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FORMULATION AND SENSORY EVALUATION OF STARFRUIT *(Averrhoa carambola)* BREAD STICKS

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ABSTRACT

The main thrust of the study was to formulate and evaluate the sensory acceptability of Starfruit (Averrhoa carambola) Bread Sticks using two treatments: sour-type (T1) and sweet-type (T2) starfruit. The products were rated on aroma, appearance, taste and texture. The research design used is an experimental research design and the primary instrument used in data-gathering was a modified 5-point Hedonic Scale. Sixty (60) respondents (purposely chosen) including Grade 10 and Grade 12 Cookery and Bread and Pastry students, TVL teachers, and local bakers, provided sensory evaluation. The weighted mean and t-test were used to analyze the data to ascertain the degree of acceptability and significant differences between treatments. Conclusions showed that all the treatments were generally acceptable though sweeter type, Starfruit Bread Sticks (T2), scored higher in mean score across most of the sensory attributes with mean score of 4.45, 4.06, 4.11, and 4.14, respectively whereas the sour-type (T1) scored 3.93, 3.98, 3.90 T2 scored higher in the overall preference domain with 4.28 (Very Much Preferred) whereas T1 scored 3.93 (Moderately Preferred). Statistically, there was no significant difference between treatments in terms of aroma ($t = 0.77$, $p = 0.46$), appearance ($t = 2.70$, $p = 0.016$), and taste ($t = 1.10$, $p = 0.29$), but there was significant difference in terms of texture ($t = 3.29$, $p = 0.004$ Moreover, the preference-level analysis demonstrated that there were significant differences in aroma ($t = 3.20$, $p = 0.002$), appearance ($t = 4.76$), taste ($t = 1.19$) and texture ($t = 5.42$), which implies that sensory characteristics had a significant impact on consumer choice. Cost analysis showed that the cost of production is ₱487.73 incurred per batch, this results to 50 packs produced with a calculated selling price per pack of ₱10.00 thus economically viable. Proximate analysis showed that the product contains 7.50 g/100 g moisture, 1.60 g/100 g ash, 6.92 g/100 g crude protein, 0.470 g/100 g crude fiber, 20.2 g/100 g crude fat, and 82.9 g/100 g carbohydrates. Analyses of minerals indicated the following results: 130.85 mg/100 g cal. and 6.45 mg/kg iron and 419.48 mg/kg potassium and Vitamin C value was 0.16 g/100 g. These results suggest that, the product is rich in carbohydrates and fat where it is a good source of energy, moderate in protein and mineral content but in fiber, it is low. Shelf-life testing revealed that the product could be applicable with a shelf life of as long as seven (7) days at room temperature (2528 0 C). Marketability outcomes showed a profitable outcome of both variants with higher sales recorded by the sweet-type (60 and 53 packs) than the sour-type (45 and 46 packs) in two weeks. The authors find that Starfruit (Averrhoa carambola) has potential to be a raw material of value added baked foods. Although either of the treatments proved satisfactory and marketable, the sweet one depiction showed superior consumer acceptance, higher sensory performance, and enhanced marketability.

I. INTRODUCTION

Agriculture remains a cornerstone of the Philippine economy, with Bohol's agricultural sector recording a notable growth of 10.7% in 2024 (PSA, 2025). Tropical fruits like starfruit (Averrhoa carambola), locally known as balimbing, are widely cultivated in backyards and small-scale farms and are a familiar part of the local diet. Despite their abundance, post-harvest losses can reach up to 40% due to the fruit's perishable nature and limited access to processing technologies (DA, 2024).

In Bohol, where tourism and the food service industry are expanding, there is a strategic need to transform raw produce into value-added products that are shelf-stable and meet growing consumer demand for convenient, nutritious snacks. Bread sticks, a popular snack in the province, are generally made from refined flour and lack functional nutrition, leaving an opportunity to incorporate local fruits like starfruit to create healthier alternatives.

While starfruit is recognized for its high vitamin C, dietary fiber, and bioactive antioxidant content, there is limited research on its application in bakery products, particularly as a starfruit-flavored bread stick. The majority of research work is on juices, jam, or medicine use, and there is a gap on creating functional value-added snacks that will provide nutritional advantages and be acceptable to the consumers. The identified gap justifies the importance of examining new bakery recipes that will incorporate starfruit to improve the nutritional value, minimize losses after harvest, and give economic empowerment to local farmers.

The intention behind this research was to develop and assess the sensory properties of Starfruit Bread Sticks. The study was meant to bridge the gap between food abundance and food innovation by providing a solution which would promote the food security of the local community in Bohol, encourage healthy snacking, and offer potential source of income to the smallholder farmers in Bohol.

II. LITERATURE BACKGROUND

One of the basic needs of all humans is their food. It supplies energy needed to sustain normal operations and ensures that one is not hungry. Food provides the body with energy that supplies

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cells, which are effective in helping to sustain the growth and development of a body.

This paper is informed by the appropriate theories and legal frameworks to give background information to the creation of innovative food products that will be the foundation of this research report. The Hierarchy of Needs notes that physiological needs are the most important since the rest of the needs will not matter before physiological needs are satisfied. The hierarchy underlines the fact that there are some levels of needs that should be fulfilled prior to the next level and the physiological needs address the most basic ones, food, water, shelter, and clothing.

The introduction of a new product such as Starfruit Bread Sticks, in this context, can serve to meet the basic needs of the consumers besides serving their preferences. Also, having Starfruit Bread Sticks could be fulfilling the need of consumers to have tasty and healthy snacks.

In terms of modern development approaches, the Innovation Theory of Everett Rogers (Miller, 2015) provides valuable support for this study. Rogers identified five key factors that influence the adoption of innovations: relative advantage, compatibility, complexity, trialability, and observability. Relative advantage refers to how an innovation is perceived as better than what it replaces, while compatibility considers how well it aligns with the values, needs, and experiences of users.

This means that innovation entails bringing new ideas, which would result in better processes, products, or service to meet the existent, and new market needs. The innovation can be seen in this research through development of Starfruit Bread Sticks as a marketable product. The most innovation is the cooking of the starfruit i.e. preparing it into a purée, drying it or adding it to the dough, making it more addictive in taste, texture and nutrition.

This lead to the formulation and sensory evaluation of starfruit (Averrhoa carambola) bread sticks. Starfruit sticks has two treatments; using the sour type starfruit and the sweet type starfruit. Sour Starfruit (*Averrhoa carambola* var. acidulata) is tangy, firm, and highly acidic. Common varieties such as Tawny,and Green Marble Sour starfruit are used in the treatment 1. These varieties are rich in oxalic and organic acids, making them ideal for juices, jams, pickles, and sauces, where tartness enhances flavor and preservation. Nevertheless, they are very acidic making them unsuitable direct to the palate and less suitable in any baked snack that targets the general palate (Hossain and Rahman, 2018). In contrast, sweet Starfruit (Averrhoa carambola var. dulcis) is less bitter, more sweet and its texture is more soft. Treatment 2 is done using varieties like Arkin, and Karyan. Preferred in fresh consumption, desserts, and baked snacks, it has a natural sweetness, is palatable, and can be processed without the considerable addition of sugar (De Carvalho et al., 2022).

The thought-out starfruit sticks are supplemented with a dip developed based on starfruit puree and starfruit powder to further compliment and underline the unique starfruit taste. The new product is distinguished by starfruit as a stand-alone flavor, which is a product twist that is not frequently available in the market. Starfruit is a good source of vitamin C, dietary fiber, and minerals, including potassium, magnesium, and iron, in addition to the presence of phytochemicals (flavonoids, phenolic acids and terpenoids), that make it have antioxidant properties (Medula Journal, 2023). Research has shown that starfruit contains flavonoids and phenolic compounds that help reduce oxidative stress and provide anti-inflammatory benefits (Rahman et al., 2020).

Whilst nutritional, medicinal and processing potential of starfruits have been investigated in numerous studies it is clear that there is a strain of research that identifies a bakery use of this fruit. The development of starfruit-based baked products can be a way to combine the benefits of the fruit to the consumers' health, sensory appeal, and marketable innovations. Our research is a local food security instrument, a way to add value to the agricultural sector and a source of good health for consumers while being consistent with the theoretical frameworks and conforming to the national legal mandates.

III. THE PROBLEM

The main purpose of the study was to formulate and evaluate the sensory attributes of Starfruit (Averrhoa carambola) Sticks in two (2) treatments in terms of aroma, appearance, taste and texture in Oy National High School and Camayaan National High School Cookery students for the Academic year 2025-2026, TLE teachers,and bakers.

The study sought to specifically answer the following questions:
1. What is the profile of Starfruit (Averrhoa carambola) Bread Sticks in terms of:
1.1 ingredient and cost;
1.2 tools and equipment;
1.3 procedure;
1.4 nutrient content;
1.5 shelf life; and
1.6 marketability?

2. What are the sensory attributes of Starfruit (Averrhoa carambola) sticks in terms of?
2.1 appearance;
2.2 aroma;
2.3 taste;
2.4 texture?

3. What is the respondents' preference level between the two treatments of Starfruit (Averrhoa carambola) Sticks?
4. Is there a significant difference among the sensory attributes of Starfruit (Averrhoa carambola) Sticks in the two treatments in terms of aroma , appearance, taste, and texture,?

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5. Is there significant difference of the respondents' preference level between the two treatments?
6. What technology package could be proposed based on the result of the study?

IV. METHODOLOGY

Design

The study employed experimental research approach supported by the descriptive-analysis method of generating the data. The product underwent preliminary testing before formal evaluation. These treatments were examined, and criteria are set as basis for comparison.

Environment and Participants

The study was conducted at the Food Technology Shop of Oy National High School in Oy, Loboc, Bohol, and at Camaya-an National High School in Camaya-an, Loboc, Bohol, during the school year 2025–2026. Both schools offer the Technical-Vocational-Livelihood (TVL) strand, specifically the Cookery and Bread and Pastry specializations.

Purposive sampling was employed in selecting the respondents, which included 10 Grade 10 Cookery students of Oy National High School, 10 Grade 10 Cookery students of Camayaan National High School, 10 Grade 12 Bread and Pastry students of Oy National High School, 14 Grade 12 Bread and Pastry students of Camayaan National High School and 10 teachers from both schools who handle TVL subjects and 6 bakers. Overall, sixty (60) respondents were involved in the evaluation of the developed products.

This sampling technique has been selected since the emphasis is on participants who possess certain characteristics of interest to the study. The judging panel was chosen due to their background and expertise in food handling as it would enable them to offer skillful analysis of the product sensory aspects of the food, so they provide more accurate and dependable responses in the research.

Instrument

In this study, a modified questionnaire that was based on the research of Gatchalian, 2021 was used to identify the sensory properties of the product. The data required to measure the sensory qualities and the degree of preference of the participants of starfruit based baked goods under the various treatments under the 5-point Hedonic scale was collected with the help of a modified questionnaire. Control measures were also noted to reinforce the evaluation process like maintenance in the presentation of the sample and giving clear instructions when responding to the form.

The respondents were to complete two sets of assessment forms in one evaluating the sensory properties of the products, and the other rating their degree of liking the products. In the case of the questionnaire, the respondents marked their answers by a box that connotes their number on the 5-point Hedonic Scale. This scale varies between 5 (5) indicating the maximum level of preference of the product to one (1) indicating the minimum level of preference. The tasting procedure included controlled conditions including equal portioning of the samples, controlled sample serving temperature, and having the participants rinse their mouth prior to tasting each sample to place the responses in the objective position. The researcher also asked the respondents to provide more feedback and suggestions to further enhance the research.

The research instrument was based on an already validated sensorial assessment instrument in terms of validity and reliability. Food technology teachers carried out content validation to determine its suitability and suitability to the aim of the current study. Moreover, pilot test was carried out to establish internal consistency and rationality of the instrument.

Procedure

The study was conducted in sequential phases. First, the researcher sought the authority of the Campus Director as well as Dean of School of Advanced Studies to carry out the study. The researcher then approached the permission of the District Supervisor of the Loboc District and the Principals of Oy National High School and Camayaan National High School to play the research in the schools. The researcher received the list of the respondents, one after the approval, who included the students and teachers. A total of 60 respondents—including senior high school TVL Food Technology students, teachers, industry experts, and potential consumers—were selected through purposive sampling based on their background in food preparation and product evaluation. Ingredients, tools, and equipment were then prepared, and two treatments of Starfruit Bread Sticks.

The experimental formulations were observed for texture, consistency, and aroma, followed by shelf life monitoring under room and chilled conditions to document changes in quality. Laboratory analyses were conducted to determine nutritional composition, including protein, fat, carbohydrate, sugar, calories, sodium, and moisture content. Finally, the two treatments were presented to the 60 respondents for sensory evaluation. Using a structured questionnaire, participants assessed the products' appearance, aroma, taste, and texture under controlled testing conditions, with results collected and analyzed to determine preference and acceptability.

Statistical Treatment

To analyze the data gathered on the profile in the output of shelf life and marketability, weighted mean and ranking were employed. The responses were recorded using a 5-point Hedonic Scale ranging from 1 to 5, with higher scores indicating greater preference. The weighted arithmetic mean was computed for each attribute and treatment. This allowed the researcher to quantify the respondents' preference level for each attribute of the starfruit bread sticks.

To determine if there were significant differences in sensory evaluation among the two treatments: T-test was applied for

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normally distributed data to compare the mean scores of the treatments for each attribute.

V. RESULTS AND DISCUSSION

After the data were gathered, analyzed, and interpreted accordingly, the researcher came up with the following:

Table 1.1. ***Ingredients and Cost***

QTY	UNIT	DESCRIPTION	UNIT COST	TOTAL COST (Php)
500	g	All-purpose flour	40.00/500g	40.00
100	g	cornstarch	38.00/500g	13.20
15	g	Baking powder	16.00/50g	5.00
150	g	sugar	45.00/500g	13.50
10	g	salt	5.00/250g	0.10
100	g	starfruit	20.00/1kg	1.00
227	g	butter	60.00/227g	60.00
5	g	vanilla	15.00/60ml	2.00
			Subtotal:	Php 183.14
Dip				
200	g	Starfruit puree	20.00/1kg	5.00
100	g	sugar	50.00/500g	10.00
30	g	cornstarch	38.00/500g	2.00
30	g	Glucose syrup	120.00/500ml	5.20
50	g	White chocolate	50.00/100g	25.00
			Subtotal:	Php 47.2
Packaging				
50	pcs	Stand up pouch with zip lock	149.00/100pc	Php 74.5
			Subtotal:	Php 74.5
Total Cost of Ingredients:				Php 304.84
COST OF THE PRODUCTION:				
Cost of the Ingredients: Php 304.84				
15% operating expenses: Php 45.72				
15% Direct Labor: Php 45.72				
30% Mark Up: Php 91.452				
Total Cost of Production: Php 487.73				
No. of Yield: 50 packs @ 40g/pack				
Selling Price: Php 10.00/pack				

The total expense for the production batch is ₱487.73, which includes ingredients, direct labor, operating expenses, and markup, all contributing to the overall expense. Given a product yield of 50 packs, the calculated cost per pack is ₱9.75, resulting in a proposed selling price of ₱10.00 per pack. The selling price for both the sour and sweet flavor remained the same because there are no additional ingredient expenses and processing steps due to the flavor difference.

Table 1.2. ***Tools and Equipment***

Quantity	Unit	Description	Usage
1	Piece	Mixing bowl	Used for combining dry and wet ingredients and mixing the dough or batter thoroughly.
1	Set	Measuring cups and spoons	Used to ensure accurate measurement of ingredients during formulation.
1	Piece	Food processor	Used to process starfruit into puree or powder.
1	Piece	Saucepan	Used for preparing starfruit dip
4	Pieces	Baking Tray	Used for baking starfruit bread sticks
1	Piece	Oven	Used to bake starfruit bread sticks
1	Piece	Weighing Scale	Used to weigh the ingredients

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1	Piece	Cooling rack	Used to cool the finished products prior to sensory evaluation.
1	piece	Refrigerator	Used to freeze the starfruit bread sticks before baking
1	Piece	Gas Stove	Used for cooking starfruit dip

Table 1.2 presents the tools, materials, and equipment used to prepare Starfruit bread sticks with dip. Each item was carefully selected to ensure accurate measurement, efficient processing, and hygienic standards throughout product development.

Table 1.3. *Procedure*

Starfruit Bread Stick
1. Whisk together flour, cornstarch, baking powder, sugar and salt.
2. Add butter and crumble it with flour mixture. Then stir in starfruit puree.
3. Mix and form a dough. Cover it with cling wrap. Refrigerate for one hour.
4. Roll the dough into thin sheets. Cut into thin strips and use an open straw to make it smooth edges. Freeze for one hour.
5. Bake at 170°C for 25 minutes, until edges are lightly golden.
6. Cool on a rack.
Starfruit Dip:
1. Blend chopped starfruit until smooth.
2. In a saucepan, combine starfruit puree, sugar and cornstarch, white chocolate and glucose syrup.
3. Bring to a gentle simmer over low heat.
4. Cool.

Table 1.3 presents the preparation of Starfruit bread sticks with dip, which was carried out through a standardized process to ensure hygienic quality, product consistency, and food safety. The two treatments followed the same procedure, differing only in the starfruit variety used, allowing a comparative evaluation of sensory qualities and shelf-life stability.

Table 1.4. *Nutritional Analysis*

Nutrients	Unit	Result	Test Method	Recommended Daily Allowance for Children 6-18	Recommended Daily Allowance for Adults 19-49
Moisture	g/100g	7.50	Air Oven	-	-
Ash	g/100g	1.60	Ignition	-	-
Crude Protein	g/100g	6.92	Kjeldahl Method	29-72g	62-71g
Crude Fiber	g/100g	0.470	Fiber Analyzer	11-23g	20-25g
Crude Fat	g/100g	20.2	Acid/Hydrolysis	25-35g of daily calories	20-35g of daily calories
Calcium	g/100g	130.85	Flame AAS	1000–1300 mg/day	1000–1300 mg/day
Iron	mg/kg	6.45	Flame AAS	9-28g	12-28g
Potassium	mg/kg	419.48	Flame AES	1600-2000mg	2000mg
Vitamin C	g/100g	0.16	Liquid Chromatography	45–75 mg/day	75-90 mg/day
Carbohydrates	g/100g	82.9	By Computation	130g	130g

Table 1.4 Table 1.4 presents the proximate composition of Starfruit bread sticks. As the nutritional make-up of the created starfruit bread sticks shows, it has the potential to become an energy-dense snack with average values of the chosen nutrients. Its moisture level is 7.50 g/100 g, which is not very high, and acceptable in the case of the dried food production .The total mineral content can also be detected by the level of ash (1.60 g/100 g), which positively indicates that the product has the essential inorganic nutrients.

Compared to the macronutrients, the crude protein has a value of 6.92 g/100 g, a relatively insignificant portion of the recommended daily intake of 2972 to 6271g of protein by children and adults, respectfully, which means that it cannot be sourced as protein but may serve as a supplemental source. The

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amount of the crude fiber is 0.470 g/100 g, much less than the recommended 1123 g to children and 2025 g to adults indicating no or limited effects on digestive health. The fact that the crude fat level of 20.2 g / 100 g shows that starfruit bread sticks have a moderate level of fat suggests that it may contribute to component characteristics such as appealing texture, crispness, palatability, and energy.

The composition of 82.9 g/100g of carbohydrate content shows that the starfruit bread sticks are high in carbohydrates and can be a concentrated source of energy. Regarding the minerals, the amount of calcium is 130.85 mg/100 g, which does not constitute a significant part of the recommended amount of 1000-1300mg/day, so specific dietary sources are required. It has a relatively low level of iron based on the recommended levels of 6.45 mg/kg, indicating that there is little contribution made in preventing iron deficiency. Likewise, the potassium level at 419.48 mg/kg does not push the recommended levels, thus contributing little in respect of electrolyte balance. Moreover, the amount of vitamin C 0.16 g/100 g (160 mg/100 g) seems to be higher than the recommended daily vitamin C 45-75 mg/kg of body weight and 75-90 mg/kg of body weight, respectively. Nonetheless, We and others (Lim et al. 2021; Liu et al. 2020) have found that vitamin C in starfruit is very susceptible to heat and oxidation, and major losses can be attained during baking and drying.

Table 1.5. *Shelf Life*

No. of Days	Treatment 1	Treatment 2
(Initial Observation)	**Standard Characteristics:** Golden-brown color; smooth and uniform stick shape; pleasant starfruit aroma; crisp texture; balanced sweet-tangy taste; dip is smooth, glossy, and homogeneous	**Standard Characteristics:** Golden-brown color; smooth and uniform stick shape; pleasant starfruit aroma; crisp texture; balanced sweet-tangy taste; dip is smooth, glossy, and homogeneous
1–3	No significant changes in aroma, taste, texture, or appearance; product remains crisp and palatable	No significant changes in aroma, taste, texture, or appearance; product remains crisp and palatable
4–5	Texture slightly softens; slight decrease in crispness; aroma and taste remain acceptable; dip remains stable and smooth	Texture slightly softens; slight decrease in crispness; aroma and taste remain acceptable; dip remains stable and smooth
6–7	Stick becomes noticeably less crisp; slight changes in aroma may be detected; dip may show minor separation but still acceptable	Stick becomes noticeably less crisp; slight changes in aroma may be detected; dip may show minor separation but still acceptable
8	Product no longer optimal for consumption; stick softens significantly; possible off-aroma; dip shows separation	Product no longer optimal for consumption; stick softens significantly; possible off-aroma; dip shows separation

Table 1.5 illustrates the shelf life of Starfruit Sticks (Averrhoa carambola) stored at room temperature (25–28°C) for two variations: Treatment 1 (sour) and Treatment 2 (sweet). Both variations exhibited similar trends in stability. The sticks maintained desirable sensory characteristics—including aroma, appearance, taste, and texture—within the first three days of storage. Between 4 to 5 days, there was a slight decrease in texture, still the dip was stable. After days 6-7 the sticks were less crisp and small separation in the dip was to be observed. The product became suboptimal to take by the 8th day, indicating the end of its shelf life under ambient conditions. The observed changes over time can be attributed primarily to moisture migration and fat oxidation in the baked sticks, which gradually reduce crispness (Onyango et al., 2020).

Table 1.6 *Marketability*

Week 1	Sour (T1)			Sweet (T2)		
DAY	**Displayed**	**Sold**	**Unsold**	**Displayed**	**Sold**	**Unsold**
1	15	12	3	15	15	-
2	15	8	7	15	15	-
3	15	10	5	15	10	5
4	15	10	5	15	10	5
5	15	5	10	15	10	5
Total	75	45	30	15	60	15
Rank		2			1	

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Week 2	Sour (T1)			Sweet (T2)		
DAY	Displayed	Sold	Unsold	Displayed	Sold	Unsold
1	15	11	4	15	14	1
2	15	12	3	15	12	3
3	15	8	7	15	10	5
4	15	6	9	15	9	6
5	15	9	6	15	8	7
Total	75	46	29	75	53	22
Rank		2			1	

Table 1.6 shows both the sales data of Sour Starfruit Sticks and Sweet Starfruit Sticks were recorded for two weeks consecutively, and 50 packs were distributed in different sales outlets. The daily number of packs sold sheds light on customer demand and their approval of the product. The sales records kept by vendors and students involved in the peddling of the products indicate that both Sour and Sweet Starfruit Sticks were marketable and profitable. The marketing and sales performance of the Sweet Starfruit Sticks surpassed that of the Sour Starfruit Sticks as the former was sent off in the highest number of pouches, that is, a total of 60 packs in Week 1 and 53 packs in Week 2. However, with the example of the Sour Starfruit Sticks, the number of packs sold during Week 1 and Week 2 were 45 and 46, respectively, which is just slightly lower than the preferred by consumers.

Table 2 ***Sensory Attributes of the Two Treatments***

Sensory Attributes	Treatment 1 (Sour type)			Treatment 2 (Sweet type)		
	Total Score	Mean Score	Description	Total Score	Mean Score	Description
Appearance	240	3.93	Appealing color and form	272	4.45	Very appealing
Aroma	243	3.98	Distinct and pleasant starfruit aroma, slightly mild but still appealing and natural Preferred	248	4.06	Distinct and pleasant starfruit aroma, slightly mild but still appealing and natural.
Taste	238	3.90	Tasty with clear starfruit flavor; slightly less balanced but still delightful.	251	4.11	Tasty with clear starfruit flavor; slightly less balanced but still delightful.
Texture	193	3.16	Slightly crisp	253	4.14	Crisp

The data presented in Table 2 indicate that Treatment 2 consistently obtained higher mean scores across all sensory attributes compared to Treatment 1. Regarding visual impression, T2 scored 4.45 which can be translated as Very Appealing whereas T1 scored 3.93, which can be translated as Appealing color and form. This means that the sweetness might have developed a more desirable color development and product form. Aromatically, the two treatments were characterized as a clear and pleasant starfruit aroma, slightly mild, but nonetheless, appealing and natural, with the T2 (4.06) slightly higher than the T1 (3.98). This shows that the processing unit maintained the natural aromatic elements of starfruit. On the topics of taste, T2 scored higher with a mean of 4.11 than T1 with 3.90 which was characterized as tasty with a strong taste of starfruits. Regarding the texture, T2 received much higher mean score of 4.14 which can be considered as Crisp as opposed to T1 score of 3.16 which can be considered as Slightly crisp. This implies the sweet treatment possessed a better textual finish. All in all, the results indicate that Treatment 2 (Sweet type) is more acceptable regarding its appearance, aroma, taste and texture.

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Table 3. ***Preference level of Starfruit bread sticks of the two treatments***

Treatment	Aroma	Appearance	Taste	Texture	Mean	Descriptive Rating
T1 – Sour Starfruit Sticks	3.77	3.98	4.19	3.81	3.93	Moderately Preferred
T2 – Sweet Starfruit Sticks	4.19	4.52	4.04	4.39	4.28	Very much Preferred

Table 3 presents evidence that T2 – Sweet Starfruit Sticks was met with the highest weighted mean of 4.28, which corresponds to the Very much Preferred level of preference, thus, it became the formulation most acceptable to the respondents. This treatment always had a higher score in visual, and texture, which were the factors that led to an overall preference rating. After T2, there is T1 – Sour Starfruit Sticks, which got a weighted mean of 3.93, also confirming the interpretation of preference as Moderately Preferred.

Besides being highly accepted, its scores in texture was slightly lower, thus affecting the ranking of its overall preference. The more acidic profile of sour starfruit might have contributed to the influence of flavor and odor as well, since acidity can both release and hide sweetness (Dunkel et al., 2014). The research findings indicate that the Sweet Starfruit Sticks (T2) were the most preferred by the consumers. Possibly this means that sweetness not only makes the food tastier but also gives a more balanced sensory experience, especially in baked goods, where consumers are likely to expect a harmonious blending of flavor, aroma, and texture (Ruiz-Capillas & Herrero, 2021; Stone & Sidel, 2020).

Table 4 ***Difference Among the Sensory Attributes of Starfruit Bread Sticks in Two*** *Treatments*

Variable	t-value	p-value	Interpretation	Decision
Aroma	0.77	0.46	Not Significant	Accept Null Hypothesis
Appearance	2.70	0.016	Significant	Reject Null Hypothesis
Taste	1.10	0.29	Not Significant	Accept Null Hypothesis
Texture	3.39	0.004	Significant	Reject Null Hypothesis

Table 4 presents the results of the paired t-test conducted to determine whether there is a significant difference in the sensory attributes of Starfruit (Averrhoa carambola) Bread Sticks between Treatment 1 (Sour) and Treatment 2 (Sweet). The analysis compares the computed t-values and corresponding p-values at a 0.05 level of significance to determine whether to accept or reject the null hypothesis. In terms of aroma, the computed p-value is 0.46, which is greater than the 0.05 level of significance. Therefore, the null hypothesis is accepted, indicating that there is no significant difference between the two treatments in terms of aroma. Superficially, the p-value calculated is 0.016 and it is less than 0.05. Therefore, the null hypothesis is rejected and thus, the two treatments are significantly different. This is to say that there was a treatment (probably the sweet) that was more visually appealing compared to the other treatment. H. D. Lawless and Hildegarde Heymann think that appearance is a decisive element on consumer acceptance as it is the first impression and has a powerful impact on the quality and desirability of food items.

As regards taste, the computed p-value is 0.29 which is larger than 0.05. Hence, we reject the null hypothesis implying that there is no significant difference in taste of the two treatments. This means that the sour and sweet formulations were equally acceptable among the respondents. This outcome is consistent with the evidence by Harry T. Lawless, who pointed out that people are able to perceive various flavour profiles provided that they are balanced and palatable, so both treatments obtained acceptable quality of taste.

Lastly, to compute the p-value; the calculated p-value is 0.004, smaller than 0.05. Therefore, the null hypothesis is not accepted meaning that there is a significant difference in terms of texture between the two treatments.

Table 5 ***Significant Difference in the Respondents' Preference Level Between the Two Treatments of Starfruit Sticks***

Variables	T-Stat value	df	P-Value	Interpretation	Decision
Aroma	3.20	60	0.002	Significant	Reject null hypothesis
Appearance	4.76	60	1.23	Significant	Reject null hypothesis
Taste	1.19	60	0.23	Significant	Reject null hypothesis
Texture	5.42	60	1.08	Significant	Reject null hypothesis

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Table 5 shows the high difference between the preference level of the respondents in the two treatments of starfruit sticks in terms of sensory attribute selected i.e. aroma, appearance, taste, and texture. The use of a t-test was to establish whether the differences in the respondents evaluation were significant.

The outcome of the substantial variation in the preference level of the respondents in the two treatments in regards to the level of starfruit sticks indicate that all sensory qualities such as the aroma, appearance, taste and texture were all perceived to indicate that they are significant, thus rejecting the null hypothesis. In particular, aroma ($t = 3.20$, $p = 0.002$) is a statistically significant discriminant of preference, which implies that participants had a noticeable distinct perception of different treatments in terms of smell. On the looks front ($t = 4.76$, $p = 1.23$), a significant list was also discovered, which presupposes that the respondents had visual qualities to be considered in their decision. On taste ($t = 1.19$, $p = 0.23$) the difference was not as significant as on other attributes, but still significant in this analysis. In the meantime, the difference in texture ($t = 5.42$, $p = 1.08$) was significant, which suggests that the aspect of mouthfeel had a significant influence on preference. In general, the results indicate that the preference levels of the respondents were influenced considerable by the kind of treatment used, and their overall rating of the starfruit sticks was influenced by aroma, appearance, taste and texture

TECHNOGUIDE IN THE PREPARATION OF STARFRUIT *(AVERRHOA CARAMBOLA)* BREAD STICKS

Rationale

Thanks to innovation, various types of food are now produced nearly everywhere. New products are launched periodically, providing consumers with easier access to foods that meet their preferences. Nonetheless, in numerous areas, despite the abundance of resources, only a small portion is being effectively utilized and converted into value-added products. This lack of utilization of local crops and dairy items underscores the necessity for research that investigates their potential for creating nutritious, affordable, and culturally appropriate food products. While starfruit is widely available and recognized for its high vitamin C, dietary fiber, and bioactive antioxidant content, there is limited research on its application in bakery products, particularly as a starfruit-flavored bread stick. The majority of research work is on juices, jam, or medicine use, and there is a gap on creating functional value-added snacks that will provide nutritional advantages and be acceptable to the consumers. The identified gap justifies the importance of examining new bakery recipes that will incorporate starfruit to improve the nutritional value, minimize losses after harvest, and give economic empowerment to local farmers.

In this connection, the researcher pursued an experiment on the preparation Starfruit bread sticks. The intention was not merely to introduce a new product for profit but to develop a healthy, locally sourced bread sticks that balances sensory satisfaction with nutritional value.

Objectives

The main thrusts of this proposed technology guide are the following to:

1. acquaint and introduce the school administrators, teachers, parents, students, and consumers about Starfruit bread Sticks
2. stimulate the utilization of local agricultural crops by demonstrating their potential in food innovation and product development.
3. encourage the interest of students, spread producers, and especially cookery majors in utilizing locally available resources by developing innovative food products such as Starfruit bread sticks
4. Serve a new healthy food product in the school canteen, bakeshops and in the market.

VI. CONCLUSION AND RECOMMENDATIONS

Conclusions

Based on the findings of the study, it is concluded that starfruit can be utilized in the development of value-added baked products such as starfruit bread sticks, thereby addressing the problem of creating innovative and nutritious snack alternatives. The results revealed that both Sour and Sweet Starfruit Bread Sticks attained acceptable ratings in terms of appearance, aroma, taste, and texture, indicating that the incorporation of starfruit does not negatively affect the overall sensory quality of the product.

Nevertheless, when deciding which treatment to make more acceptable, the Sweet Starfruit Bread Sticks received a higher mean rating particularly in taste and aroma meaning a greater preference among the respondents because of its middle ground on sweetness and a better tasting profile. Contrarily, the Sour Starfruit Bread Sticks retained similar acceptability of the outlook and feel which suggested that the degree of sourness had little substantial bearing on the structural and the aesthetic nature of the product.

Further, the research paper tackled the issue of product stability and quality by determining that adequate formulation, processing as well as packaging are vital in the preservation of sensory properties and the shelf life of the product. These are some of the factors that have an impact in the overall market and acceptability of the starfruit bread sticks.

Thus, it is possible to conclude that both treatments are acceptable, the Sweet Starfruit Bread Sticks have a higher preference in terms of sensory characteristics, such as taste and aroma. The implication of this is that baked goods made of starfruits can be highly commercialized and could act as an alternative when developing healthy and attractive snack goods.

Recommendations

Based on the conclusions made during the study, the next recommendations are structured according to the product-specific (strengths and areas of improvement) to the more general ones:

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1. Treatment 2 (Sweet Starfruit Bread Sticks) can be broadly produced as it is more preferred by the consumer and easy to prepare.
2. It is suggested that a better design of its packaging should be developed in a manner that the starfruits bread sticks and starfruits dip are packed differently in a single packaging. This ensures quality of products, preservation of texture as well as improving convenience and appeal by consumers.
3. Eleaboration and processing of Starfruit Bread Sticks can be improved more to enhance their texture, taste and acceptability, particularly other forms of treatment with low acceptability.
4. The Starfruit Bread Sticks product can be made available to consumers to enhance their understanding and perceptions about using starfruit as a diverse ingredient in baked foods.
5. The product can be advertised by way of community outreach, school programs and local food fairs to enhance market acceptability.
6. The Starfruit Bread Sticks can be sent to a laboratory to view the extent of shelf-life as well as a general, detailed nutritional assessment (macro- and micronutrients).
7. The composition and processing of Starfruit Bread Sticks may be considered for intellectual property protection, such as patenting, to safeguard the innovation of the researchers.
8. Future researchers may use this study as a reference in conducting related studies and in developing other starfruit-based baked products.

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