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Formulation, analyses and acceptability of root crop Piaya

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ABSTRACT

To contribute to the reduction of food waste and alleviate poverty, this study developed rootcrop-based piaya utilizing taro, cassava, and lesser yam. The research aimed to formulate and evaluate the sensory qualities—appearance, aroma, taste, and texture—of the piaya, determine consumer acceptability, assess differences in sensory attributes. The best-performing variant underwent microbial and proximate analyses. The method used in this study was the experimental-developmental method of research using a Completely Randomized Design (CRD), the study included three treatments: Treatment A (taro), Treatment B (cassava) and Treatment C (lesser yam), 10 semi-trained panelists, and 100 consumer evaluators. A Nine-Point Hedonic Scale was used for evaluation, and data were analyzed using mean and ANOVA. Result showed in sensory qualities of root crop piaya among three treatments Treatment A (75g taro) received the highest rating in appearance very much appealing, was rated very much pleasant in aroma, very much delicious in taste, and very much flaky in texture, Furthermore, the consumer's general acceptability of root crop piaya among three treatments, Treatment A (75g taro) was the most preferred among the three treatments. It received the highest mean scores in all sensory attributes, which described as liked extremely. Additionally, it indicates that Treatment A was consistently favored by the evaluators in all aspects. There were significant differences in general acceptability across all four aspects. Among the three treatments, Treatment A (75g taro) 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: product formulation, product analyses, product acceptability, rootcrop, rootcrop Piaya

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INTRODUCTION

The growing demand for nutritious, locally sourced, and innovative food products has led to the exploration of root crops such as cassava (Manihot esculenta) and taro (Colocasia esculenta) as alternative ingredients in baked goods. These crops are widely cultivated in tropical and subtropical regions due to their hardy nature, high carbohydrate content, and versatility in food applications (FAO, 2020).

One of the traditional delicacies in the Philippines, Piaya, a flatbread with a sweet filling, offers a promising avenue for innovation by incorporating taro, cassava, and lupisan (a native variant of a root crop or flour substitute) into its formulation.

Cassava is known for its high starch content, gluten-free nature, and potential to improve texture and structure in baked goods (Charles et al., 2017). Taro, on the other hand, is an excellent source of dietary fiber and good carbohydrates, making it a valuable addition to baked and confectionery products (Huang et al., 2021).

Combining these ingredients in piaya production could enhance both nutritional value and sensory acceptability, catering to health-conscious consumers and those with dietary restrictions.

The study by Arianti and Harinta (2021) revealed that incorporating taro as a filling for piyaya, a traditional pastry known for its sweet filling and flaky texture, presents an opportunity to enhance both its nutritional profile and sensory qualities. Taro, are rich in essential nutrients such as vitamins A, C, and dietary fiber. These nutrients contribute to overall health by supporting immune function and digestion. Incorporating taro into piaya can make it a more appealing option for health-conscious consumers.

Parle and Lamba (2015) emphasized that the nutritional value of taro makes them an excellent ingredient for improving the health benefits of traditional snacks. Their research highlighted how the consumption of taro-based products aligns with global trends in healthier eating habits. With consumers becoming more mindful of their food choices, traditional snacks with added health benefits are gaining popularity. This shift in preference presents an opportunity for piaya manufacturers to innovate while preserving cultural flavors.

The study by Airaodion et al. (2019) revealed that cassava, scientifically known as Manihot esculenta, plays an essential role in global culinary traditions, particularly as a filling in traditional delicacies such as piyaya. This sweet flatbread, typically filled with various ingredients, benefits from cassava's nutritional and functional properties, which enhance its overall appeal. The ability of cassava to blend seamlessly into different dishes showcases its flexibility in various food applications. Its presence in piaya not only improves the texture but also contributes to the dish's overall taste experience.

One of cassava's notable characteristics is its versatility as a food ingredient. It can be processed into flour or starch, which allows it to be used in various baked goods, including piyaya (Tupas, 2021). This transformation enables cassava to serve as a viable alternative to traditional wheat-based ingredients. By incorporating cassava into piyaya, bakers can introduce a unique texture and flavor that distinguishes it from other flatbreads.

The study by Pramono et al. (2020) revealed that lesser yam (Dioscorea esculenta) presents promising applications in traditional food products like piyaya, a type of flatbread. The inclusion of lesser yam in piaya filling enhances both its nutritional profile and sensory

characteristics, making it a valuable ingredient in food development. This makes lesser yam an attractive alternative to conventional fillings, offering a unique flavor and improved dietary benefits. Additionally, its versatility in different food applications highlights its potential in modern and traditional culinary practices.

Lesser yam flour is particularly rich in dietary fiber and inulin, both of which function as prebiotics that promote gut health and improve food texture. Pramono et al. (2020) noted that the inulin content in lesser yam flour serves as an effective carbon source for lactic acid bacteria, which enhances organoleptic properties in fermented dairy products like yogurt, suggesting its potential for similar applications in piaya. The ability of lesser yam to support beneficial gut bacteria further strengthens its appeal as a functional food ingredient. Moreover, this property can contribute to improved digestion and overall well-being for consumers who include it in their diet.

Several studies have highlighted the functional properties of root crop-based flour in baking. Research by Okpala and Egwu (2015) demonstrated that cassava composite flour improved the moisture retention and texture of baked products, making them more palatable. Similarly, Almazan et al. (2019) found that sweet potato-based pastries exhibited higher consumer preference due to their natural sweetness and vibrant color, which could be beneficial for piaya innovation.

Furthermore, sensory evaluation and consumer acceptability studies play a crucial role in determining the market potential of such products. A study by Garcia et al. (2020) emphasized that consumers prefer baked goods with soft texture, moderate sweetness, and good mouthfeel, attributes that can be achieved by optimizing the formulation of taro, cassava, and lesser yam in piaya production.

By conducting a scientific formulation, analysis, and acceptability study, this research aims to develop a novel, nutritious, and locally inspired variant of piaya that can contribute to food diversification and economic opportunities for farmers, entrepreneurs, and food technologists.

Statement of the problem

Generally, the objective of this research is to develop and formulate the taro, cassava and lesser yam piaya. Specifically, it aimed to:

1. determine the sensory qualities of root crop piaya yam in terms of appearance, aroma, taste, and texture among three treatments;
2. determine the general acceptability of root crop piaya in terms of appearance, aroma, taste, and texture among three treatments;
3. find out if there is a significant difference in the sensory qualities of root crop piaya considering the different treatments;
4. find out if there is a significant difference in the general acceptability of root crop piaya considering the different treatments;
5. determine the shelf – life of root crop piaya in terms of room and chilling temperature;
6. submit the best product for microbial test and proximate analysis.

METHODOLOGY

This study utilized an experimental–developmental research design, combining the systematic manipulation of variables characteristic of experimental research with the product-focused orientation of developmental research. The experimental method was applied to investigate the use of taro, cassava, and lesser yam as fillings for piaya through three treatments. Experimental research, as emphasized by Ibrahim (2016), provides a scientific technique of controlling and altering variables to determine their effects on one another, making it well-suited for analyzing differences in sensory qualities. At the same time, the developmental aspect sought to create a potential product that could contribute to innovation and commercialization, highlighting its practical application in improving people's quality of life (Rabie, 2016).

The study adopted a Completely Randomized Design (CRD) as the experimental layout. The treatments involved three variations of filling: Treatment A (taro), Treatment B (cassava), and Treatment C (lesser yam). These treatments were subjected to sensory evaluation to determine significant differences in appearance, taste, texture, aroma, and overall acceptability. Each treatment incorporated the same quantities of base ingredients while varying the type of root crop. Specifically, the experimental design called for 150 grams of all-purpose flour, 70 grams of shortening, 60 grams of water, 120 grams of evaporated milk, 40 grams of condensed milk, 25 grams of sugar, 14 grams of butter, and 5 grams of vanilla, which remained constant across all treatments. The variable component consisted of the root crop filling, prepared in three formulations of 25 grams, 50 grams, and 75 grams, combined with 25 grams of sugar, 120 grams of evaporated milk, and 76 grams of condensed milk. This systematic proportioning allowed for reliable comparisons among treatments.

The materials, tools, and equipment used to conduct the experiment included a working table, a liquid measuring cup, one mixing bowl, three utility bowls, a flour sifter, a set of measuring spoons, a rubber scraper, a rolling pin, a weighing scale, a stove, a non-stick pan, a casserole, and a gas range. These ensured accuracy and consistency in preparation. The ingredients used in the study were all-purpose flour, shortening, water, sugar, evaporated milk, condensed milk, vanilla, butter, and the three selected root crops: taro, cassava, and lesser yam.

The experimental procedures were carefully carried out in two stages. In preparing the fillings, the root crops were first selected and sorted for quality to avoid contamination. They were then washed, drained, weighed, cut, and boiled in a casserole. After boiling, they were transferred to a tray, peeled, mashed, and blended into a smooth texture before being cooked into a filling. The prepared fillings were then cooled and stored in bowls for later use. In preparing the piaya dough, all ingredients were weighed, mixed, and kneaded to form dough. The dough was portioned, filled with the cooled fillings, flattened, and cooked until finished piaya was produced. This sequential method ensured the reliability of the preparation and minimized procedural variability.

Data collection was conducted through evaluation sheets designed to assess sensory attributes of the products. These sheets measured appearance, aroma, taste, and texture, while also including overall acceptability ratings. A total of 110 evaluators participated in the study, composed of 10 semi-trained panelists and 100 consumers, ensuring a balance between expert and consumer perspectives. The evaluators were randomly selected and oriented on the evaluation process to ensure consistent judgment. The evaluation instrument employed a nine-

point hedonic scale, where scores corresponded to descriptive categories. For example, scores of 8.12–9.00 indicated "extremely appealing" for appearance, "extremely pleasant" for aroma, "extremely delicious" for taste, "extremely flaky" for texture, and "liked extremely" for overall acceptability. Scores from 7.23–8.11 indicated very positive evaluations, while scores from 1.00–1.88 corresponded to the lowest level of appeal, pleasantness, or acceptability. This scaling system provided a structured interpretation of evaluator responses.

The data obtained from these evaluations were then scored, tabulated, and analyzed using both descriptive and inferential statistics. The arithmetic mean was employed to measure the central tendency of ratings in each sensory attribute. To determine whether there were significant differences among treatments, the Analysis of Variance (ANOVA) was applied, with the level of significance set at 0.01. This ensured that only highly reliable differences were considered statistically significant. The data analysis was carried out using the Statistical Package for the Social Sciences (SPSS), which provided accurate and systematic computation of results. By combining experimental precision, developmental orientation, structured evaluation, and rigorous statistical analysis, the study was able to generate valid conclusions regarding the sensory qualities and overall acceptability of root crop-based piaya.

RESULTS AND DISCUSSION

A total of 110 evaluators participated in the sensory evaluation of root crop piaya, consisting of 10 semi-trained panelists and 100 consumers. As outlined in the methodology, three treatments were tested using taro, cassava, and lesser yam as fillings. Each treatment used the same base ingredients, with the root crop type serving as the primary variable. The evaluators assessed the finished products using a nine-point hedonic scale to measure appearance, aroma, taste, texture, and overall acceptability. Data were then analyzed using the arithmetic mean and Analysis of Variance (ANOVA) to determine significant differences among treatments.

Sensory qualities of root crop Piaya

The results revealed clear variations in the sensory qualities of the root crop piaya across treatments. In terms of appearance, Treatment A (75 g taro) obtained the highest mean score of 8.10, described as very much appealing, followed by Treatment B (75 g cassava) with a mean score of 7.90 and Treatment C (75 g lesser yam) with 7.80, both also described as very much appealing. This suggests that the taro variant was visually the most preferred by evaluators. For aroma, all three treatments—taro, cassava, and lesser yam—achieved identical mean scores of 8.00, categorized as very much pleasant, showing no distinct preference among root crops in this attribute.

Taste evaluations indicated that Treatment B (75 g cassava) and Treatment C (75 g lesser yam) were rated the highest, each with a mean score of 8.00, described as very much delicious, while Treatment A (75 g taro) followed with 7.80, still falling under the same descriptive category. This suggests cassava and lesser yam were more favorable in flavor. In terms of texture, Treatment C (75 g lesser yam) emerged as the most preferred with a mean score of 7.80, rated as very much flaky, followed by Treatment A (75 g taro) with 7.70 and Treatment B (75 g

cassava) with 7.40, both also considered very much flaky. These findings are consistent with the studies of De Leon (2020) and Dela Cruz (2021), which noted that taro generally contributes to better appearance and aroma, while cassava enhances taste and lesser yam improves texture.

General acceptability of root crop Piaya

The general acceptability of the products further highlighted taro's dominance in certain sensory areas. For appearance, Treatment A (taro) was rated highest with a mean of 8.73, described as liked extremely. It was followed by Treatment C (lesser yam) with 8.22, also liked extremely, and Treatment B (cassava) with 7.92, described as liked very much. Aroma ratings placed Treatment A first again, with a mean of 8.62 (liked extremely), followed by lesser yam at 8.22 (liked extremely), and cassava at 7.79 (liked very much). Taste showed similar patterns: taro received the highest score of 8.87 (liked extremely), lesser yam followed with 8.49 (liked extremely), and cassava scored 7.83 (liked very much). Texture results placed taro at 8.77 (liked extremely), lesser yam at 8.31 (liked extremely), and cassava at 7.36 (liked very much). For overall acceptability, taro was again most favored with 8.75, followed by lesser yam at 8.32, and cassava at 7.74.

These findings reinforce the results of Mendoza (2019) and Navarro (2020), who also observed stronger consumer preferences for taro-based products, particularly in terms of appearance, aroma, and overall appeal. Cassava, though acceptable, consistently scored lower, while lesser yam demonstrated moderate acceptability, especially in texture.

Differences in sensory qualities

The test of differences in sensory qualities revealed that there was no significant difference among the three treatments in terms of appearance (f-value = 1.674, $p = .433 > .01$), aroma (f-value = 2.000, $p = .368 > .01$), taste (f-value = 6.134, $p = .047 > .01$), and texture (f-value = 0.949, $p = .622 > .01$). This indicates that despite variations in mean scores, the treatments did not significantly differ from one another at the 0.01 level of significance. These findings are consistent with Ramirez (2019) and Aquino (2021), who found that delicacies made from root crops such as cassava, yam, and taro did not show statistically significant differences in sensory attributes when prepared under similar conditions. While mean scores suggest some preferences, statistical analysis supports the conclusion that all three root crop fillings are acceptable alternatives.

Differences in general acceptability

In contrast, tests for general acceptability showed significant differences across treatments. For appearance, the f-value was 54.003 ($p = .000 < .01$); for aroma, 60.484 ($p = .000 < .01$); for taste, 99.805 ($p = .000 < .01$); and for texture, 174.222 ($p = .000 < .01$). These results indicate that evaluators expressed varying preferences when considering overall product acceptability. The results are consistent with the studies of Thompson (2020) and De Vera (2018), who observed that consumer preferences for root crop-based delicacies vary significantly depending on visual appeal, aroma intensity, taste, and texture. This suggests that while the

sensory qualities were not significantly different, the overall acceptability of piaya made from taro, cassava, and lesser yam reflected more distinct consumer preferences.

Shelf-life of root crop Piaya

Shelf-life testing revealed that the products maintained their quality for seven days when stored at room temperature in a dry, well-lit, and sealed environment. By the fourteenth day, visible mold growth appeared, accompanied by discoloration and unpleasant odor, indicating spoilage. Mold formation persisted for up to fifteen days, after which the product was deemed unsuitable for consumption. When stored under chilling conditions at 32°F to 40°F, the piaya showed no changes for the first ten days. Between fifteen and thirty days, however, molds and spots began to develop, demonstrating extended but not indefinite shelf-life under refrigeration.

Microbial analysis

Microbial testing was conducted by the Negros Prawn Producers Cooperative Analytical and Diagnostic Laboratory under Reference No. 25-8633, submitted and analyzed on May 2, 2025, and reported on May 9, 2025. The analysis included aerobic plate count, total coliform, Salmonella detection, yeast count, and mold count. Results showed an aerobic plate count of 340 CFU/g, which is within the BFAD reference rejection level. Total coliform and E. coli were not detected, and Salmonella was absent in 25 g of sample. Yeast count was 20 CFU/g, while mold count was 10 CFU/g. These values indicate that the root crop piaya met food safety standards, confirming its microbiological safety for consumption.

Proximate analysis

Proximate analysis was also performed on a 250-gram sample of root crop piaya. The laboratory results indicated that the product contained 0.80% fat (by Soxhlet Extraction Method), 80.4% carbohydrates (by Phenol Sulfuric Acid Method), 12.3% moisture (by Gravimetric Oven Drying), 4.7% protein (by Kjeldahl Method), and 87 calories per 250 grams. These values reflect the product's nutritional profile, showing that root crop piaya is predominantly carbohydrate-based with modest protein and fat content. The results provide essential information for potential commercialization, offering insights into the nutritional value of root crop-based piaya.

CONCLUSION

The primary objective of this research was to formulate, analyze, and assess the acceptability of root crop-based piaya using taro, cassava, and lesser yam as fillings. Specifically, it sought to evaluate the sensory qualities of the products in terms of appearance, aroma, taste, and texture, to determine their general acceptability, to establish whether significant differences existed among the treatments, and to submit the best-performing variant for microbial and proximate analyses. The study employed an experimental–developmental design under a Completely Randomized Design (CRD), conducted in three replicates, with one final

product selected for consumer preference evaluation. A total of 110 evaluators, consisting of 10 semi-trained panelists and 100 consumers, assessed the products using nine-point hedonic scales. Data were analyzed using arithmetic mean and Analysis of Variance (ANOVA) to identify significant differences among treatments.

Findings revealed that sensory qualities varied slightly among the three treatments, though all received favorable evaluations. In terms of appearance, piaya filled with taro (Treatment A) was rated highest, described as very much appealing, followed closely by cassava and lesser yam. For aroma, all three treatments received identical ratings of very much pleasant, suggesting equal consumer appreciation across variants. Taste evaluations showed cassava and lesser yam-based piaya as the most preferred, each described as very much delicious, while taro followed closely in the same category. Texture results indicated that the lesser yam variant ranked highest, described as very much fine, with taro and cassava following closely behind. These findings suggest that each root crop contributed unique qualities to the product, influencing consumer perceptions differently across sensory attributes.

With regard to general acceptability, taro-based piaya consistently received the highest scores across appearance, aroma, taste, and texture, with evaluators describing it as liked extremely. Lesser yam followed closely in all attributes, also falling under the liked extremely category, while cassava, though still favorably received, was rated slightly lower as liked very much. These outcomes underscore taro's superior overall appeal, although all three root crops demonstrated strong potential as acceptable and marketable ingredients for piaya fillings.

Statistical analysis revealed no significant differences in the sensory qualities of appearance, aroma, taste, and texture among the treatments. This suggests that while evaluators expressed slight preferences, the three products were broadly comparable in sensory performance. However, significant differences were observed in general acceptability across all attributes, implying that consumers made clearer distinctions when evaluating the overall appeal of the products rather than individual sensory traits.

Taken together, these findings highlight the potential of root crop-based piaya as an innovative addition to Filipino snack products. The incorporation of taro, cassava, and lesser yam not only preserved the traditional qualities of piaya but also enriched it with novel flavors, textures, and nutritional benefits. Taro emerged as the most preferred variant overall, followed closely by lesser yam, while cassava demonstrated specific strengths in taste. The study confirms that root crops can be effectively integrated into traditional pastry formats, enhancing both cultural relevance and consumer interest.

In conclusion, root crop piaya represents a successful innovation that bridges tradition with modern consumer preferences. The products exhibited strong acceptability, with each treatment contributing distinct qualities valued by evaluators. Taro was identified as the most promising variant, yet cassava and lesser yam also demonstrated considerable potential. These results not only support the viability of root crop-based piaya for wider consumer adoption but also emphasize its role in promoting sustainable use of local agricultural resources. With further refinement in formulation, packaging, and shelf-life extension, root crop piaya holds promise as a culturally rooted, nutritionally enhanced, and commercially viable product in the Philippine food industry.

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