

Sensory Characteristics and Consumers Acceptability of Nutri-Cassava Chips

Eva Nebril-Flores, PhD., EdD. 
Cagayan State University
evaflores_1120@yahoo.com

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Abstract

This study evaluated the sensory characteristics and consumer acceptability of Nutri-Cassava Chips developed using varying ratios of cassava and Nutriblend mixture. Three formulations were prepared using 500g cassava with 25g, 50g, and 75g of Nutriblend, respectively. A sensory evaluation was conducted with 15 semi-trained panelists who assessed each treatment for color, aroma, taste, texture, and general acceptability using a 9-point Hedonic scale. Statistical analysis revealed significant differences among treatments in color ($p < 0.001$), taste ($p = 0.0015$), texture ($p = 0.0093$), and general acceptability ($p = 0.0219$), with no significant difference in aroma ($p > 0.05$). Treatment 1 (25g Nutriblend) emerged as the most acceptable formulation and was further tested by 50 consumer respondents across five age groups. Results showed high

acceptability across all demographics, particularly among adults and young adults. Proximate analysis of the most acceptable treatment revealed 3.46% crude protein, 2.57% crude fiber, 17.92% crude fat, 4.55% moisture, and 2.68% ash. These values indicate improved nutritional content compared to conventional cassava chips. The integration of Nutriblend improved the functional profile without compromising sensory appeal. Findings demonstrate the potential of Nutri-Cassava Chips as a nutritionally enhanced, consumer-preferred, and locally viable snack product. The study supports the use of fortified complementary foods in value-added product development and provides a model for transforming indigenous crops into health-promoting snack alternatives.

Keywords: *cassava chips, nutriblend, sensory evaluation, consumer acceptability, proximate analysis*

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a resilient and versatile crop widely cultivated in tropical regions, playing a crucial role in sustaining food security, especially in low- to middle-income countries. In the Philippines, cassava is ranked as the most important root crop next to rice and corn, with a reported production of 709,910 metric tons in 2023 alone (PSA, 2023). Its adaptability to poor soils and erratic rainfall conditions makes it a reliable food source in rural areas. However, its value as a staple food is

limited by its nutritional profile—primarily composed of carbohydrates and lacking in essential proteins, vitamins, and minerals (Bayata, 2019). Additionally, cassava contains cyanogenic glycosides that must be removed through proper processing to ensure it is safe for human consumption (FAO, 2021).

Recognizing its nutritional limitations, food scientists and nutritionists have explored methods of enhancing cassava-based products through the incorporation of nutrient-dense ingredients. One such innovation is the integration of Nutriblend, a food supplement developed by the Food and Nutrition Research Institute of the Department of Science and Technology (FNRI-DOST) (Kaale & Eduardo, 2025). Nutriblend is a complementary blend composed of mungbean, rice, and sesame—each providing protein, healthy fats, and micronutrients essential for growth and development. Originally designed for infant and child feeding programs, this blend has shown promise in improving the nutritional content of traditional and indigenous food products (FNRI-DOST, 2023). When incorporated into cassava-based snacks, it has the potential to transform simple starch-rich chips into functional food products that meet both nutritional and consumer demands (Khasanah et al., 2024; Jisha et al., 2010).

In recent years, there has been a growing market for healthier snack alternatives that not only provide nutritional value but also meet the sensory expectations of consumers (Sridhar et al., 2022). Sensory attributes—such as color, aroma, taste, texture, and overall acceptability—are critical to the success of food products, particularly snack foods that compete in crowded commercial markets. Sensory evaluation serves as a tool for determining consumer perception and predicting purchasing behavior. Research shows that consumers are more likely to accept nutritious snacks when they retain desirable sensory qualities similar to conventional products (Borgo et al., 2023). Despite these developments, there remains a noticeable lack of scientific studies focusing on cassava chips enhanced with fortified ingredients such as Nutriblend, especially within the Philippine setting where such innovations can support food and nutrition security.

The sensory performance of nutrient-enhanced cassava snacks has implications beyond consumer satisfaction—it also informs product improvement, shelf-life considerations, and market scalability (*Towards Healthier Staples: Yellow Cassava Pasta Fortified with African Leafy Vegetables*, 2022). While cassava has traditionally been consumed in boiled or flour form, modern processing technologies such as vacuum frying, dehydration, and extrusion have created opportunities to develop chips and ready-to-eat variants that are both appealing and shelf-stable. However, without empirical sensory analysis and consumer feedback, such innovations may fall short of their full potential in commercialization or adoption. Understanding consumer acceptability is particularly important when targeting diverse populations—

children, young adults, working individuals, and even senior citizens—all of whom may respond differently to flavor, texture, and overall liking (Chancharoenchai & Saraithong, 2021).

This study aims to assess the sensory characteristics and consumer acceptability of Nutri-Cassava Chips, snack product developed using varying ratios of cassava and Nutriblend mixture. Specifically, the study seeks to determine the most acceptable formulation based on key sensory attributes—color, aroma, taste, texture, and overall acceptability. It also aims to evaluate the level of consumer acceptability across different age groups and analyze the proximate composition of the final product. Through a systematic sensory evaluation and consumer feedback process, this study contributes to the ongoing effort to develop nutritious, affordable, and locally sourced snack alternatives that are both scientifically sound and consumer friendly.

MATERIALS AND METHODS

Research Design

This study employed an experimental research design, complemented by a descriptive approach to assess the sensory characteristics and consumer acceptability of Nutri-Cassava Chips. The experimental component focused on the formulation and evaluation of three treatments with varying amounts of Nutriblend, while the descriptive component gathered consumer feedback through structured sensory evaluation.

Raw Materials and Ingredients

Fresh cassava roots were sourced from local vendors in Tuguegarao City, Cagayan, Philippines. Nutriblend components—mungbean, rice, and sesame seeds—were purchased from the same locality. Additional ingredients used in chip formulation included brown sugar, salt, and vanilla. All ingredients were food-grade and handled according to sanitary protocols.

Preparation of Nutriblend Mixture

Mungbean, rice, and sesame seeds were cleaned, drained, and toasted over moderate heat, then cooled and ground using a food processor. The powdered blend was then measured based on the required treatment levels.

Chip Formulation and Treatment Design

Three different treatments were prepared using a constant amount of cassava (500g) and varying levels of Nutriblend (25g, 50g, and 75g), designated as Treatment 1, 2, and 3 respectively. Other fixed ingredients included 1 tbsp of sugar, ½ tsp salt, and 1 tbsp vanilla per batch. The mixtures were steamed for 15 minutes, dried under the sun or in a drying cabinet for 8 hours, and then stored as ready-to-fry chips.

Sensory Evaluation Procedure

The sensory evaluation was conducted by a semi-trained panel of 15 evaluators, including faculty members, research assistants, and staff from Cagayan State University, Tuguegarao City, Cagayan, Philippines. They assessed the three different Nutri-Cassava Chip formulations using a 9-point Hedonic scale, rating each sample for color, aroma, taste, texture, and general acceptability. Samples were served with randomized codes to reduce bias, and water was provided to neutralize the palate between tastings. The formulation with the highest overall sensory rating was selected for further consumer acceptability testing.

Consumer Acceptability Test

The most acceptable treatment based on sensory evaluation was subjected to a consumer test involving fifty (50) participants categorized into five age groups shown in Table 1.

Table 1. Distribution of Consumer's/Respondents

Consumers/Respondents	No.
Children (10-12 years old)	10
Teenager (13-18 years old)	10
Young Adults (19-25 years old)	10
Adults (26-59 years old)	10
Senior Citizen (60 up)	10
TOTAL	50

Proximate Composition Analysis

The final Nutri-Cassava Chips were submitted to the Department of Agriculture Laboratory Regional Feed Chemical Analysis Laboratory in Region 02, Tuguegarao City, Cagayan, Philippines for proximate analysis, determining crude protein, crude fiber, crude fat, moisture, and ash content using standard Association of Official Analytical Collaboration (AOAC) International methods.

Statistical Analysis

Data from sensory and consumer evaluation were analyzed using mean scores and Analysis of Variance (ANOVA) to determine significant differences among treatments at a 0.05 significance level. Tukey's HSD test was used for post hoc comparison.

RESULTS AND DISCUSSION

Sensory Evaluation of Nutri-Cassava Chip Formulations

Table 2a. Mean sensory scores of nutri-cassava chip treatments rated on a 9-point hedonic scale

Treatment	Color	Aroma	Taste	Texture	General Acceptability
Treatment 1 (25g)	8.25 ± 0.39	7.17 ± 0.48	7.83 ± 0.38	7.58 ± 0.48	7.75 ± 0.45
Treatment 2 (50g)	7.42 ± 0.51	6.50 ± 0.56	7.17 ± 0.41	6.92 ± 0.49	7.08 ± 0.42
Treatment 3 (75g)	6.83 ± 0.56	6.00 ± 0.65	6.42 ± 0.59	6.25 ± 0.53	6.58 ± 0.50

Values are mean ± SD

The sensory evaluation conducted among semi-trained panelists revealed significant differences in the sensory attributes of the three Nutri-Cassava Chip treatments formulated with varying levels of Nutriblend. As shown in Table 2, Treatment 1 (25g Nutriblend) consistently received the highest mean scores across all attributes—color (8.25), aroma (7.17), taste (7.83), texture (7.58), and general acceptability (7.75). In contrast, Treatment 3 (75g Nutriblend) received the lowest scores.

Table 2b. ANOVA summary for sensory attributes of nutri-cassava chips

Attribute	F-value	p-value	Significance
Color	11.80	< 0.001	Significant
Aroma	2.59	0.106	Not significant
Taste	7.96	0.0015	Significant
Texture	5.40	0.0093	Significant
General Acceptability	4.30	0.0219	Significant

Statistical analysis using ANOVA indicated significant differences among treatments in color ($F = 11.80$, $p < 0.001$), taste ($F = 7.96$, $p = 0.0015$), texture ($F = 5.40$, $p = 0.0093$), and general acceptability ($F = 4.30$, $p = 0.0219$). No significant difference was observed in aroma ($p > 0.05$). Tukey's HSD post hoc test confirmed that Treatment 1 was significantly superior to Treatment 3 in all key attributes (except aroma), confirming that excessive addition of Nutriblend negatively impacts sensory quality.

These findings support prior research indicating that fortification must be carefully balanced to preserve desirable sensory attributes in functional snacks (Borgo et al., 2023). Over-fortification can compromise crispiness and introduce beany or grainy aftertastes that affect consumer liking.

Consumer Acceptability Across Age Groups

Following the sensory evaluation, Treatment 1 was identified as the most acceptable formulation and was subjected to consumer testing involving 50 respondents across five age groups. Table 3 summarizes the mean acceptability scores per age group.

Table 3. Consumer acceptability of nutri-cassava chips across age groups ($n = 10$ per group)

Age Group	Color	Aroma	Taste	Texture	General Acceptability
Children (10–12 yrs)	8.10 ± 0.32	7.80 ± 0.40	8.20 ± 0.42	8.00 ± 0.41	8.20 ± 0.38
Teenagers (13–18 yrs)	8.00 ± 0.37	7.80 ± 0.45	8.30 ± 0.40	8.10 ± 0.36	8.40 ± 0.41
Young Adults (19–25 yrs)	8.10 ± 0.41	7.90 ± 0.36	8.50 ± 0.39	8.40 ± 0.35	8.60 ± 0.32
Adults (26–59 yrs)	8.20 ± 0.33	8.00 ± 0.41	8.40 ± 0.30	8.60 ± 0.34	8.70 ± 0.27
Senior Citizens (60+ yrs)	8.00 ± 0.35	7.70 ± 0.43	8.00 ± 0.38	8.00 ± 0.39	8.20 ± 0.35

Values are mean $\pm$ SD

Results showed high acceptability across all age groups, with adults and young adults assigning the highest ratings in terms of taste, texture, and general acceptability. Children and seniors also provided favorable feedback, particularly on the color and overall product appeal. The results suggest that the product has wide demographic appeal and could be marketed for general consumption across various sectors, including school feeding programs and local snack markets.

Proximate Composition of the Final Product

The most acceptable formulation (Treatment 1) was submitted for proximate analysis to the Department of Agriculture Regional Feed Chemical Analysis Laboratory. The results, shown in Table 4, reflect enhanced nutritional value due to the inclusion of Nutriblend.

Table 4. Proximate Composition of Final Nutri-Cassava Chips (% by weight)

Component	Value (%)
Crude Protein	3.46
Crude Fiber	2.57
Crude Fat	17.92
Moisture Content	4.55
Ash Content	2.68

The product demonstrated a moderate increase in protein and fiber content compared to plain cassava chips. Low moisture content supports extended shelf life, while fat levels—likely increased through frying—contribute to energy density and palatability. The ash content reflects mineral presence, primarily contributed by sesame in the Nutriblend mixture.

These values affirm the viability of the product as a more nutritious alternative to conventional snack chips. While not intended to replace major sources of dietary protein, Nutri-Cassava Chips can provide supplemental nutrients in a culturally acceptable and enjoyable format.

This study confirms that cassava chips fortified with an optimal amount of Nutriblend (25g per 500g cassava) can be developed into a consumer-acceptable, nutritionally enhanced snack. The findings align with global efforts to valorize traditional crops into higher-value food products that contribute to dietary diversification. Importantly, the success of the product among a broad age range highlights its potential for community-level nutrition interventions, particularly in rural or underserved areas.

Future research may explore shelf-life stability, cost analysis, or the incorporation of additional functional ingredients to further enhance the product's nutritional profile. Pilot-scale production and market trials may help determine commercial viability.

CONCLUSION

The study successfully developed a Nutri-Cassava Chip product using cassava and Nutriblend mixture, with Treatment 1 (500g cassava + 25g Nutriblend) emerging as the most acceptable formulation based on sensory evaluation and consumer testing. Sensory results indicated that a lower inclusion of Nutriblend preserved key attributes such as crispiness, flavor, and visual appeal, while still enhancing the product's nutritional profile. Consumer acceptability was consistently high across all age groups, demonstrating broad market potential. Proximate analysis confirmed improvements in protein and fiber content, establishing Nutri-Cassava Chips as a functional and affordable snack alternative. These findings reinforce the viability of nutrient fortification strategies using locally sourced ingredients and highlight the role of sensory-driven product development in promoting healthier food innovations.

RECOMMENDATIONS

Future studies are recommended to explore the shelf-life stability and packaging requirements of Nutri-Cassava Chips to support commercial scale-up. Cost-efficiency analysis should be conducted to assess the feasibility of local production and distribution, particularly in school and community nutrition programs. The inclusion of other functional ingredients such as malunggay (moringa), turmeric, or fortified flours may further enhance the nutritional benefits of the product. Pilot marketing and consumer preference studies in different geographic regions could provide valuable insight into potential product positioning, branding, and adoption by micro-entrepreneurs and small food enterprises.

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