After the evaluation of the finished product, the evaluation sheets were gathered. A total of 110 evaluators, composed of 10 semi-trained panelists and 100 consumers, evaluated the product in terms of appearance, aroma, sourness, and texture. The evaluation sheets were distributed to the evaluators which were randomly selected to ensure the reliability of the data. The evaluators were oriented on how to evaluate the product in the said variables.

The evaluation sheets were given to the participants, experts, teachers, students, and consumers with their honest opinions solicited. The evaluators were instructed to evaluate the product using a 9-Point Hedonic Scale as to appearance, aroma, sourness, and texture. The 100 consumer respondents, comprised of 20 Technology and Livelihood Education (TLE) teachers, 20 cookery students in Grade 9 and 10 at Vicente Andaya Sr. National High School Sigma, Capiz, and 50

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potential consumers, evaluated the acceptability of the product prepared in three treatments. After the evaluation of the finished products, the evaluation sheets were gathered.

Statistical Tools and Analysis

The product and treatment, exhibiting the highest mean score, underwent consumer evaluation to assess their overall acceptability. The data gathered were organized and subjected to statistical analysis utilizing the Arithmetic mean and Analysis of Variance (ANOVA). This analysis was conducted using the Statistical Package for the Social Sciences (SPSS) software for data processing and comprehensive evaluation.
The mean served as the key statistical tool for determining the level of sensory and general acceptability of appearance, aroma, sourness, and texture.

The Analysis of Variance (ANOVA) served as the key statistical tool for determining significant differences among the three products. The ANOVA was applied with an alpha level set at 0.01 to discern notable differences concerning its appearance, aroma, sourness, and texture.

III. RESULTS AND DISCUSSION

Sensory Qualities of Fruit Souring Paste

The result showed that in terms of appearance, Treatment C got the highest mean score of 8.60, described as “extremely appealing”, followed by Treatment B with the mean score of 7.40, described as “very much appealing,” and Treatment A with the mean score of 7.30, described as “very much appealing,” as evaluated by the evaluators. This implies that Treatment C was preferred most in terms of appearance.

In terms of aroma, Treatment C got the highest mean score of 8.40 which described as “extremely pleasant”. This was followed by Treatment A and Treatment B with the mean score of 7.40, described as “very much pleasant,” as evaluated by the evaluators. This implies that Treatment C was preferred in terms of aroma.

In terms of sourness, Treatment C got the highest mean score of 8.40 which described as “extremely sour” followed by Treatment A with the mean score of 8.20 which mean “extremely sour” and Treatment B with the mean score of 8.10 which described as “very much sour” as evaluated by the evaluators. This implies that Treatment C was preferred most in terms of sourness.

In terms of texture, Treatment C got the highest mean score of 8.70, described as “extremely fine”, followed by Treatment B with the mean score of 7.70, described as “very much fine,” and Treatment A with the mean score of 7.20, described as “moderately fine,” as evaluated by the evaluators. This implies that Treatment C stood out and preferred most in terms of texture.

The result of this study supported Mohd (2019), who explored the development of fruit jam from cucumber tree to assess its sensory acceptability. The findings indicated that the jam possessed good sensory qualities, suggesting its potential for broader consumption.

The result also aligned with that of Merca’s (2017). The research demonstrated that both fresh and powdered forms of batuan were acceptable as souring agents in dishes, highlighting their potential in culinary applications.
The result also supported Quevedo’s (2016) assertion that green mangoes are traditionally utilized in various culinary applications for their sour flavor, indicating potential for developing acceptable paste products.

Table 2. Sensory qualities of fruit souring paste.

Sensory Attributes	**Treatment A** (Cucumber Tree)		**Treatment B** (Batuan)		**Treatment C** (Green Mango)	
	Mean	AD	Mean	AD	Mean	AD
Appearance	7.30	VMA	7.40	VMA	8.60	EA
Aroma	7.40	VMP	7.40	VMP	8.40	EP
Sourness	8.20	ES	8.10	VMS	8.40	ES
Texture	7.20	MF	7.70	VMF	8.70	EF

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Legend: *EA- Extremely Appealing* *VMA -Very Much Appealing*
EP - Extremely Pleasant *VMP - Very Much Pleasant*
ES - Extremely Sour *VMS - Very Much Sour*
EF - Extremely Fine *VMS - Very Much Fine*
MF - Moderately Fine

General Acceptability of Fruit Souring Paste among Three Treatments

The result showed that, in terms of appearance, Treatment C got the highest mean score of 8.40, described as "liked extremely," followed by Treatment A with the mean score of 7.91, described as "liked very much," and Treatment B with the mean score of 7.86, described as "liked very much," as evaluated by the evaluators. This implies that Treatment C was preferred most in terms of appearance.

In terms of aroma, Treatment A got the highest mean score of 8.16, described as "liked extremely," followed by Treatment C with the mean score of 8.05, described as "liked very much," and Treatment B with the mean score of 7.84, described as "liked very much," as evaluated by the evaluators. This implies that Treatment A was preferred in terms of aroma.
In terms of sourness, Treatment B got the highest mean score of 8.20, described as "liked extremely," followed by Treatment C with the mean score of 7.95, described as "liked very much," and Treatment A with the mean score of 7.86, described as "liked very much," as evaluated by the evaluators. This implies that Treatment B was preferred in terms of sourness.

In terms of texture, Treatment C got the highest mean score of 8.29, described as "liked extremely," followed by Treatment B with the mean score of 7.84, described as "liked very much," and Treatment A with the mean score of 7.43, described as "liked very much," as evaluated by the evaluators. This implies that Treatment C was preferred in terms of texture.

The result supported Rusdiaman (2018), who emphasized the importance of cucumber tree as a value-added product and its potential applications in the food industry. The research highlighted how cucumber tree can be used to create functional food ingredients with enhanced health benefits. With its rich nutritional profile and bioactive compounds, cucumber tree stands out as an alternative paste that can serve both as a preservative and a nutrient-dense addition to food products. Rusdiaman also discussed the economic advantages of using cucumber tree in the food processing industry, particularly in local communities. As a versatile ingredient, cucumber tree can help promote sustainability and local food security through its incorporation into various paste-based food products.

The result also supported Kiloes et al.'s (2021), who argued that the acceptability of green mango paste has been a growing area of interest, particularly in understanding consumer preferences and market dynamics. Renowned for their rich flavor and diverse varieties, green mangoes hold a pivotal role in the global fruit market. Sensory attributes like taste, aroma, and texture are crucial to consumer acceptance, with studies emphasizing the importance of retaining the natural sweetness and aroma of fresh mangoes to enhance marketability.

Table 3. General acceptability of fruit souring paste among three treatments.

Sensory Attributes	**Treatment A (**Cucumber Tree**)**		**Treatment B (**Batuan**)**		**Treatment C** (Green Mango**)**	
	Mean	AD	Mean	AD	Mean	AD
Appearance	7.91	LVM	7.86	LVM	8.40	LE
Aroma	8.16	LE	7.84	LVM	8.05	LVM
Sourness	7.86	LVM	8.20	LE	7.95	LVM
Texture	7.43	LVM	7.84	LVM	8.29	LE
Acceptability	7.84	LVM	7.94	LVM	8.17	LE

Legend: *LE- Liked Extremely* *AD- Adjectival Description*
LVM- Liked Very Much

The result also supported the study of Awoyale et al. (2021). The rheological properties of food pastes, such as viscosity and texture, are critical in determining their usability. Their research indicated that modifying these properties through specific ingredients could make pastes like batuan as an alternative paste more versatile in culinary applications.

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Optimizing these functional attributes could expand batuan's appeal as a spread or cooking base. Such advancements would also ensure greater consumer satisfaction and adaptability.

IV. CONCLUSION

Based on the established findings, the following conclusions are formulated:
Green mango show strong potential as value-added ingredients for making souring pastes, particularly when applied to sour fish soup "fish *sinigang*". These pastes received high approval from both semi-trained panelists and consumers, indicating broad acceptance and favorable sensory appeal.

A significant difference was observed among the cucumber tree, batuan, and green mango pastes in terms of sensory attributes, including appearance, aroma, sourness, texture, and overall acceptability. Among these, the green mango paste demonstrated superior sensory qualities and was the most preferred by evaluators. Furthermore, microbiological analysis confirmed that the green mango paste is safe for consumption, complying with the standards set by the Bureau of Food and Drugs (BFAD) for seasonings commonly used in fish-based dishes such as *sinigang*.

Overall, incorporating cucumber tree, batuan, and green mango pastes as natural souring agents in sour fish soup "fish *sinigang*" enhances sensory quality and consumer satisfaction. With further research and product development, these pastes have the potential to become popular and commercially viable products in the market.

V. RECOMMENDATION

Based on the established generalizations, the following recommendations are made:
Cucumber tree, batuan, and green mango is recommended as viable ingredients for producing paste. Its incorporation has shown positive results in terms of sensory qualities and consumer acceptance.

Local Government Units (LGUs), agricultural agencies, and food product developers may promote these products in local and regional markets. These stakeholders can organize product demonstrations, develop promotional materials, and collaborate with Small and Medium Enterprises (SMEs) to scale up production and distribution. By doing so, they can help increase public awareness, support local farmers, and encourage the use of natural, indigenous ingredients in Filipino cuisine.

Cucumber tree, batuan and green mango paste made from cucumber tree, batuan and green mango may be showcased at events, such as school food fairs and other food exhibitions. Their originality and unique flavor profile make them stand out and can attract interest from attendees.

To ensure the longevity of the food products, it is recommended to seal their packaging to maintain freshness. This will enable them to be transported to different locations or displayed in food centers without compromising their quality.

Other researchers are encouraged to explore additional variants or factors that were not covered in the current study. This can lead to further insights and innovations in utilizing cucumber tree, batuan, and green mango as paste production.
By following these recommendations, stakeholders can leverage the potential of cucumber tree, batuan and green mango as paste, enhancing their marketability and appeal to consumers.

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