DEVELOPMENT OF CARISSA CARANDAS JAM AND JUICE

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Abstract

The study focused on the Development of *Carissa Carandas* Jam and Juice and evaluating their sensory acceptability and financial viability. The overall sensory attributes of *Carissa carandas* jam and juice such as appearance, aroma, taste and texture received a favorable acceptability with a descriptive value of like very much in all treatments.

Findings of the study revealed a no significant difference in all the sensory attributes of both *Carissa carandas* jam and juice indicating consistent consumer satisfaction. Treatment 2(1500 grams of *Carissa carandas*), turned out as the best formulation for *Carissa carandas* jam while Treatment 3 (650 grams Carissa carandas) turned out as the best formulation for *Carissa carandas* juice. The microbiological test results of *Carissa carandas* jam such as aerobic plate count, mold count and yeast count were found within the allowable limits set by the FDA. The microbiological test results of *Carissa carandas* juice such as aerobic plate count, total coliform and Escherichia coli count, total mold and yeast count were also found within the allowable limits set by the FDA.

The *Carissa carandas* jam and juice production reveals the viability of both products. Recommendations include utilization of *Carissa carandas* jam and juice aside from the treatment currently employed, conduct of the same study in other location, standardization process of *Carissa carandas* jam and juice, proper hygiene of the production site to sustain zero microbial qualities, adopt the development *Carissa carandas* jam and juice as a source of income, utilize the learning material developed for instruction and further reference, conduct of nutritional analysis, farmers to venture into planting *Carissa carandas* and development of new food products aside from jam and juice.

Keywords: Carissa carandas, Jam, Juice, Sensory Acceptability, Microbiological Analysis

1. Introduction

Global food systems are currently challenged by population growth, climate change, food insecurity, and significant postharvest losses, particularly of fruits and vegetables. In response, researchers and policymakers have emphasized the need to diversify food sources by utilizing underexploited and neglected plant species with nutritional, functional, and economic potential (Chacha et al., 2022). Underutilized fruits are increasingly recognized as valuable resources for improving dietary diversity, enhancing nutrition, and promoting sustainable agriculture, especially in developing regions where conventional crops dominate food production systems.

One such underutilized fruit is *Carissa carandas* L., commonly known as karonda or Bengal currant. *Carissa carandas belongs* to the family Apocynaceae and is a perennial, thorny shrub widely distributed in tropical and subtropical regions of South and Southeast Asia. The plant thrives in semi-arid and marginal environments, requires minimal agricultural inputs, and exhibits strong resistance to drought and poor soil conditions (Mahajan et al., 2022). Despite these

agronomic advantages, its utilization remains largely limited to household-level consumption and ornamental purposes.

The fruit of *Carissa carandas* is small, oval to round, and undergoes a color change from green to pinkish red and dark purple as it ripens. It is characterized by a distinct sour-to-tart flavor, which limits its acceptability in its raw form but makes it suitable for processed products such as jams, juices, syrups, and preserves (Meena et al., 2020). Nutritionally, *Carissa carandas* is rich in dietary fiber, vitamin C, iron, calcium, and a wide range of phytochemicals, including phenolic acids, flavonoids, tannins, and anthocyanins (Bibha et al., 2024). These compounds exhibit antioxidant, antimicrobial, antidiabetic, anti-inflammatory, and anticancer activities, positioning the fruit as a promising ingredient for functional food development (Saher et al., 2019).

Despite its nutritional and therapeutic attributes, *Carissa carandas* remains underutilized due to several constraints. These include limited consumer awareness, a short harvesting period, high perishability, and inadequate postharvest handling and processing technologies (Mahajan et al., 2022). In many rural communities in the Philippines and other Asian countries, the fruit is grown primarily as an ornamental hedge plant, and ripe fruits are frequently discarded, resulting in food waste and lost economic opportunities. Addressing these challenges requires developing value-added processing strategies that improve shelf life, palatability, and marketability.

Processing fruits into jam and juice is among the most effective and widely adopted preservation techniques. These products rely on sugar concentration, acidity, and thermal processing to inhibit microbial growth, ensuring safety while retaining desirable sensory attributes. Several studies have demonstrated that *Carissa carandas* can be successfully incorporated into processed food products with acceptable sensory quality and storage stability (Laxmi et al., 2021; Dunghav & Hingane, 2022). However, formulation optimization is critical, as variations in fruit concentration can influence taste, aroma, texture, and overall acceptability.

Sensory evaluation plays a pivotal role in determining the success of newly developed food products. Consumer acceptance is largely driven by sensory characteristics, including appearance, aroma, taste, and texture, which strongly influence purchasing behavior and repeat consumption (Mamoona et al., 2023). The use of hedonic scales in sensory testing provides a systematic and reliable approach to assessing product acceptability and identifying preferred formulations. For underutilized fruits such as *Carissa carandas*, sensory evaluation is particularly important in overcoming consumer unfamiliarity and promoting market acceptance.

Food safety is another critical consideration in the development of fruit-based products. Microbiological analysis is essential to ensure that processed foods meet regulatory standards and do not pose health risks to consumers. Routine testing for aerobic plate count, mold and yeast, total coliforms, and pathogenic microorganisms such as *Escherichia coli*serves as a key indicator of product safety and hygienic processing conditions (Sornoza, 2024). Compliance with food safety standards not only protects public health but also enhances consumer confidence and supports product commercialization (ElexBio, n.d.).

Beyond nutritional quality and safety, the economic viability of food products determines their sustainability as livelihood and entrepreneurial ventures. Cost analysis and computation of return on expenditure (ROE) provide valuable insights into production efficiency, pricing strategies, and profitability. Previous studies have shown that value addition through processing of indigenous and underutilized fruits can generate meaningful income opportunities for farmers, small-scale processors, and community-based enterprises (Kamble et al., 2023). In regions where raw materials are locally abundant, developing low-cost, marketable food products contributes to rural development and poverty alleviation.

This study is grounded in experiential and empirical approaches to food product development, emphasizing systematic experimentation, observation, and evaluation. By integrating product formulation, sensory testing, microbiological assessment, and economic analysis, the research provides a comprehensive evaluation of *Carissa carandas* as a raw

material for jam and juice production. Moreover, the study aligns with global initiatives promoting sustainable food systems and the use of indigenous plant resources, including the United Nations Sustainable Development Goals on food security, nutrition, and sustainable agriculture.

Given the limited local studies that comprehensively assess the sensory, microbiological, and economic aspects of *Carissa carandas*-based food products, there remains a need for empirical evidence to support its broader utilization. Therefore, this study aimed to develop jam and juice from *Carissa carandas* and evaluate their sensory acceptability, microbiological quality, and economic viability. Specifically, it sought to determine the level of sensory acceptability across appearance, aroma, taste, and texture; identify the optimal formulation for each product; assess compliance with microbiological safety standards; and compute the return on investment. The findings of this study are expected to contribute to food innovation research, promote the use of underexploited fruits, and support sustainable livelihoods.

2. Method

2.1 Research Design

This study employed a descriptive–experimental research design focused on food product development and evaluation. The design integrated experimental formulation, sensory assessment, microbiological analysis, and economic evaluation to determine the feasibility of developing jam and juice from *Carissa carandas* fruit. This approach is appropriate for studies that aim to develop value-added food products while simultaneously assessing quality, safety, and economic performance.

The experimental phase involved preparing *Carissa carandas* jam and juice using four treatments per product, including a control. The treatments varied in the quantity of *Carissa carandas* fruit used, while other ingredients and processing conditions were kept constant to isolate the effect of fruit concentration on product quality. This controlled variation enabled objective comparisons among treatments and the identification of the most acceptable formulation.

Sensory evaluation followed a quasi-experimental design using a completely randomized design (CRD). Product samples were randomly presented to respondent-evaluators to minimize bias and order effects. Sensory acceptability was assessed using a 9-point Hedonic scale covering appearance, aroma, taste, and texture. Descriptive and inferential statistical analyses were employed to determine differences in sensory attributes among treatments.

Microbiological analysis constituted a confirmatory component of the design, conducted to evaluate product safety and compliance with food safety standards. Standard laboratory testing was performed to determine aerobic plate count, mold and yeast count, total coliforms, and *Escherichia coli*, providing objective indicators of hygienic processing and microbial stability.

An economic evaluation was incorporated through the computation of Return on Expenditure (ROE). Production costs, yield, pricing, gross income, and net income were analyzed to determine the financial viability of the developed products. Integrating economic analysis into the experimental design enabled a holistic assessment of the products' potential for small-scale commercialization and livelihood generation.

Overall, the descriptive–experimental design enabled a comprehensive evaluation of *Carissa carandas* jam and juice by linking formulation, consumer acceptability, food safety, and economic feasibility within a single methodological framework.

2.2 Participants

A total of thirty (30) respondent-evaluators participated in the sensory evaluation component of the study. The panel consisted of ten (10) teachers and twenty (20) students from Eastern Pangasinan Agricultural College (EPAC). The teacher-evaluators were faculty members

teaching Technical-Vocational Education (TVE) and Technical-Vocational-Livelihood (TVL) subjects, particularly Bread and Pastry Production (BPP), Cookery, and Food Processing. They were included to provide expert perspectives relevant to food preparation and product quality assessment. The student-evaluators were included to represent general consumers and provide preference-based evaluations of the developed products.

Participants were selected to capture both expert-informed assessments and consumer-oriented perceptions of the sensory attributes of *Carissa carandas* jam and juice. All participants served as sensory panelists to evaluate product samples across treatments using a standardized 9-point Hedonic scale.

The sensory evaluation was conducted at EPAC under controlled conditions, and panelists were instructed to rinse their mouths with water between sample evaluations to minimize carryover effects. Participation was voluntary, and responses were treated confidentially and used solely for academic and research purposes.

2.3 Instrumentation

Sensory acceptability of the developed *Carissa carandas* jam and juice was assessed using a structured sensory scorecard based on the 9-point Hedonic rating scale. The instrument measured four sensory attributes: appearance, aroma, taste, and texture. Each attribute was rated on a scale from 1 (extremely disliked) to 9 (extremely liked). The scorecard also provided space for panelists' optional comments and suggestions to capture qualitative feedback relevant to product improvement.

The same scorecard format and rating scheme were applied to all treatments for both products to ensure consistent and comparable responses. Panelists were instructed to rinse their mouths with water between samples to minimize sensory carryover and improve rating reliability.

The microbiological quality of the selected jam and juice samples was determined through laboratory analysis conducted at a regional standard and testing facility. Standard microbiological test procedures were used to generate quantitative results for aerobic plate count, mold and yeast count, total coliform count, and Escherichia coli count. These parameters served as objective indicators of hygienic processing, microbial stability, and product safety.

Economic viability was assessed using a costing and pricing worksheet developed for the study. The worksheet captured ingredient costs, packaging and overhead expenses, total yield, cost per unit, mark-up, selling price, gross income, net income, and Return on Expenditure (ROE). This instrument enabled standardized computation and comparison of financial outcomes for the best-performing jam and juice formulations.

2.4 Data Analysis

Data from the sensory evaluation, microbiological testing, and economic assessment were organized, processed, and analyzed using appropriate statistical and analytical methods aligned with the study's objectives.

Descriptive statistics, including mean, standard deviation, frequency, and percentage, were used to summarize the level of sensory acceptability of *Carissa carandas* jam and juice in terms of appearance, aroma, taste, and texture. Mean hedonic scores were interpreted using the corresponding qualitative descriptions of the 9-point Hedonic scale.

Inferential statistical analyses were conducted to determine whether significant differences existed among treatments. For sensory evaluation data, multivariate analysis using Wilks' Lambda was employed to examine the overall effect of treatments on combined sensory attributes. Tests of between-subjects effects were used to assess differences in individual sensory attributes across treatments. When applicable, pairwise comparisons with Bonferroni adjustment were performedto identify specific treatment differences. Statistical significance was set at $\alpha = 0.05$.

Results of microbiological analyses were interpreted descriptively by comparing laboratory findings with established food safety standards and allowable limits for jam and juice products. Compliance with microbiological criteria was used as an indicator of product safety and adequacy of hygienic processing practices.

Economic data were analyzed through cost–return analysis. Total production cost, yield, selling price, gross income, and net income were computed for each product. Return on Expenditure (ROE) was calculated by dividing net income by total production cost and expressing the result as a percentage. This analysis assessed the financial viability of producing *Carissa carandas* jam and juice.

All statistical analyses were conducted at a 95% confidence level, and results were presented in tables and interpreted in relation to the study objectives.

3 Results

The sensory acceptability scores for *Carissa carandas* jam and juice across treatments are summarized in Table 1. All treatments for both products obtained high mean hedonic scores, indicating favorable consumer acceptance.

For *Carissa carandas* jam, mean scores for appearance ranged from 8.37 to 8.50, aroma from 8.07 to 8.33, taste from 8.20 to 8.50, and texture from 8.20 to 8.43. All attributes across treatments were descriptively interpreted as “liked very much.” Treatment 2 recorded the highest overall mean sensory score among jam formulations.

For *Carissa carandas* juice, mean scores for appearance ranged from 8.33 to 8.57, aroma from 8.17 to 8.60, taste from 8.13 to 8.60, and texture from 8.23 to 8.50. Treatment 3 obtained the highest mean scores across all sensory attributes and was descriptively rated from “liked very much” to “extremely liked.” Overall, both products demonstrated high sensory acceptability across formulations.

Multivariate analysis using Wilks’ Lambda showed that the type of treatment had no statistically significant effect on the combined sensory attributes of *Carissa carandas* jam ($\Lambda = 0.929$, $p = 0.743$) or juice ($\Lambda = 0.905$, $p = 0.492$).

Tests of between-subjects effects further revealed no significant differences among treatments for individual sensory attributes. For jam, no significant differences were observed in appearance ($p = 0.921$), aroma ($p = 0.493$), taste ($p = 0.429$), or texture ($p = 0.420$). Similarly, for juice, differences among treatments were not statistically significant for appearance ($p = 0.519$), aroma ($p = 0.149$), taste ($p = 0.054$), or texture ($p = 0.601$).

Pairwise comparisons using Bonferroni adjustment indicated that none of the treatment pairs differed significantly ($p > 0.05$) for all sensory attributes in both jam and juice formulations. These results indicate that increasing the amount of *Carissa carandas* fruit did not result in statistically significant changes in sensory quality.

Although no statistically significant differences were detected among treatments, the best formulations were identified based on the highest overall mean sensory scores. For jam, Treatment 2 (1500 g *Carissa carandas***)** recorded the highest overall mean score and was selected as the preferred formulation. For juice, Treatment 3 (650 g *Carissa carandas***)** achieved the highest overall sensory acceptability and was identified as the best formulation.

Results of microbiological analyses for the selected jam and juice formulations are presented. For *Carissa carandas* jam, the aerobic plate count was less than 1.0 CFU/g, while mold and yeast counts were less than 10 CFU/g. These values were within the allowable limits for processed fruit products.

For *Carissa carandas* juice, aerobic plate count was less than 250 CFU/mL, total coliform count and *Escherichia coli*count were less than 3.0 MPN/mL, and mold and yeast counts were less than 10 CFU/mL. All microbiological parameters complied with established food safety standards, indicating that the products were microbiologically safe for consumption.

The economic analysis results are summarized in Tables 11 and 13. The total production cost of *Carissa carandas* jam was PHP 272.50, yielding ten 120 mL jars. The computed selling price per jar was PHP 34.06, resulting in a gross income of PHP 340.60 and a net income of PHP 68.10. The return on expenditure (ROE) for jam production was 24.99%**.**

For *Carissa carandas* juice, the total production cost was PHP 99.50, producing three 350 mL bottles. The selling price per bottle was PHP 41.46, resulting in gross income of PHP 124.38 and net income of PHP 24.88. The computed ROE for juice production was 25.01%**.**

4. Discussion

The consistently high hedonic ratings across all sensory attributes indicate that *Carissa carandas* is a viable raw material for developing fruit-based jam and juice products. This finding aligns with the literature, which describes karonda as a fruit with a substantial phytochemical and organic acid composition that can support desirable color intensity and flavor complexity when processed (Bibha et al., 2024). The observed acceptability also supports prior work showing that karonda can be transformed into palatable, consumer-acceptable processed products despite its naturally sour profile in fresh form (Meena et al., 2020).

In the present study, all treatments of jam were rated within the “liked very much” range, and juice treatments similarly demonstrated strong acceptability, with the highest mean scores observed in the most concentrated fruit formulation. These results parallel findings from value-added karonda products, in which sensory ratings remained generally favorable across formulations, supporting the concept that processing can moderate perceived sourness and improve overall product liking (Laxmi et al., 2021; Rafique et al., 2023). Moreover, studies on mixed or composite jams indicate that adjustments in fruit proportions do not necessarily produce drastic changes in hedonic outcomes, provided that sweetness, acidity, and texture remain within consumer-acceptable ranges (Ogori et al., 2021; Pushpendra et al., 2024).

From an applied product development perspective, the strong sensory results can also be interpreted through the lens of consumer perception research, indicating that color and appearance serve as high-impact cues in beverage and fruit product acceptance, influencing perceived quality and willingness to consume (Mamoona et al., 2023). Given the characteristic pigments of karonda (notably anthocyanins and related phenolics), the fruit’s natural coloration likely contributed to favorable appearance ratings in both jam and juice, especially at higher fruit concentrations (Bibha et al., 2024).

The absence of statistically significant differences among treatments suggests that the range of fruit concentrations used in the study produced products that were sensory comparable to those preferred by respondents. This pattern is consistent with the jam formulation literature, which indicates that moderate changes in fruit pulp proportion may not yield statistically distinct hedonic profiles, especially when sugar and processing steps are standardized (Ogori et al., 2021; Pushpendra et al., 2024). For practical adoption, this is advantageous: it allows small-scale processors to select formulations based on ingredient availability or cost constraints without substantially compromising consumer acceptability.

Additionally, the finding may reflect the balancing role of sugar addition and heat processing. In fruit preserves, sugar contributes not only sweetness but also mouthfeel, viscosity, and flavor masking of excessive acidity; these effects can reduce perceptible differences caused solely by varying fruit content. Evidence from karonda-based jam development indicates that acceptable sensory profiles can be achieved when formulation parameters (particularly soluble solids and acidity) are controlled (Laxmi et al., 2021; Rafique et al., 2023).

Although treatments were not statistically different, selecting a “best formulation” based on the highest mean overall acceptability is consistent with standard product development practice, especially in applied food innovation studies. The preferred jam formulation (Treatment 2) and the preferred juice formulation (Treatment 3) correspond to higher fruit quantities,

suggesting that increased fruit content may enhance overall sensory appeal, likely through stronger fruit flavor intensity and improved color saturation.

This trend is consistent with karonda-based product studies where increasing karonda proportion can improve sensory scores for attributes linked to fruit character (e.g., color, taste, mouthfeel), if sourness remains balanced (Pushpendra et al., 2024). Similarly, karonda jam research has shown that acceptable products can be achieved and optimized through iterative trials, with the best-performing formulation typically reflecting a balance of fruit solids, sweetness, and texture (Laxmi et al., 2021).

From a processing standpoint, identifying preferred formulations supports future standardization efforts. Standardization is particularly relevant for underutilized fruits due to variability in ripeness, acidity, and pigment concentration. Such variability can influence batch-to-batch consistency, and controlled formulation selection offers a practical pathway toward quality assurance and potential commercialization.

Microbiological test results indicated that both jam and juice samples were within acceptable limits for key indicators, including aerobic plate count, mold and yeast, and coliform-related measures. These findings support the conclusion that the applied processing steps (e.g., heating, pasteurization, hygienic handling, and sealed storage) were effective in reducing microbial risks.

The result aligns with established food microbiology principles: thermal processing combined with sugar concentration and acidity typically reduces water activity and creates an inhibitory environment for microbial proliferation in jams and similar preserves. Research on karonda jam and karonda squash likewise reports microbiological safety during storage when hygienic processing is implemented (Laxmi et al., 2021; Laxmi et al., 2022).

The broader literature emphasizes that microbiological testing is a core component of food safety and quality assurance, enabling detection of contamination and verification of sanitary practices (Sornoza, 2024). Industry guidance also underscores that routine microbiological analyses strengthen consumer trust and provide evidence of compliance readiness for small-scale product commercialization (ElexBio, n.d.). Notably, plant-derived bioactive compounds in karonda have been reported to possess antimicrobial potential, which may complement processing controls; however, such effects should be considered supportive rather than a substitute for good manufacturing practices (Bibha et al., 2024).

The ROE values for jam and juice (approximately 25% in both products) indicate that *Carissa carandas* processing can be financially viable at a small scale. This supports the broader argument that value addition can transform underutilized fruits from household waste into income-generating commodities. Such outcomes are consistent with research highlighting that underutilized plant resources can contribute to nutrition while also supporting local enterprise development when processing and marketability are addressed (Chacha et al., 2022; Kamble et al., 2023).

Economic feasibility is particularly relevant in contexts where *Carissa carandas* is locally available and often underused. When raw materials are accessible, and production inputs are limited to standard household or community-level equipment, the barrier to entry for microenterprise adoption is reduced. Additionally, comparable product development studies (including syrup and jam formulations from karonda) suggest that processed karonda products can be positioned as affordable functional foods with potential niche appeal due to distinctive flavor and perceived health value (Dunghav & Hingane, 2022).

Collectively, the sensory, microbiological, and economic results support the feasibility of developing *Carissa carandas*jam and juice as safe, acceptable, and market-viable products. The study adds applied evidence to existing research on karonda's nutritional and functional promise (Bibha et al., 2024; Saher et al., 2019) and reinforces the role of value-added processing as a strategy to reduce fruit waste and enhance community-level food utilization. The findings also

provide a practical basis for product standardization, food processing education and training activities, and small-scale entrepreneurship initiatives.

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