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Acceptability and Nutritional Assessment of Macaroons Fortified with Cassava-Based Sagip Nutri Powder: A Sensory and Nutrient Evaluation

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Abstract: This study evaluated the nutritive value and acceptability of macaroons fortified with cassava-based sagip nutri powder. The macaroons were formulated with varying proportions of cassava-based sagip nutri-pack and cake flour, and their nutritional content and sensory characteristics were assessed. The results indicated that macaroons fortified with cassava-based sagip nutri powder exhibited higher energy content compared to commercial macaroons, with formulation 3 having the highest energy value. Additionally, fortification with turmeric increased the macaroons' antioxidant properties and fiber content. Sensory evaluation revealed that Formulation 2 with 25% Cassava-Based Sagip Nutri Powder and 75% cake flour had the highest acceptability in terms of color, flavor, and aroma, followed by Formulation 1 which is the commercial macaroons which excelled in texture. The findings suggest that while turmeric fortification improves the nutritional profile of cassava-based macaroons, further optimization is needed to match the acceptability of commercial products. This study highlights the potential of using cassava as a base ingredient for fortified macaroons to promote better nutrition. Future research is recommended to investigate the potential health benefits of consuming Macaroon Fortified with Cassava-Based Sagip Nutri Powder, exploring its effects on nutrition, digestion, and overall well-being.

Keywords: cassava, macaroons, fortification, nutritive value, sensory evaluation, general acceptability, nutritional enhancement, antioxidant properties, food formulation

1. Introduction

A snack is a tiny amount of food or drink that you eat between meals to keep your energy up and your hunger down. Snacks are often easier to cook, lighter, and quicker than full meals. Because of this, people of all ages consume them every day.

The Food and Nutrition Research Institute (FNRI, 2020) says that snacking is an important part of Filipino culture, especially for youngsters and teens. They often consume merienda, which are snacks in the morning, at lunchtime, and even at midnight. These snacks can really help a child obtain more energy and nutrients every day, especially if they don't eat enough main meals or skip them. Studies have shown that most snacks individuals eat are not very good for them because they are heavy in sugar, fat, and sodium but low in vitamins and minerals. This causes a lot of people to worry about how snacking might cause both undernutrition and over nutrition, especially in schools. Researchers and public health advocates underline the need to produce and promote healthier snack options that are both good for youngsters and tasty (Garcia et al., 2021).

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Coconut macaroons are one of the popular snacks in the Philippines. It is available in bakeries, sari-sari stores, and school cafeterias. Macaroons are soft, sweet, and affordable, which makes them a favorite with kids and a must-have for merienda/snack. On the other hand, store-bought or commercial macaroons are usually high in calories but poor in nutrients because they are largely made of sugar, sweetened condensed milk, butter and grated coconut. They don't add much to kids' vital nutrient intake. The Food and Nutrition Research Institute (FNRI, 2020) reports that many Filipino kids eat foods that are heavy in sugar and fat but poor in vitamins. This makes them more likely to not get enough food and do poorly in school.

Coconut macaroons are a great way to add nutrients to food because they are loved by kids. The incorporation of beneficial ingredients, such as the Cassava-Based Sagip Nutri Powder, may enhance the nutritional value of the dishes you already enjoy. Studies like Del Rosario et al. (2018) support this plan. They found that students who added snacks that were simple to access in the vicinity ate a lot more micronutrients and did better on exams. The World Health Organization (2016) also says that school-based fortification programs are one of the best ways to keep kids from being malnourished, especially when they are added to foods that kids already appreciate.

Schools that offer fortified meals as snacks have found that this is a good way to help kids who are missing micronutrients and make them healthier and do better in school. Fortified snacks are conventional foods that have been improved with important vitamins and minerals including iron, vitamin
A, iodine, and zinc. Manykids, especiallythose who live in low income areas, don't get enough of the se nutrients in their diets (WHO, 2016). These snacks can assist fill up nutritional shortages and enco urage optimal growth, stronger immunity, greater concentration, and higher school attendance when given during school hours.

The Cassava-Based Sagip Nutri Powder, made from cassava, mung bean, sesame, malunggay (moringa), turmeric, and cacao pod husk, forms a nutrient-rich blend that supports the health and development of learners. Moringa is high in calcium, protein, and vitamins A, C, and E, making it effective in addressing micronutrient deficiencies (Gopalakrishnan et al., 2016). Cassava contains flavonoids like quercetin that help regulate blood sugar and support metabolism (Laya et al., 2022). Turmeric's curcumin offers strong antioxidant and anti-inflammatory benefits (Hewlings & Kalman, 2017). Mung beans improve heart health and insulin sensitivity due to their polyphenols and peptides (Tang et al., 2014). Sesame seeds provide sesamol, which supports cognitive function (Ghosh et al., 2023), while cacao pod husks, rich in fiber and antioxidants, promote digestive health (Akinwale et al., 2021). When combined into school snacks, these ingredients create a functional food that can help combat malnutrition and boost learning outcomes among students.

Adding Cassava-Based Sagip Nutri Powder to traditional macaroons makes for a cheap, tasty, and nutrient-dense local snack. This new idea not only helps with problems like poverty and starvation, but it also gives people a chance to improve their health and well-being.

On the other hand, this product is beneficial to the public, especially the Department of Education, as it offers a solution to malnutrition in schools. The development of Macaroons Fortified with Cassava-Based Sagip Nutri Powder provides a nutritious alternative snack for learners, helping reduce malnutrition both in schools and the community. It also supports local producers of Cassava-Based Sagip Nutri Powder, turmeric, malunggay, and cacao pod husk powder by increasing demand, which can create livelihood opportunities and help reduce poverty.

The study will also help home bakers add a new product to sell, benefiting the community and helping combat poverty. The positive results on the product's acceptability may encourage people to start small businesses, offering both a nutritious food option and a potential source of income.

This study supports five Sustainable Development Goals (SDGs): No Poverty, Zero Hunger, Good Health and Well-Being, Quality Education, and Partnerships for the Goals. It aims to address poverty and hunger by providing students with a nutritious and cost-effective alternative to food. By enhancing children's health and nutrition, the study contributes to improved learning outcomes and academic achievement, thereby promoting quality education. Additionally, it fosters collaboration between educational institutions and local communities, aligning with the goal of strengthening partnerships for sustainable development.

Overall, this study helps improve the health and nutrition of the community by making traditional macaroons more nutritious to satisfy the health needs of pupils, which in turn helps their schoolwork. It is also a useful resource for academics, teachers, and extension workers in the future.

1.1 Statement of the Problem

This study was conducted to determine the consumers' Acceptability and Nutritive value of Macaroon Fortified with Cassava-Based Sagip Nutri Powder.

Specifically, this study aimed to answer the following questions:

1. What is the nutritive value of Macaroon Fortified with Cassava-Based Sagip Nutri Powder?
2. Which among the five formulations is more acceptable in terms of color/appearance, odor/aroma, taste/flavor, and texture?
3. What is the acceptability of Macaroon Fortified with Cassava-Based Sagip Nutri Powder based on the Acceptability Consumers Index?
4. What is the difference of the acceptability when evaluators are group according to age?
5. What is the Return-on-Investment (ROI) computed for the different formulation?
6. What educational materials may be developed based on the study?

2. Materials and Methods

The table below presents the proportions of ingredients used in the preparation of Macaroon Fortified with Cassava-Based Sagip Nutri Powder across different formulation groups. The ingredients include Cassava-Based Sagip Nutri-pack, turmeric powder, all-purpose flour, baking powder, salt, sugar, butter, eggs, condensed milk, vanilla extract, and desiccated coconut. The study involved five formulations with varying amounts of the Cassava-Based Sagip Nutri-pack and turmeric powder.

Ingredients	**F1**	**F2**	**F3**	**F4**	**F5**
Cassava-Based Sagip Nutri-pack	0 g	28.5 g	57 g	85.5 g	114 g
Cake flour	114 g	85.5 g	57 g	28.5 g	0 g
Baking powder	2.4 g	2.4 g	2.4 g	2.4 g	2.4 g
Salt	1.5 g	1.5 g	1.5 g	1.5 g	1.5 g
Sugar	50.22 g	50.22 g	50.22 g	50.22 g	50.22 g
Butter	76 g	76 g	76 g	76 g	76 g
Egg	114 g	114 g	114 g	114 g	114 g
Condensed milk	388 g	388 g	388 g	388 g	388 g
Vanilla extract	2.17 g	2.17 g	2.17 g	2.17 g	2.17 g
Desiccated coconut	240 g	240 g	240 g	240 g	240 g

Table 1. Proportion of Ingredients Used in Cooking Macaroon Fortified with Cassava-Based Sagip Nutri Powder

To prepare the macaroons, the following tools and equipment were used: measuring cups, measuring spoons, wire whisk, mixing bowls, sifter, macaroon pans, macaroon liners, rubber spatula, trays, and an oven.

The turmeric powder was sourced from the College of Agriculture, ISU, specifically from the One Health Product Development Center under Dr. A. Martin Jr. The Cassava-Based Sagip Nutri-Pack, fortified with Malunggay and Turmeric Powder, was obtained from Barangay Salvacion,

Echague, Isabela, through the research of Dr. M. Peñalber. Additionally, Cacao Pod Husk Powder was provided by the Cagayan Valley Cacao Development Center through research of Dr. M. Corpuz.

In the preparation, all ingredients were measured accurately. The butter was creamed using a hand mixer or wire whisk on low speed, then sugar was added and mixed until fluffy. Eggs were incorporated one at a time, followed by the condensed milk and vanilla extract. In a separate bowl, the dry ingredients (flour, salt, baking powder, and desiccated coconut) were combined and then added to the wet ingredients. The mixture was scooped into paper-lined macaroon pans and baked at 350°F for 15 to 20 minutes or until golden and a toothpick inserted into the center came out clean. After baking, the macaroons removed from the pan and allowed them to cool.

The main ingredients in the study remained consistent, except for the cake flour, which was adjusted according to the proportion of Cassava-Based Sagip Nutri Powder used.

The five formulations were as follows:

F1: Commercial Macaroon (Control)
F2: 25% Cassava-Based Sagip Nutri Powder (28.5g) and Cake Flour (85.5g)
F3: 50% Cassava-Based Sagip Nutri Powder (57g) and Cake Flour (57g)
F4: 75% Cassava-Based Sagip Nutri Powder (85.5g) and Cake Flour (28.5g)
F5: 100% Cassava-Based Sagip Nutri Powder (114) and Cake Flour (0)

The nutritional content of the experimental Macaroon samples was analyzed at the Regional Food Technology Development and Incubation Center, Integrated Laboratory Division of the Department of Agriculture in Tuguegarao City, Cagayan.

Sensory evaluation of the macaroons was conducted at the Food Processing Laboratory, CEd Cafeteria, Isabela State University, and other local venues such as Ambatali Elementary School, Ramon National High School, and Ambatali Community Center. A sensory panel of 100 individuals (50 boys and 50 girls) was randomly selected from teachers, students, staff, and civilians. The panelists, aged 10 to 50 years, were screened for health status and non-smoking and non-drinking habits. The evaluation used a 9-point Hedonic Scale to assess the color/appearance, odor/aroma, taste/flavor, texture, and overall acceptability of the macaroons. Each sample was presented to the panelists, who were asked to rate them after rinsing their mouths between evaluations.

The study employed a randomized block design with five formulations (F1-012, F2-025, F3-043, F4-071, F5-096) to eliminate bias during sensory evaluation. The experimental units were grouped into blocks as shown in the arrangement figure.

A cost analysis was performed to evaluate the economic feasibility of selling the Macaroon Fortified with Cassava-Based Sagip Nutri Powder in local canteens or bakeries. This analysis included all costs associated with producing the macaroons and calculated the unit cost and return on investment (ROI) for each formulation.

The results from the sensory evaluation were analyzed using one-way analysis of variance (ANOVA), with F-test, mean, and descriptive statistics to determine any significant differences between the formulations. Duncan's Multiple Range Test (DMRT) was used to identify whichformulations significantly differed in terms of color/appearance, taste/flavor, odor/aroma, texture, and overall acceptability.

3. Results

This section presented the findings of the study on the nutritive value and acceptability of cassava-based macaroons fortified with turmeric powder, highlighting the effects of turmeric fortification on the nutritional content and sensory characteristics of the macaroons, and how these contribute to the overall acceptability of the Cassava-Based Macaroon Fortified with Cacao Pod Husk, Malunggay and Turmeric Powder.

Table 1. Nutritive Value of Macaroon Fortified with Cassava-Based Sagip Nutri Powder

	F1	%RENI	F2	%RENI	F3	%RENI	F4	%RENI	F5	%RENI

Energy (kcal)	50	2%	48	2%	53	2%	51	2%	51	2%
Energy from Fat (kcal)	22		18		24		22		22	
Total Fat (g)	2		2		3		2		2	
Total Carbohydrates (g)	6		7		6		6		7	
Crude Fiber (g)	1		1		1		1		1	
Total protein (g)	1	1%	1	1%	1	1%	1	1%	1	1%
No. of Servings per container: 12										
Serving Size: 12g										

Table 6 shows that, on average, Macaroons Fortified with Cassava-Based Sagip Nutri Powder have more energy (kcal) than store-bought macaroons (F1). F3 has the most energy (kcal) of the cassava-based macaroons, and F2 has the least. F3 has more energy from fat (kcal) than the store-bought macaroons, and the total fat content (g) follows the same pattern. F2 and F5 have more total carbs than commercial macaroons.

The amount of crude fiber and protein is the same in all formulation groups, even the commercial macaroonsFoods made from cassava have long been recognized for their health benefits. This is due to cassava's high carbohydrate content, which can be increased by mixing it with other foods. In addition to adding more fiber and nutrients, turmeric powder improves the health of cassava products by enhancing their ability to combat free radicals (Kumar et al., 2021; Dutta & Chattopadhyay, 2022). Verma et al. (2023) claim that adding turmeric to cassava-based macaroons improves their functionality, which benefits energy values as well as other essential nutrients like proteins and fats.

Table 2. Distribution of evaluators by Sex

SEX	Frequency	Percent
Male	50	50.0
Female	50	50.0
Total	100	100.0

Table 2 shows the frequency and percentage distribution of sex among evaluators. Results then revealed that there is an equal distribution for sex, in which male and female evaluators both have counts of 50% out of the total respondents.

The balance between male and female participants is crucial for assessing gender-based differences in food acceptability. Gender differences in food preferences and sensory evaluations have been studied, with findings suggesting that women generally show higher sensitivity to certain food attributes like taste and aroma (Hassan & Sarwar, 2021; Lee et al., 2022). Thus, evaluating food products with equal gender distribution allows for a more representative understanding of general consumer acceptability.

Table 3. Distribution of evaluators by age

Age	Frequency	Percent
10-20	69	69.00
21-30	11	11.00
31-40	10	10.00
41-50	10	10.00
Total	100	100.00
MEAN AGE = 22		

Table 3 shows the frequency and percentage distribution of age among evaluators. Based on the findings, the age group of 10 to 20 years old had the highest percentage of 69%, which dominated the

population. Age groups of 21 to 30 got 11%, 10% for 31 to 40 years old, and 10% for 41 to 50 years old.

Age groups play a significant role in determining food preferences and acceptability. Younger age groups tend to favor novel foods and products with enhanced sensory qualities (Patel et al., 2020). Studies by Adebayo et al. (2021) show that age is a critical factor influencing sensory evaluation, with younger individuals preferring stronger, more intense flavors compared to older groups. Therefore, it is important to evaluate how different age brackets respond to new food formulations such as cassava-based macaroons.

Table 4. Degree of acceptability in terms of color or appearance of Macaroon Fortified with Cassava-Based Sagip Nutri Powder

Formulation	MEAN	QD
F1 – 100% Cake Flour (114g)	7.72	LVM
F2 – 25% Cassava-Based Sagip Nutri Powder (28.5g), 75% Cake Flour (85.5g)	8.06	LVM
F3 – 50% Cassava-Based Sagip Nutri Powder (57g), 50% Cake Flour (57g)	7.42	LM
F4 – 75% Cassava-Based Sagip Nutri Powder (85.5g), 25% Cake Flour (28.5)	7.21	LM
F5 – 100% Cassava-Based Sagip Nutri Powder (114g)	7.36	LM

According to the data, F2 (25% Cassava-Based Sagip Nutri Powder, 75% Cake Flour) had the highest mean score (8.06), making it the most favored formulation with a liked very much Quality Descriptor in terms of color/appearance. This suggests that F2 was rated on par with or better than the commercial macaroons (F1), which also received a liked very much rating and had a mean score of 7.72. F3, which is made up of 50% cake flour and 50% cassava-based sagip nutri powder, scored 7.42, which is lower than both F2 and F1. It was given a moderate Quality Descriptor, which indicates a lower preference or quality rating. With scores of 7.36 and 7.21, respectively, F5 (100% Cassava-Based Sagip Nutri Powder, 0% Cake Flour) and F4 (75% Cassava-Based Sagip Nutri Powder, 25% Cake Flour) were both classified under the Like Moderately Quality Descriptor. The lower scores show that formulations with a higher percentage of cake flour were more effective than those with a higher percentage of cassava-based powder.

One of the most important sensory factors influencing consumers' acceptance of food is appearance. According to research, consumers' preferences are greatly influenced by the visual appeal of food products; foods that are more appealing and colorful are frequently accepted more readily (Tiwari & Bhandari, 2021). The formulation 2 (F2) received the highest color scores, which is in accordance with the study's findings and supports a theory that consumers' perceptions of color influence their propensity to try new products (Hassan et al., 2021).

Table 5. Degree of Acceptability in Terms of Taste and Flavor of Macaroon Fortified with Cassava-Based Sagip Nutri Powder

Formulation	MEAN	QD
F1 – 100% Cake Flour (114g)	7.60	LVM
F2 – 25% Cassava-Based Sagip Nutri Powder (28.5g), 75% Cake Flour (85.5g)	7.81	LVM
F3 – 50% Cassava-Based Sagip Nutri Powder (57g), 50% Cake Flour (57g)	7.31	LM
F4 – 75% Cassava-Based Sagip Nutri Powder (85.5g), 25% Cake Flour (28.5)	7.57	LVM
F5 – 100% Cassava-Based Sagip Nutri Powder (114g)	7.02	LM

Table 10 shows how acceptable the taste and flavor of macaroons are when they are made with different amounts of cassava-based Sagip Nutri Powder. The scores for all the formulations were mostly positive, with scores ranging from "Liked Moderately" (LM) to "Liked Very Much" (LVM). The highest score (7.81, LVM) went to F2 (25% cassava), which was better than the commercial macaroons (F1), which scored 7.60 (LVM). This shows that adding a small amount of cassava improved the taste and flavor. F4 (75%) also kept a good rating (7.57, LVM), which suggests that it was still acceptable even though it had more cassava. F3 (50%) and F5 (100%), on the other hand, got lower scores of 7.31 and 7.02, respectively, both of which were "Liked Moderately." This shows that people liked them less as the amount of cassava increased. Overall, the data show that fortification up to 75% keeps the taste and flavor that people like, but full substitution may make it a little less acceptable, though still within acceptable limits.

One of the primary factors influencing food acceptability is taste. Research by Zhang et al. (2020) highlights how flavor profiles catered to regional consumer preferences can increase the acceptability of fortified products. Research indicates that although adding turmeric to cassava-based macaroons may change their flavor, the overall flavor quality can still be improved to meet customer preferences (Kumar et al., 2021).

Table 6. Degree of Acceptability in Terms of Odor or Aroma of Macaroon Fortified with Cassava-Based Sagip Nutri Powder

Formulation	MEAN	QD
F1 – 100% Cake Flour (114g)	7.88	LVM
F2 – 25% Cassava-Based Sagip Nutri Powder (28.5g), 75% Cake Flour (85.5g)	8.11	LVM
F3 – 50% Cassava-Based Sagip Nutri Powder (57g), 50% Cake Flour (57g)	7.17	LM
F4 – 75% Cassava-Based Sagip Nutri Powder (85.5g), 25% Cake Flour (28.5)	7.27	LM
F5 – 100% Cassava-Based Sagip Nutri Powder (114g)	7.24	LM

The data shows how acceptable different levels of cassava-based Sagip Nutri Powder make macaroons smell or taste. All the formulations got ratings that were mostly good, from "Liked Moderately" (LM) to "Liked Very Much" (LVM). F2, which had 25% cassava, got the best score of 8.11 (LVM). This means that adding a small amount of cassava improved the smell and taste, and people liked it better than the commercial macaroons (F1), which got a score of 7.88 (LVM). On the other hand, formulations with more cassava—F3 (50%), F4 (75%), and F5 (100%)—got lower scores, between 7.17 and 7.27, all of which were in the "Liked Moderately" category. The results show that aroma is fine at all levels of substitution, but it is best at lower levels of cassava-based powder. Increasing the cassava content above 25% may slightly lessen the appeal of the aroma, but this drop is still within acceptable limits.

When it comes to food sensory evaluation, aroma is crucial because it affects consumer preference and purchase decisions. According to research, food products' initial impressions are influenced by their aroma, which could lead to increased acceptability when pleasant scents are present (Yang et al., 2022; Pinto et al., 2023). According to the results of earlier research on the significance of aroma in food acceptability, the formulation 2 (F2) were rated as having the strongest aroma among the cassava-based macaroons fortified with turmeric in this study.

Table 7. Degree of Acceptability in Terms of Texture of Macaroon Fortified with Cassava-Based Sagip Nutri Powder

FORMULATION	MEAN	QD
F1 – 100% Cake Flour (114g)	7.69	LVM
F2 – 25% Cassava-Based Sagip Nutri Powder (28.5g), 75% Cake Flour (85.5g)	7.83	LVM
F3 – 50% Cassava-Based Sagip Nutri Powder (57g), 50% Cake Flour (57g)	7.32	LM

F4 – 75% Cassava-Based Sagip Nutri Powder (85.5g), 25% Cake Flour (28.5)	7.53	LVM
F5 – 100% Cassava-Based Sagip Nutri Powder (114g)	7.37	LM

The sensory evaluation of macaroons with different amounts of Cassava-Based Sagip Nutri Powder shows that most panelists liked them. Respondents "liked very much" formulations F1 (commercial macaroons), F2 (25% cassava), and F4 (75% cassava), which all got mean scores higher than 7.5. The commercial macaroon (F1) got the highest score of 7.83, which suggests that people liked the standard formulation a little more. Formulations F3 (50% cassava) and F5 (100% cassava) got slightly lower average scores of 7.32 and 7.37, respectively. They were in the "like moderately" group. These scores are still good, but they suggest that increasing the amount of cassava powder to 50% or 100% may make it less appealing to the senses. This could be because the texture or flavor changes. Overall, the results show that adding up to 75% cassava-based Sagip Nutri Powder keeps the sensory qualities that people like, and the 25% and 75% formulations are just as acceptable as the commercial standard.

Another important component that affects whether people eat food is its texture. Gupta et al. (2022) say that how people perceive texture is quite subjective and change from one demographic group to another. The results of this study show that people liked the texture of the commercial macaroons (F1) and formulation 2 (F2) for the fortified macaroons.

Table 8. General Acceptability of Macaroon Fortified with Cassava-Based Sagip Nutri Powder

FORMULATION	MEAN	QD
F1 – 100% Cake Flour (114g)	7.57	LVM
F2 – 25% Cassava-Based Sagip Nutri Powder (28.5g), 75% Cake Flour (85.5g)	7.92	LVM
F3 – 50% Cassava-Based Sagip Nutri Powder (57g), 50% Cake Flour (57g)	7.61	LVM
F4 – 75% Cassava-Based Sagip Nutri Powder (85.5g), 25% Cake Flour (28.5)	7.42	LM
F5 – 100% Cassava-Based Sagip Nutri Powder (114g)	7.17	LM

The information displays the average flavor acceptability scores and quality descriptors (QD) for different macaroon recipes. Formulation 2 (F2), which contained 75% cake flour (85.5g) and 25% cassava-based Sagip Nutri Powder (28.5g), received the highest mean score of 7.92, which is classified as liked very much (LVM), indicating the most palatable flavor profile. Formulation 3 (F3), which contained a 50% cassava and cake flour mixture, received a mean score of 7.61 and was categorized as LVM, indicating favorable acceptability.

With a score of 7.57, the commercial macaroons (F1) were still classified as LVM, meaning that their flavor acceptability was like that of the cassava-based versions with moderate substitution. With 75% cassava and 25% cake flour, Formulation 4 (F4) received an average score of 7.42. By contrast, Formulation 5 (F5), which was made entirely of cassava, had the lowest mean score (7.17). The moderately liked (LM) ratings for both formulations indicate that flavor preference decreases as cassava content rises. The findings demonstrate that it is feasible to incorporate cassava-based Sagip Nutri Powder into macaroons; F2 demonstrates that the best flavor was achieved with a 25% cassava mix. In general, flavor acceptability decreases as the percentage of cassava increases.

General acceptance is the sum of all the sensory qualities. Recent research shows that products with balanced sensory profiles, which can be accomplished through careful formulation, are more likely to be accepted by a larger group of people (Ribeiro et al., 2021; Lee et al., 2022). The current study backs this up by showing that formulation 2 (F2) were the best overall, but formulations like commercial macaroons (F1) and F3 had a lot of promises for widespread acceptability.

Table 9. Acceptability Consumers Index (ACI)

	Appearance	22	Aroma	19	Texture	19.5	Taste	39.5	100	RANK
F1	7.72	1.70	8.11	1.54	7.69	1.50	7.6	3.00	7.72	2
F2	8.06	1.77	7.88	1.50	7.83	1.53	7.81	3.08	7.90	1

F3	7.42	1.63	7.17	1.36	7.32	1.43	7.31	2.89	7.31	4
F4	7.21	1.59	7.27	1.38	7.53	1.47	7.57	2.99	7.43	3
F5	7.36	1.62	7.24	1.38	7.37	1.44	7.02	2.77	7.20	5

The sensory evaluation data for five macaroon recipes shows that F2 with (25% Cassava-Based Sagip Nutri Powder and 75% Cake Flour) had the greatest ACI mean score of 7.90, putting it in first place. It got the highest scores in Appearance (8.06), Aroma (7.88), and Taste (7.83), making it the most popular formulation. F1 (Commercial Macaroons) came in second with an average score of 7.72. It did especially well in Aroma (8.11) and Taste (7.60), but it was a little less acceptable overall than F2. F4, which was made up of 75% cassava-based sagip nutri powder and 25% cake flour, came in third with a mean score of 7.43. It did well in Texture (7.53), but not so well in Appearance (7.21) and Aroma (7.27). F3, which was made up of 50% cassava-based sagip nutri powder and 50% cake flour, came in fourth with a score of 7.31. This was the lowest score for both aroma (7.17) and taste (7.31). Finally, F5 (100% Cassava-Based Sagip Nutri Powder and no Cake Flour) came in fifth with the lowest score of 7.20. This was mostly because its Taste (7.02) and Aroma (7.24) scores were lower. These results show that the optimum sensory acceptance comes from a mix of cassava and cake flour that is balanced, like in F2.

The Acceptability Consumer Index (ACI) is a single assessment of overall product quality that takes into consideration many sensory factors. Kumar et al. (2021) show how useful these kinds of indices are for figuring out what consumers want. They give a numerical summary of how people reacted to a product's sensory features. This means that the ACI is an important tool for figuring out how much market potential macaroons with cassava-based Sagip Nutri Powder have.

4. Conclusion

Based on the findings of this study, it can be concluded that fortifying cassava-based macaroons with turmeric powder positively influences both the nutritional value and sensory characteristics of the product. The study demonstrates that cassava-based macaroons fortified with turmeric not only enhance the energy and nutrient profile, particularly in terms of protein, fat, and carbohydrates, but also contribute to the functional benefits of these macaroons. Among the various formulations, F3 (50% Cassava-Based Sagip Nutri-Pack and 50% Cake Flour) exhibited the highest energy content and nutritional enhancement, suggesting a promising approach for improving the nutritional profile of traditional snacks.

In terms of sensory attributes, formulation 2 (25% Cassava-Based Sagip Nutri-Pack and 75% Cake Flour) had the highest acceptability compared to all experimental formulations. F2 achieved the highest scores for color, taste and aroma, while formulation 1 excelled in texture. Formulation 2 showed strong making it a viable alternative to traditional macaroons. While the turmeric fortification impacted sensory qualities, particularly aroma and taste, it still yielded products with a satisfactory level of consumer acceptability.

Furthermore, the study highlighted that the demographic profile of evaluators, particularly age and gender, influenced the sensory evaluation outcomes. Younger participants showed a higher preference for novel formulations, suggesting that cassava-based macaroons fortified with turmeric might appeal more to a younger consumer base. Gender-based differences in sensory evaluation also contributed to a more comprehensive understanding of consumer preferences.

In conclusion, cassava-based macaroons fortified with turmeric powder present a nutritious and acceptable alternative to traditional macaroons, with significant potential for enhancing the overall health benefits of snacks while maintaining reasonable sensory appeal. Further exploration and refinement of the formulations, especially in terms of flavor balance, could improve consumer acceptance and expand the market potential for these fortified products.

4.1. Recommendations

For Food manufacturers/Business Owners, they may consider using Macaroon Fortified with Cassava-Based Sagip Nutri Powder as a healthier alternative to commercial macaroons, with potential

marketing opportunities highlighting the higher energy and nutrient content. More importantly, they adopt the F2 formulation as a viable alternative to commercial macaroons, with potential marketing opportunities highlighting the product's unique characteristics and nutritional benefits.

For school canteen operators/managers, they may recommend macaroons fortified with cassava-based sagip nutri powder as an additional nutritious snack option for the school-based feeding program that can give a huge help in abolishing malnutrition in school and give learners alternative nutritious snack to improve their healthy diet and make them become active in participating in class activities.

For consumers, patronizing fortified macaroons offers more than just a delicious dessert or snack—it will provide them additional nutritional benefits that will support overall health and well-being. By choosing to incorporate fortified macaroons into their diet, consumers not only satisfy their cravings with sweet but also take a small yet meaningful step toward a healthier lifestyle.

For Nutritionists and dietitians, they may recommend cassava-based macaroons fortified with turmeric as a nutritious snack option, particularly for individuals requiring higher energy intake.

Future researchers may investigate the potential health benefits of consuming Macaroon Fortified with Cassava-Based Sagip Nutri Powder, exploring its effects on nutrition, digestion, and overall well-being.

4.2. Development of Information, Education, and Communication (IEC) Materials

Figure 1 shows the trifold developed Information, Education, and Communication (IEC) Materials to give information and promote the Macaroons Fortified with Cassava Based Sagip Nutri Powder to School Learners, Community, and to the public. It is also one way of educating the consumers as well as to easily disseminate and advertise the Macaroons which can help attaining good health and wellness.

This contains the name, ingredients, and procedure of the Macaroons Fortified with Cassava Based Sagip Nutri Powder. It also gives information on the benefits and other facts of Macaroons Fortified with Cassava Beasd Sagip Nutri Powder. The contact persons are also included in the material.

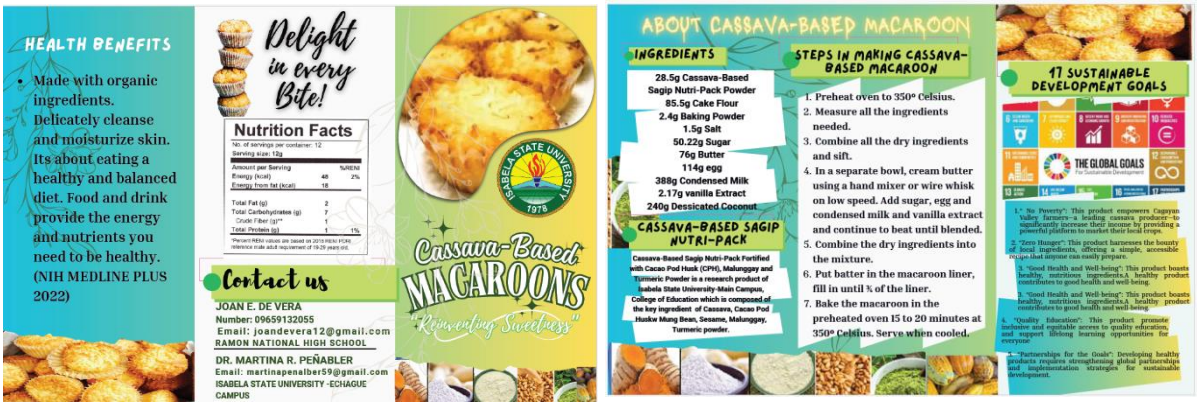

Figure 1. Developed Information, Education, and Communication (IEC) material.

Contributions

De Vera J.E Conceptualized the idea, did the experiment, processed the experimental data and performed the data analysis. Peñalber M.R Supervised the work. De Vera J.E and Peñalber M.R interpreted the results and wrote the manuscript.

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