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Development and Acceptability of Breadnut Seed (Artocarpus camansi) Polvoron

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Abstract: *This developmental study formulated breadnut seed (Artocarpus camansi) polvoron and evaluated its sensory characteristics, acceptability, and reported nutritional composition. Three formulations using different proportions of breadnut seed flour (100%, 50%, and 25% as described in the source) were tested by 120 purposively selected evaluators: 20 food technology experts and 100 students. Descriptive sensory assessments and a nine-point hedonic scale were analyzed using means, standard deviations, analysis of variance (ANOVA), and reported Scheffé comparisons. All formulations had a characteristic nutty aroma and flavor and were moderately sweet. Formulation C achieved the highest composite acceptability mean (7.94), followed by B (7.71) and A (7.34). Omnibus tests showed significant differences in color, flavor, sweetness, texture, and composite appeal (reported $p < 0.01$), but not aroma ($p = 0.62$). For Formulation C, age-group ratings did not differ significantly; texture and composite appeal differed by sex. Nutritional analysis reported 45 kcal, 1.5 g fat, 8 g carbohydrate, and 0 g protein per 10-g serving. Breadnut seed polvoron showed favorable initial sensory acceptance, especially Formulation C, but further work is needed on formulation standardization, nutritional claims, safety, shelf life, and broader consumer testing.*

Keywords: Artocarpus camansi; breadnut seed flour; polvoron; food product development; sensory acceptability

I. INTRODUCTION

Product diversification using locally available and underutilized food crops offers an avenue for value addition, community-based processing, and the development of alternatives to conventional snack ingredients. Current food-innovation literature increasingly considers unconventional raw materials for new formulations [1]. Breadnut (Artocarpus camansi), a tropical tree crop associated with Philippine and Southeast Asian food systems, has edible seeds that can be processed into flour. Reviews of its postharvest handling and utilization describe opportunities for improving the use of this resource while addressing practical processing and quality concerns [2].

Research on breadnut seeds and their flour identifies proximate nutrients and functional properties of relevance to product development [3], [4]. Literature on keluwih or breadnut use likewise discusses its food applications and bioactive constituents [5]. More broadly, reviews of the Artocarpus genus [6] and laboratory work on breadnut seed extracts [7] have examined phytochemical or antioxidant properties. These studies motivate investigation of the ingredient, but bioactivity findings for isolated ingredients must not be interpreted as demonstrated health effects of a finished confectionery product.

Breadnut seed flour has been explored in different food products. Studies supplied with the manuscript describe its application as an ice-cream ingredient [8], in breadnut-seed yogurt [9], in breadnut-seed butter [10], and in steamed cake [11]. Research involving aqueous extracts from breadfruit and breadnut parts adds background on chemical properties [12]. Together, these applications show that breadnut is technically adaptable, although each food system has distinct processing conditions and sensory requirements. In particular, a dry, crumbly product such as polvoron requires appropriate flour texture, fat binding, sweetness, and flavor balance.

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Polvoron is a familiar Filipino molded confection traditionally prepared with roasted flour, powdered milk, sugar, and fat. Incorporation of breadnut seed flour may create a locally sourced variant, but changes in flour proportions could influence appearance, aroma, flavor, texture, and overall liking. Prior applications do not establish the acceptability of breadnut-based polvoron, and experimental comparison is necessary. This study therefore developed three formulations and examined their descriptive sensory attributes, hedonic acceptability, differences among formulations, differences in ratings of the preferred formulation across respondent groups, and reported nutritional composition. The purpose was to evaluate product-development potential, not to establish therapeutic benefits or commercial shelf stability.

II. METHODOLOGY

Research design, setting, and evaluators

A developmental research design with exploratory and descriptive components was implemented at the Food Technology Innovation Center, Surigao del Norte State University, Surigao City, Philippines. The study used controlled formulation, expert product critiquing, sensory evaluation, and nutritional testing. Purposive sampling yielded 120 participants, comprising 20 food technology experts and 100 student consumers. In the sample, 60.0% were aged 20 years or younger, 55.0% were female, 96.7% were single, and 92.5% were at college level. These characteristics define the evaluation population and limit generalization to other market segments.

Formulation and sample preparation

Three breadnut seed polvoron formulations were developed using the manuscript's reported proportions of 100%, 50%, and 25% breadnut seed flour, with the other ingredients described as fixed. Mature seeds were cleaned, peeled, sliced, dehydrated for six hours, and milled into flour. Breadnut seed flour was mixed with roasted all-purpose flour, powdered milk, sugar, butter, and flavoring ingredients, blended to a uniform consistency, molded, cooled, and packaged. Food technology experts critiqued the prototypes before consumer evaluation. The source does not provide complete mass-based ingredient specifications for each formulation; these should be supplied for reproducibility.

Measurements, statistical analysis, and ethics

Coded samples were assessed using a descriptive sensory score sheet and a nine-point hedonic scale, anchored from 1 (dislike extremely) to 9 (like extremely). The acceptability evaluation included color, aroma, flavor, dominant flavor, texture, and composite appeal as recorded in the source results. Respondents rinsed their mouths between samples. Frequencies and percentages summarized profiles, while means and standard deviations summarized ratings. Repeated-measures one-way ANOVA and reported Scheffé post hoc comparisons were used to compare formulations, and independent-group ANOVA assessed Formulation C ratings by age and sex at the 0.05 significance level. The selected formulation underwent reported nutritional analysis through DOST–Caraga. The source reports institutional approval, informed consent, confidentiality, participant withdrawal rights, and food allergy precautions.

III. RESULTS AND DISCUSSION

Descriptive sensory attributes and acceptability

Descriptive assessments identified a nutty aroma and flavor across all formulations and moderate sweetness. Formulations A and C were characterized as light brown, while B was described as cream-colored. Color-description scores were 4.49, 3.41, and 3.54 for A, B, and C, respectively, using the manuscript's descriptive instrument. Aroma means ranged from 3.60 to 3.78 and flavor means from 3.85 to 3.92. These descriptive indicators should be distinguished from hedonic liking scores, which use a different response scale.

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TABLE I: SENSORY ACCEPTABILITY OF BREADNUT SEED POLVORON (NINE-POINT HEDONIC SCALE; MEAN ± SD)

Attribute	Formulation A	Formulation B	Formulation C
Color	7.36 ± 1.48	7.73 ± 1.39	7.88 ± 1.25
Aroma	7.34 ± 1.51	7.38 ± 1.55	7.48 ± 1.61
Flavor	7.06 ± 1.65	7.40 ± 1.63	7.78 ± 1.28
Dominant flavor	7.01 ± 1.54	7.40 ± 1.47	7.66 ± 1.47
Texture	6.85 ± 1.58	7.28 ± 1.55	7.38 ± 1.54
Composite appeal	7.34 ± 1.48	7.71 ± 1.39	7.94 ± 1.25

As shown in Table I, all three variants received generally favorable scores, falling within the manuscript's descriptive interpretations of "like moderately" or "like very much." Formulation C obtained the highest mean for all reported hedonic attributes, particularly composite appeal (7.94) and color (7.88), followed by Formulation B for overall appeal (7.71). Aroma ratings were similar among variants, whereas texture was the lowest-rated attribute in Formulation A (6.85). These results suggest room for refinement in mouthfeel, but the numerical rankings alone do not establish statistically significant differences between every pair of formulations.

Differences among formulations

TABLE II: REPORTED ANOVA OF SENSORY ACCEPTABILITY AMONG FORMULATIONS

Sensory attribute	F statistic	Reported p	Decision (α = .05)
Color	8.63	0.00	Significant
Aroma	0.47	0.62	Not significant
Flavor	13.87	0.00	Significant
Sweetness	11.90	0.00	Significant
Texture	7.70	0.00	Significant
Composite appeal	11.39	0.00	Significant

Note: Values shown as 0.00 are rounded values reported in the source, not literal zero. "Sweetness" appears in the ANOVA table, while the hedonic table separately labels "dominant flavor"; the original instrument should clarify this labeling difference.

The omnibus ANOVA (Table II) indicated differences in color, flavor, sweetness, texture, and composite appeal; aroma did not differ significantly ($p = 0.62$). The manuscript's pairwise comparisons reported significant A–C differences for color ($p = .001$), flavor ($p < .001$), sweetness ($p < .001$), texture ($p = .003$), and composite appeal ($p < .001$). Composite appeal did not differ significantly between B and C (reported $p = .142$), even though C had the higher mean. Several source pairwise rows with $p < .05$ were incorrectly labeled "not significant." This synthesis follows the reported p-values rather than the inconsistent decision labels; author verification of the original post hoc output remains necessary before submission.

The pattern suggests that formulation changes influenced several dimensions of liking, whereas the characteristic nutty aroma remained stable. As observed in other breadnut-derived products, the interaction between plant-based flour and the surrounding food matrix is important for sensory performance [8]–[11]. The reported data support use of Formulation C as a promising prototype, not as proof of statistically superior acceptability over Formulation B on composite appeal.

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Subgroup differences in acceptability

TABLE III: FORMULATION C SUBGROUP COMPARISONS AND SEX-GROUP RATINGS

Outcome	Age-group test	Sex-group test	Male mean	Female mean
Texture	p = .60	F = 8.47; p = .00	6.94	7.74
Composite appeal	p = .13	F = 9.14; p = .00	7.57	8.24

Note: The remaining age-group tests (color, aroma, flavor, sweetness) and sex-group tests (color, aroma, flavor, sweetness) were all nonsignificant at $\alpha = .05$. Source values displayed as 0.00 were rounded.

No significant differences were found between age groups for any evaluated attribute of Formulation C (reported p values .13–.93). Grouping by sex yielded significant differences for texture (reported F = 8.47, p = .00) and composite appeal (F = 9.14, p = .00), but not for color, aroma, flavor, or sweetness. Female respondents rated texture and composite appeal more favorably than male respondents, as summarized in Table III. These are within-sample associations and should not be interpreted as biological causes or generalized sex-based preferences, given the purposive sample and predominantly student evaluators.

Nutritional composition and product-development implications

TABLE IV: REPORTED NUTRITION FACTS FOR SELECTED FORMULATION C (10-G SERVING)

Component	Amount per serving
Energy	45 kcal
Total fat	1.5 g
Total carbohydrate	8 g
Total protein	0 g

Laboratory nutrition facts (Table IV) report that a 10-g serving of Formulation C provides 45 kcal, 8 g carbohydrate, 1.5 g fat, and 0 g protein. The product is therefore principally an energy-providing confection within this small serving size; its composition does not support characterizing it as protein-enriched or attributing clinically meaningful functional benefits. Although breadnut seed itself has been studied for nutrients, flour functionality, and phytochemical activity [3], [4], [7], the finished polvoron was not reported to have been tested for antioxidant potency, dietary fiber, or vitamin and mineral content. Moreover, favorable sensory ratings cannot establish shelf stability or microbiological safety. Ingredient-standardization, analytical confirmation, shelf-life testing, and broader consumer evaluation would be appropriate next steps.

IV. CONCLUSION

The three developed breadnut seed (Artocarpus camansi) polvoron formulations were favorably evaluated by 120 food technology experts and student consumers. Formulation C achieved the highest observed composite acceptability score (7.94/9), while significant overall differences were reported for color, flavor, sweetness, texture, and composite appeal, but not aroma. The difference in composite appeal between B and C was not statistically significant in the reported post hoc test. Ratings for Formulation C were comparable across age groups, while sex-group differences were detected in texture and composite appeal. Its reported nutritional composition per 10-g serving was 45 kcal, 8 g carbohydrate, 1.5 g fat, and no protein. These findings support further development of breadnut seed polvoron as a locally sourced confectionery product, subject to verification of statistical reporting, standardized formulations, product safety, shelf life, and nutritional claims.

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