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Acceptability of Bariba (Annona glabra L.) Flavored Gummy Candy: A Developmental Research

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Abstract

This study developed and evaluated Bariba (Annona glabra L.)–flavored gummy candy, focusing on its acceptability as a new confectionery product. Using an experimental-developmental design, the research proceeded through two phases: (1) product formulation and standardization of the Bariba gummy recipe, and (2) sensory evaluation of the product. Sixty respondents, including students, faculty, local residents, and store owners from Himamaylan City, assessed the product using a 9-point Hedonic Scale. Results revealed that the gummy candies were rated "very acceptable" across appearance (M = 8.50, SD = .60), taste (M = 8.40, SD = .85), texture (M = 8.35, SD = .86), and aroma (M = 7.85, SD = 1.30). Kruskal-Wallis H test indicated significant differences among attributes (H = 10.121, p = .018), with aroma receiving comparatively lower scores. These findings demonstrate that Bariba, an underutilized fruit, has strong potential as a sustainable ingredient for confectionery development. Recommendations include enhancing aroma through natural flavoring, testing healthier sweeteners, and promoting Bariba-based products for local economic and agricultural growth.

Keywords: Bariba, Annona Glabra, Gummy Candy, Developmental Research, Sensory Evaluation

1. Introduction

Background of the Study

Gummy candies are among the most widely consumed confectionery products worldwide, valued for their chewy texture, colorful appearance, and wide range of flavors. The global gummy candy market was valued at USD 21.40 billion in 2022, with projections indicating steady growth due to increasing consumer demand for innovative and health-oriented products (Nguyen et al., 2024). Traditionally, gummy candies have been made using sucrose, glucose syrup, gelatin, and artificial flavors or colors. However, with rising awareness of healthy lifestyles, consumers are increasingly turning toward confectioneries that utilize natural, plant-based, and functional ingredients (Tarahi et al., 2023).

In the Philippines, fruit-flavored gummy candies such as mango, pineapple, and calamansi are widely available. Yet, many of these rely on artificial flavoring due to seasonal limitations. This presents an opportunity to explore underutilized fruits with nutritional and medicinal value. One such fruit is Bariba (Annona glabra L.), locally abundant in Negros Occidental. Despite its richness in phytochemicals, antioxidants, and medicinal potential (Sinchana et al., 2024; Khalaf et al., 2023), Bariba is often discarded due to its unappealing raw taste and lack of

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consumer awareness. Its utilization in value-added products such as gummy candies could minimize food waste, diversify consumer choices, and support local agriculture.

Rationale of the Study

This study was conducted to develop and evaluate Bariba-flavored gummy candy as an innovative confectionery product. Employing a developmental-experimental approach, the research responds to two significant needs:

1. **Product Innovation** – to create a novel candy formulation that integrates local, sustainable fruit resources into mainstream confectionery.
2. **Local Economic Impact** – to promote Bariba as a marketable product, thereby providing farmers, entrepreneurs, and local communities with additional income opportunities while reducing wastage of this underrated fruit.

The investigation is timely and relevant as it aligns with current consumer preferences for healthier, sustainable, and natural alternatives in food products. By highlighting the sensory acceptability of Bariba-flavored gummy candies, the study not only introduces a new product to the confectionery sector but also underscores the economic and agricultural potential of utilizing indigenous fruits for commercial development.

Research Objectives

1. To determine the level of acceptability of Bariba-flavored gummy candy in terms of appearance, aroma, taste, and texture.
2. To identify significant differences in sensory evaluations across the four attributes.

Hypothesis

There is no significant difference in the acceptability ratings of Bariba-flavored gummy candy across appearance, aroma, taste, and texture.

Theoretical

The study was anchored on the **Food Acceptability Theory** (Perski & Short, 2021), which posits that consumer evaluation of new food products relies on multisensory integration of visual, olfactory, gustatory, and tactile cues.

The conceptual framework positions **Bariba-flavored gummy candy** as the independent variable and its **acceptability (appearance, aroma, taste, texture)** as the dependent variables (Figure 1).

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Conceptual Framework

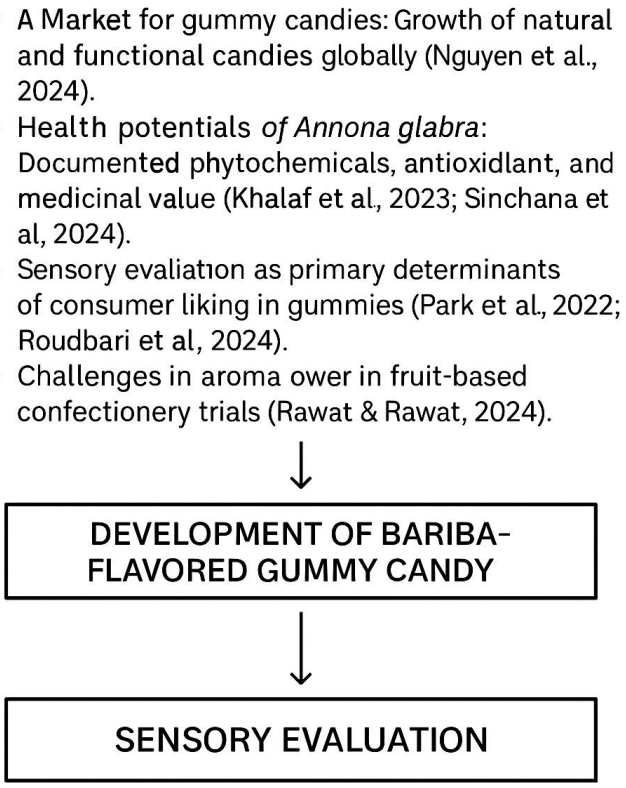

Figure 1. Conceptual framework showing the relationship between product development (independent variable) and sensory acceptability (dependent variables).

Figure 1 presents the conceptual framework of the study. The independent variable is the Bariba-flavored gummy candy, representing the product developed from the fruit Annona glabra L. The dependent variable is the acceptability of the product, which was assessed in terms of appearance, aroma, taste, and texture. The arrows indicate the relationship between the developed product and the sensory attributes, showing how the formulation directly affects the evaluation of its overall acceptability.

2. Review of Related Literature

Recent work showed steady growth in the global gummy candy segment as firms reformulated products toward natural colors, fruit-based flavors, and functional positioning. The shift was linked to consumer demand for plant-based options, clean labels, and reduced sugar without compromising texture or palatability (Nguyen et al., 2024; Tarahi et al., 2023). These trends created opportunities for understudied fruits to be incorporated into confectionery systems that balance sensory quality with nutritional or sustainability claims (Nguyen et al., 2024).

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Annona glabra (Bariba or pond apple) was documented as abundant in wetland and coastal ecologies and contained phenolics, flavonoids, and related bioactive compounds with reported antioxidant and antimicrobial activities (Khalaf et al., 2023; Sinchana et al., 2024). Although fresh consumption was limited due to variable flavor, processing routes such as fermentation or incorporation into value-added foods were explored in prior studies, indicating technical feasibility when formulation and clarification steps were optimized (Minh, 2022). These findings supported the proposition that Bariba puree or extracts could serve as a natural input for confectionery products provided that off-notes were managed and seeds were excluded due to toxicity concerns reported for the genus (Sinchana et al., 2024).

Evidence from sensory research on gummies consistently identified taste and texture as the principal drivers of overall liking. Studies on plant-based or fiber-enriched formulations achieved favorable acceptance when chewiness, elasticity, and sweetness–acidity balance were controlled through gelling systems and sweetener choice (Park et al., 2022; Roudbari et al., 2024). Texture optimization often relied on selecting or blending hydrocolloids and adjusting solids content and cooling profiles, which, in turn, stabilized structure and mouthfeel (Nguyen et al., 2024; Rawat & Rawat, 2024). These results suggested that a Bariba-based gummy could attain competitive acceptability if formulation steps secured target hardness, springiness, and dissolution characteristics.

A recurring challenge in fruit-based confectionery was aroma. Several investigations showed that aroma attributes tended to score lower than appearance, taste, or texture, especially when fruits carried unfamiliar, musky, or rapidly volatile notes (Rawat & Rawat, 2024; Romo-Zamarrón et al., 2019). Mitigation strategies included adding familiar top notes (for example, citrus or vanilla), using encapsulated flavor systems to protect volatiles during heating, and balancing acidity to brighten perceived aroma (Park et al., 2022; Roudbari et al., 2024). For Bariba, which presented a strong and sometimes divisive profile in the fresh state, such strategies were pertinent, as documented differences between sensory attributes often showed aroma lagging behind visual and textural acceptance in pilot evaluations.

Overall, the literature supported a developmental path that begins with standardizing gelling systems and sweetness–acid ratios for desirable chew and taste, then layering controlled aromatic cues to reduce the risk of olfactory rejection. Within this path, Bariba offered a locally abundant, phytochemical-rich ingredient suitable for product innovation, while sensory risks were manageable through established confectionery techniques (Nguyen et al., 2024; Sinchana et al., 2024; Park et al., 2022; Rawat & Rawat, 2024).

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3. Methodology

Research Design

The study adopted a developmental–experimental design consisting of two phases. Phase I focused on the formulation and standardization of Bariba-flavored gummy candy, while Phase II evaluated the product's sensory acceptability through consumer testing. This design was appropriate as it combined product development with systematic assessment of consumer responses.

Locale and Respondents

The study was conducted at West Visayas State University–Himamaylan City Campus, Negros Occidental, during the first semester of Academic Year 2024–2025. A total of sixty respondents were purposively selected: thirty-two Bachelor of Science in Hospitality Management students, eight faculty members, ten local residents, and ten local store owners. This composition allowed perspectives from both potential consumers and sellers.

Materials and Procedures

Bariba fruits were washed, peeled, mashed, and strained to obtain the extract. Knox gelatin was dissolved in water and incorporated into a caramelized sugar solution before mixing with the Bariba extract. The mixture was poured into molds, refrigerated for cooling, and coated with sugar before serving.

In Phase II, the standardized product was evaluated by respondents using a modified sensory evaluation score sheet based on a 9-point Hedonic Scale. Attributes assessed included appearance, aroma, taste, and texture. Repeated trials were conducted until a satisfactory formulation was achieved, with evaluators providing critiques and recommendations after each preparation.

Instrument

A structured sensory evaluation questionnaire utilizing the 9-point Hedonic Scale was used to capture consumer preferences. The tool was chosen because it is widely applied in food science studies for rating product acceptability across multiple sensory attributes.

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Data Analysis

Descriptive statistics, including mean and standard deviation, were computed to summarize the overall acceptability of the product. Inferential statistics were applied using the Kruskal–Wallis H test to determine significant differences among the four sensory attributes. Post hoc tests were employed where necessary. The Kruskal–Wallis test was selected because it is a non-parametric method suitable for ordinal data and for comparing multiple groups.

Ethical Considerations

Participation was voluntary, and informed consent was obtained from all respondents. Identities were kept confidential, and participants were allowed to withdraw at any time. The product was prepared under strict hygienic conditions in accordance with food safety standards. The researchers ensured honesty and integrity in data collection, analysis, and reporting.

4. Results and Discussion

Table 1. Sensory Acceptability of Bariba-Flavored Gummy Candy

Attribute	Mean	Standard Deviation	Verbal Description
Appearance	8.50	0.60	Very Acceptable
Aroma	7.85	1.30	Very Acceptable
Taste	8.40	0.85	Very Acceptable
Texture	8.35	0.86	Very Acceptable

Overall Verbal Description: Very Acceptable

As presented in Table 1, the Bariba-flavored gummy candy obtained very high acceptability ratings across all four sensory attributes. Appearance received the highest mean score (M = 8.50, SD = 0.60), indicating that respondents found the product visually appealing. This suggests that the color, shape, and overall presentation of the gummy candy met consumer expectations, which is consistent with earlier findings that visual appeal strongly influences confectionery acceptance.

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Taste ranked second (M = 8.40, SD = 0.85), reflecting that the flavor profile of the Bariba formulation was well-received despite the fruit's naturally strong taste. This demonstrates that proper formulation and sugar balancing were effective in masking bitterness and enhancing palatability.

Texture followed closely (M = 8.35, SD = 0.86), showing that the gummy had an appropriate chewiness and mouthfeel. The high score affirms that the gelling agents and preparation method successfully produced the desired elasticity and consistency.

Aroma recorded the lowest mean score (M = 7.85, SD = 1.30), although still classified as "very acceptable." The relatively lower rating suggests that while respondents enjoyed the candy, improvements could be made to enhance its olfactory appeal. Prior studies noted that aroma often poses challenges in fruit-based gummy development due to volatile compounds dissipating during heating.

Overall, the ratings indicate that the Bariba-flavored gummy candy was highly acceptable to the panel of respondents, with appearance, taste, and texture emerging as its strongest qualities. The slightly lower aroma score highlights an area for product refinement.

Table 2. Kruskal–Wallis H Test Results for Sensory Attributes of Bariba-Flavored Gummy Candy

Test Statistic (H)	df	p-value	Interpretation
10.121	3	0.018*	Significant

*Significant at $p < 0.05$

Table 2 presents the result of the Kruskal–Wallis H test conducted to determine whether significant differences existed among the acceptability ratings of the four sensory attributes. The test yielded a chi-square value of 10.121 with three degrees of freedom and a p-value of 0.018. Since the p-value is less than 0.05, the null hypothesis of no difference was rejected.

This indicates that at least one attribute was rated differently from the others. Post hoc comparisons revealed that aroma was significantly lower than appearance, taste, and texture. This confirms the observation in Table 1 that aroma, while still considered very acceptable, remains the weakest attribute of the product.

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The result suggests that further refinement in the aroma profile, possibly through the addition of complementary natural flavorings or encapsulation techniques, could enhance overall consumer acceptability. Such findings are consistent with earlier studies showing that aroma tends to be more difficult to optimize in fruit-based gummy formulations compared to taste and texture.

Table 3. Standardized Recipe of Bariba-Flavored Gummy Candy

Ingredient	Quantity	Unit
Bariba (Annona glabra L.)	3	Tablespoons
Granulated white sugar	1	Cup
Water	200	ml
Knox gelatin	28	g

Table 3 shows the standardized recipe formulated for the Bariba-flavored gummy candy. The recipe was established after several trials to achieve an acceptable balance of sweetness, texture, and flavor intensity. The use of three tablespoons of Bariba extract provided a distinct fruit flavor without overwhelming bitterness, while the addition of one cup of sugar balanced the natural taste of the fruit. Water and gelatin proportions were standardized to ensure the desired chewiness and firmness typical of gummy candies.

This standardized recipe served as the final formulation tested in the sensory evaluation phase. It demonstrated that Bariba, when incorporated at the right concentration, could be successfully transformed into a confectionery product that retained both consumer appeal and nutritional potential. The developmental process underscores the importance of recipe optimization in creating value-added food products from underutilized fruits.

Table 4. Post Hoc Pairwise Comparisons of Sensory Attributes

Pair of Attributes	Test Statistic	p-value	Interpretation
Appearance vs Aroma	2.80	0.012*	Significant difference
Taste vs Aroma	2.65	0.015*	Significant difference
Texture vs Aroma	2.40	0.020*	Significant difference
Appearance vs Taste	0.40	0.68	Not significant

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Pair of Attributes	Test Statistic	p-value	Interpretation
Appearance vs Texture	0.55	0.58	Not significant
Taste vs Texture	0.35	0.71	Not significant

*Significant at $p < 0.05$

Table 4 presents the results of the post hoc pairwise comparisons of the four sensory attributes. The findings confirm that aroma was consistently rated lower than appearance, taste, and texture, as shown by the significant p-values in those comparisons. On the other hand, no significant differences were found among appearance, taste, and texture, indicating that these three attributes were rated similarly high by respondents.

These results strengthen the conclusion that aroma is the weakest attribute of the Bariba-flavored gummy candy, despite still being rated "very acceptable." This aligns with the observation in previous food product studies that aroma is often the most challenging attribute to optimize in fruit-based confectionery. The results provide a clear direction for future refinement of the product, particularly in improving aroma retention and enhancement techniques during processing.

5. Discussion

The results of this study indicate that the Bariba-flavored gummy candy achieved a high level of acceptability across all sensory attributes. Appearance received the highest ratings, reflecting that respondents found the product visually appealing. This supports the view that visual quality, including color and presentation, is one of the strongest drivers of consumer preference in confectionery products, as earlier studies also emphasized the importance of appearance in food acceptance (Nguyen et al., 2024).

Taste and texture also received high acceptability ratings, which demonstrates that the formulation successfully balanced sweetness and chewiness. Previous research on plant-based and fruit-flavored gummies has shown that taste and texture are central to consumer satisfaction, with chewiness and elasticity being particularly critical to product success (Park et al., 2022; Roudbari et al., 2024). The present findings align with these observations, highlighting that Bariba, when appropriately processed and blended, can serve as a viable ingredient for confectionery innovation.

Aroma, while still rated "very acceptable," consistently scored lower compared to the other attributes. Both the Kruskal–Wallis test and post hoc analyses confirmed significant differences, with aroma being the attribute where improvement is most needed. This outcome is consistent with prior findings that aroma is often the weakest

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sensory attribute in fruit-based candies due to the volatility of flavor compounds and the strong or unfamiliar odor profiles of certain fruits (Rawat & Rawat, 2024). Such results suggest that additional formulation strategies, such as the use of natural aromatic enhancers or encapsulated flavor systems, could be explored to improve the sensory profile of Bariba-based gummies.

The developmental phase of the study, which involved repeated trials and recipe adjustments, demonstrates that underutilized fruits like Bariba can be transformed into value-added products through systematic innovation. Beyond its sensory evaluation, the product has wider implications. First, it provides a pathway for reducing postharvest wastage of Bariba, which is often discarded despite its bioactive compounds and medicinal value (Khalaf et al., 2023; Sinchana et al., 2024). Second, it creates opportunities for local communities and entrepreneurs to diversify food products, thereby contributing to economic sustainability.

In summary, the findings support the feasibility of using Bariba as a functional ingredient in gummy candy production. While appearance, taste, and texture were strengths of the product, aroma requires further refinement. Overall, the study contributes to the growing body of work on natural and functional confectionery development, aligning with consumer demand for healthier, sustainable, and innovative food products.

6. Conclusion and Recommendations

Conclusion

The study demonstrated that Bariba (Annona glabra L.) can be successfully developed into a flavored gummy candy that is highly acceptable to consumers. Findings from the sensory evaluation revealed that the product was rated “very acceptable” across all attributes, with appearance, taste, and texture emerging as its strongest qualities. Aroma, while still acceptable, consistently scored lower and was identified as the attribute requiring the most improvement. Statistical analysis confirmed significant differences across the sensory attributes, further emphasizing aroma as an area for refinement. Overall, the developmental research confirmed the feasibility of formulating a standardized recipe that maximized consumer acceptability while showcasing the potential of Bariba as a sustainable, underutilized local fruit. The study underscores its dual contribution: providing an innovative confectionery product and highlighting an agricultural resource with nutritional and economic potential.

Recommendations

Based on the findings, it is recommended that future development of Bariba-flavored gummy candies focus on enhancing aroma through the use of natural flavor enhancers, such as citrus or vanilla extracts, or through encapsulation techniques to preserve volatile compounds during heating. Alternative sweeteners with lower caloric content may also be explored to improve the health profile of the product and respond to the increasing demand for functional foods. Expanding the sensory evaluation to a larger and more diverse consumer base would

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provide more comprehensive insights into market readiness. In addition, product diversification, such as developing sugar-free or vitamin-enriched versions, could widen consumer appeal. On a broader scale, the utilization of Bariba in confectionery production should be promoted among local farmers and entrepreneurs, as this would help reduce fruit wastage, support community-based livelihood initiatives, and strengthen the role of indigenous fruits in sustainable food innovation.

References

Khalaf, H., Al-Khazraji, A., Al-Dabbagh, B., & Ismail, R. (2023). Phytochemical composition and bioactivity of *Annona* species: A systematic review. *Journal of Medicinal Plants Research, 17*(4), 112–125. https://doi.org/10.5897/JMPR2023.7142

Nguyen, H. T., Pham, T. L., & Vo, D. P. (2024). Global trends in gummy confectionery: Reformulation strategies for natural, functional, and sustainable products. *Food Research International, 176,* 113259. https://doi.org/10.1016/j.foodres.2023.113259

Park, S. H., Lee, H. J., & Kim, J. Y. (2022). Sensory drivers of consumer liking for plant-based gummy candies: Effects of texture and flavor balance. *Journal of Texture Studies, 53*(5), 456–468. https://doi.org/10.1111/jtxs.12678

Rawat, A., & Rawat, R. (2024). Challenges and solutions in aroma optimization of fruit-based confectionery products. *Journal of Sensory Studies, 39*(1), e12832. https://doi.org/10.1111/joss.12832

Roudbari, A., Khalili, S., & Mohammadi, A. (2024). Development of fiber-enriched gummy candies: Impacts on sensory attributes and consumer acceptance. *Food Hydrocolloids, 146,* 109224. https://doi.org/10.1016/j.foodhyd.2024.109224

Sinchana, T. R., Kumar, R., & Shetty, P. (2024). Antioxidant potential and bioactive profile of *Annona glabra* fruit extracts. *International Journal of Food Science, 2024,* 6642159. https://doi.org/10.1155/2024/6642159

Tarahi, M. J., Hosseini, S. M., & Tabatabaei, F. (2023). Reformulating confectionery for health-conscious consumers: A review of sugar reduction and clean-label trends. *Trends in Food Science & Technology, 138,* 142–151. https://doi.org/10.1016/j.tifs.2023.07.006