SENSORY EVALUATION AND FEATURES OF BLUE MACKEREL SCAD "GALUNGGONG'' (DECAPTERUS MACARELLUS) – SQUASH (CUCURBIRTA MAXIMA) COOKIES

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Abstract

The food industry has experienced numerous changes and challenges globally, primarily driven by consumer demand for safe, healthy, and appealing food options. Education plays a crucial role in developing healthy eating habits, addressing the needs and preferences of various consumer groups, including those who choose vegan, vegetarian, organic, or flexitarian diets. This study aimed to formulate cookies using blue mackerel scads and squash, followed by sensory and chemical evaluations. This research employed an experimental design using ANOVA, testing five different formulations: 100 grams of blue mackerel with 0 grams of squash, 80 grams of mackerel with 20 grams of squash, 60 grams of mackerel with 40 grams of squash, 40 grams of mackerel with 60 grams of squash, and 20 grams of mackerel with 80 grams of squash. A total of 50 respondents, spanning various age groups from 7 to over 60, evaluated the sensory characteristics of these formulations. The analysis revealed no significant mean differences in sensory evaluations among the treatments. However, the most preferred formulation was T4, which consisted of 20 grams of blue mackerel and 80 grams of squash. This recipe demonstrated a nutritional composition of 1.42% crude ash, 18.7% crude fat, 9.80% moisture, 6.54% crude protein, less than 0.6% crude fiber, 448 calories, and 63.5% carbohydrates. Microbial analysis indicated a yeast and mold count of less than 10CFU/g, confirming its safety. The study concluded with a techno-guide for producing the preferred recipe, aimed at facilitating its adoption by end-user.

Keywords: *vocational education, blue mackerel scads-squash cookies, experimental method*

Introduction

The global food sector has experienced many shifts and difficulties, mostly due to customer desire for wholesome, enticing food. Education is designed to develop healthy eating habits in response to general consent or the needs and features of particular consumer groups, accounting for dietary preferences and practices such as organic, vegan, vegetarian, and flexitarian. With the advancement of science and technology, diets and food preparation have become more individualized and sophisticated (Rosenthal et al., 2021). Furthermore, risk and social responsibility are two qualities that an individual must possess in order for innovation to succeed. The industry gains a competitive edge in the global market through innovative product innovation. The innovation sector is a wonderful place to start a business because it has expanded to be a major industry (Gimena, 2019).

Meanwhile, the most experiential and interactive value of interdisciplinary and research domains is found in the TLE (Technology and Livelihood Education) subject (moral, cultural, aesthetic, vocational, professional political and economic values). Filipino students have the chance to display real-world knowledge and abilities in this field of study, including job productivity and empathy (De Alca, 2008). In order to prepare students for the workforce, TLE works to enhance their knowledge, abilities, values, and attitudes. Students can acquire knowledge and abilities in a range of topics linked to home economics, entrepreneurship, and industrial and agricultural arts (Jacolbia, 2016). Teachers employ educational materials as teaching tools with their pupils. As the main method of instruction is practice, well-written textbooks have a big impact on what pupils learn. The right number of units is strongly tied to the number of students and high-quality study materials. Through practical practice, students gain ideas on how to apply this experience to real-world situations. This study material serves as a study aid (Albarico et al., 2014).

Food development depends on key crops and may face major challenges in the near future. Thus, divergence from these crops leads to the use of underutilized crops that have potential value as human food and play an important role in food decision making (Mayes et al. 2012; Go et al., 2015). By developing and improving traditional products through food innovation, such as incorporating blue mackerel and squash into new cookie recipes, the demands of consumers for healthier, more nutritious, and convenient options can be effectively met.

School-related meals are a vital source of nutrients and energy for kids' diets. Determining the reasons for moms' and kids' school snacks might aid in the creation of programs that encourage a balanced diet (Alcaire et al., 2021). Furthermore, Cookies are also widely used around the world. In fact, they are the largest category of food in many parts of the world (Borro et al., 2016). Cookies are good carriers of nutrients, such as carbohydrates and fats, which can fortify proteins to an appropriate level, partially replacing refined flour with high-protein flour (Soni et al., 2018).

Mackerel is a very nutritious food and contains many proteins, omega-3 fatty acids and micronutrients for a small number of calories. Mackerel is particularly rich in vitamin B12, selenium, niacin, phosphorus and other important vitamins and minerals (Link, 2018).

Furthermore, β-carotene has been found in the fruits of cucurbit (squash) maxima plants, according to many research. This is essential for mitigating the problem of vitamin A deficiency, which is the most deficient micronutrient after iron and impacts the susceptible

population, which includes women and children (Hashash et al., 2017).

A wide range of cookie products is available globally, but the effects of incorporating squash and fish, like blue mackerel scads, in functional foods have not been thoroughly evaluated. Using blue mackerel and squash in cookie recipes enhances nutritional profiles and introduces unique flavors and textures that appeal to diverse consumers. This integration supports a shift toward healthier, sustainable food choices, allowing snacks to contribute positively to diets. By embracing such innovations, food producers can differentiate their products, respond to consumer preferences, and promote healthier eating habits, fostering a thriving industry focused on nutrition and sustainability.

This study aims to formulate the Blue Mackerel Scads-Squash-based Cookies in five different treatments and determine its sensory and chemical evaluation to create an appropriate technological guide for TLE instructions.

Research Questions

This research evaluated the sensory properties and features of cookies infused with Blue Mackerel Scads and Squash, focusing on descriptive characteristics and overall acceptability. The research was conducted at Busay National High School in Moalboal, Cebu, during the school year 2021–2022, and the findings were used as the basis for developing a techno-guide. Specifically, it attempted to address the following questions:

1. What is the profile of the respondents in terms of:
    1.1. age and gender; and
    1.2. exposure to cookie products?
2. To what extent is the sensory evaluation of the aforementioned cookie formulations based on descriptive and acceptability as to:
    2.1. color;
    2.2. odor;
    2.3. flavor;
    2.4. texture; and
    2.5. general acceptability?
3. Are there significant difference among the aforementioned treatments based on their descriptive and acceptability as to:
    3.1. color;
    3.2. odor;
    3.3. flavor;
    3.4. texture; and
    3.5. general acceptability?
4. What are the features of the most preferred treatment as to:
    4.1. microbial analysis;
    4.2. proximate composition;
    4.3. shelf life; and
    4.4. cost analysis?
5. Based on the findings what techno-guide can be crafted?

Methodology

Research Design

This study employed an experimental research design of Gimena et al. (2022) using a cross over design of Go et al. (2015) using laboratory techniques and procedures in data processing wherein each respondent received samples of all treatment. The variables were the blue mackerel scads and squash having five (5) recipe formulation. T0 (0 grams ''galunggong'': 0 grams squash); T1 (80 grams ''galunggong'': 20 grams squash); T2 (60 grams ''galunggong'': 40 grams squash); T3 (40 grams ''galunggong'': 60 grams squash); and T4 (20 grams ''galunggong'': 80 grams squash). The five formulations were evaluated by the respondents for sensory evaluation and general acceptability using the descriptive and hedonic tests. The data were tabulated and analyzed as basis for generating findings, conclusion and recommendation for sensory evaluation process.

Respondents

This study involved 50 respondents, including ten (10) teachers or experts and forty (40) students randomly selected from Busay National High School, to conduct sensory evaluations of blue mackerel scads-squash cookies. Utilizing the 9-point hedonic test, these respondents provided valuable feedback on the sensory characteristics of the product.

Table 1 presents the demographic details of the study's participants, highlighting the diverse perspectives gathered to ensure a comprehensive evaluation of the cookies' acceptability. This approach strengthens the study's findings and supports the development of a product that meets consumer preferences.

Table 1. *Distribution of Respondents*

Respondents	Age Groups	Frequency				Total	Percentage
		Male	*Percentage*	*Female*	*Percentage*		
Teachers	40-59 yrs. old	1	4. 16	1	3.85	2	4%
	20-39 yrs. old	3	12.5	5	19.23	8	16%
		4	16.66%	6	23.08%	10	20%
Students	13-19 yrs. old	10	41.67	10	38.46	20	40%
	7-12 yrs. old	10	41.67	10	38.46	20	40%
		20	83.34%	20	76.92%	40	80%
Total		24	100%	26	100%	50	100%

Instrument

The data gathering tool utilized to ascertain the sensory assessment of the newly formulated blue mackerel scads-squash based cookies was the 1952, Jones and Girardot adapted questionnaire tests, cited by Lim (2021). The surveys comprised of three sections.

Part I contains the respondents' demographic profile, which includes details on their name (optional), age, gender, and exposure to cookie products.

Part II contains information on the sampling experiments that were assessed for texture, flavor, odor, and color.

Part III uses the hedonic test approach to discuss acceptance overall.

The 9-point hedonic scale is the most frequently utilized tool for assessing acceptance of the meal. The aforementioned scale was acquired by Peryam and his associates in the US Armed Forces Quartermaster Food and Container Institute to evaluate troops' nutritional preferences.

In order to ascertain whether the most favored sample from the descriptive test was generally accepted, 50 respondents were given the preference test. Microbial analysis of cookies guarantees that the product is hygienic, safe to eat, and devoid of harmful microbes.

Shelf-life assessment typically entails handling and storing new products in ways that reflect the product's supply chain as well as end-user storage settings because most shops and catering facilities have predefined parameters that indicate expected periods and temperatures for storage. It also usually involves shelf-life testing storage conditions, which are necessary for all products to be sold at their facilities. Microbiological and organoleptic evaluation across the requisite shelf-life is typically required for shelf-life testing (in certain situations, nutritional analysis is also necessary to determine that the product's nutritional performance meets standards throughout the shelf-life) conservation (Swainson et al., 2010).

Procedure

Prior to data collection, the researcher obtained written approval from the public school district supervisor to conduct the research within the school. Simultaneously, the researcher sought certification from the Local Review Ethics Committee (LREC) to ensure biosafety clearance and laboratory compliance.

Following the approval, the researcher conducted an orientation session to explain the study's objectives to the respondents. This session provided an overview of the research process and emphasized the significance of their participation.

By clarifying the sensory evaluation criteria, the researcher ensured that the participants understood what aspects of the cookies they would be assessing, such as flavor, texture, aroma and general acceptability.

A. Formulation of Blue Mackerel Scad-Squash Cookies. The formulation of the Blue Mackarel Scad-Squash cookies includes the following:

Recipe Preparation. Various cookie recipes were developed using blue mackerel scads and squash, with each recipe designed to have different formulation levels. Ingredients were measures accurately, and recipes were standardized to ensure consistency in taste and texture.

The Processing Procedures involves the following:

Washing and Cleaning: The blue mackerel and squash are washed separately under clean running water to ensure they are free from dirt and contaminants.

Steaming and Boiling: The cleaned blue mackerel is steamed to soften the flesh for easy flaking, while the cleaned squash is boiled until tender for effortless mashing.

Deboning: The bones of the blue mackerel are carefully removed to prevent any choking hazards when consuming the cookies.

Measuring: The mashed squash and flaked blue mackerel scads are weighed separately according to the required treatment amounts.

Mixing: The flaked dehydrated blue mackerel and ground dehydrated squash are combined with the basic cookie recipe according to

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the specified treatments.

B. Standard Recipe for Cookies. The standard cookie recipe is: 115 grams of unsalted butter, 104 grams of brown sugar, 125 grams of white sugar, 50 grams of whole egg, 150 grams of all-purpose flour, 9 grams of cornstarch, 3 grams of baking soda, 1. 425 grams of salt, and 4.34 grams of vanilla extract.

C. Recipe for Blue Mackerel Scads-Squash Cookies. A formulated baked recipe called "blue mackerel scads-squash cookies" combines blue mackerel scads, or "galunggong," with squash. The core cookie recipes, upon which the cookie recipe is based, include: 115 grams of unsalted butter, 104 grams of brown sugar, 125 grams of white sugar, 50 grams of whole egg, 150 grams of all-purpose flour, 9 grams of cornstarch, 3 grams of baking soda, 1. 425 grams of salt, and 4.34 grams of vanilla extract.

D. Five Treatments (Including Control Groups). Treatment 0; 0-gram `` galunggong "; 0-gram squash. Treatment 1; 80 grams `` galunggong ": 20 grams squash. Treatment 2; 60 grams of `` galunggong ": 40 grams of squash. Treatment 3: 40 grams `` galunggong ": 60 grams squash. Treatment 4; 20 grams of ''galunggong'': 80 grams of squash.

Table 2. *Recipe Formulation of Blue Mackerel Scads-Squash Cookies*

Ingredients	Treatments				
	T0 (Control Variable)	T1	T2	T3	T4
Blue mackerel	100 grams	80 grams	60 grams	40 grams	20 grams
Squash	0 gram	20 grams	40 grams	60 grams	80 grams
Butter	115 grams	115 grams	115 grams	115 grams	115grams
Brown sugar	104 grams	104 grams	104 grams	104 grams	104 grams
White sugar	125 grams	125 grams	125 grams	125 grams	125 grams
Whole egg	50 grams	50 grams	50 grams	50 grams	50 grams
All-purpose flour	150 grams	150 grams	150 grams	150 grams	150 grams
Cornstarch	9 grams	9 grams	9 grams	9 grams	9 grams
Baking soda	3 grams	3 grams	3 grams	3 grams	3 grams
Salt	1.425 grams	1.425 grams	1.425 grams	1.425 grams	1.425 grams
Vanilla extract	4.34 grams	4.34 grams	4.34 grams	4.34 grams	4.34 grams

The cookie dough was prepared in batches in a controlled environment. The dough was mixed thoroughly to ensure even distribution of ingredients.

The five recipes used in the study are presented in Table 2. These formulations are provided for informational purposes and to orient end-users, offering a clear overview of the variations that were tested during the research

E. Baking Procedures. The prepared cookie dough was shaped into uniform pieces and baked in preheat oven at a specified temperature for a predetermined time, ensuring that each batch was cooked to the same level of doneness.

The procedure involved in the preparation are: Preheat the oven to 180°C. Grease 5 baking sheets with melted butter. In a bowl, beat the unsalted butter together with the brown and white sugar with an electric whisk until creamy. Add whole egg, beating well between each addition until well blended. Stir in flour, cornstarch, baking soda, salt and vanilla extract until blended. Use a spatula to combine the dough into the bowl. Divide the batter into five equal measures, then add the five recipe formulations to each batter. Shape into balls with 2 teaspoons of the mixture. Place on the ready trays, about 5 cm apart. Gently flatten with a fork. Bake the cookies for 10-15 minutes or until the cookies are baked (ovens may vary). Once baked, remove the cookies from the oven and let them cool, directly on the trays.

F. Cooling and Storing. After baking, the cookies were allowed to cool at room temperature. Once cooled, each 30 g sample of cookies was individually packaged and labeled according to its formulation level.

G. Laboratory Testing. Prior to distribution to participants, the cookie samples underwent comprehensive laboratory testing to evaluate both safety and nutritional benefits. This process included microbiological testing, which aimed to identify any harmful pathogens that could pose a risk to consumers. Additionally, proximate composition analysis was conducted to determine the nutritional content of the cookies, including levels of moisture, protein, fat, carbohydrates, and ash. These rigorous evaluations ensured that the cookies met safety standards for consumption and highlighted their potential health benefits, such as increased nutrient density and enhanced dietary value, making them a suitable choice for health-conscious consumers.

H. Data Collection. Figure 4 shows the flow on the processing of blue mackerel scads-squash cookies.

The ratings and feedback from the participants were meticulously recorded using evaluation forms designed to capture their sensory experiences and preferences. This data will undergo statistical analysis to identify trends and patterns in preferences among the various cookie formulations. By applying statistical methods, the research aims to determine which specific attributes—such as flavor, texture, and aroma—were most favored by the participants. This analysis will provide valuable insights into consumer acceptance and help guide future product development for the blue mackerel scads-squash cookies.

Data Analysis

The collected data were analyzed using specific statistical procedures to calculate the sensory ratings of the product through the Weighted Mean. Additionally, Analysis of Variance (ANOVA) was utilized to determine whether significant differences existed among the various treatments. For the respondents' profile, the simple percentage and frequency count were used.

This comprehensive analysis not only provides valuable insights into the sensory attributes of the cookies but also helps identify the most preferred recipe based on feedback from both experts and consumers, ensuring a well-rounded evaluation of the product

Results and Discussion

Presented in this section are data that have undergone a range of statistical analyses based on their significance to the study. The significant results of the experiment are persuasively communicated to support the technology's dissemination.

Profile of the Respondents

In this study, respondent profiles were assessed based on criteria like age, gender, and exposure to cookie items. There were fifty (50) respondents in total who took part in the survey, as the Table illustrates. They were chosen at random to sample the five cookie recipes and assess the finished product on the basis of acceptability and descriptive sensory attributes (color, odor, taste, and texture).

To ensure consistent product approval, respondents were chosen at random based on age and gender, as taste preferences vary with age and gender.

Age

A person experiences psychological comfort and pleasure from consuming certain meals, which are known as comfort foods. Most research has shown that early experiences have a significant role in shaping lifelong food consumption preferences and behaviours, and that social-affective environments might affect eating choices (Cooke et al., 2005). Comprehending the dietary choices of youngsters has not received much attention in the past. To be sure, a wide variety of goods and drinks have been developed especially for the younger market as the need for kid-friendly meals grows. Food firms are becoming more interested in creating goods aimed at younger consumers, as children have a big influence on their shopping decisions and frequently purchase food items themselves (Laureati et al., 2015).

Table 3. *Profile of the Respondents as to Age*

Respondents	Age Groups		Frequency		Total	Percentage
			Male	Female		
Teachers	Middle adulthood	40-59 years old	1	1	2	4%
	Early adulthood	20-39 years old	3	5	8	16%
Students	Adolescence	13-19 years old	10	10	20	40%
	Middle Childhood	7-12 years old	10	10	20	40%
Total			14	26	50	100%

In the above table, the student participants are represented by 80% of the respondents, who are between the ages of 7 and 19. On the other hand, 20% of the respondents, or the teacher's participants, are between the ages of 20 and 59.

Adults and children have distinct food preferences (Smith et al., 2016), which is crucial for developing products like blue mackerel scads-squash cookies. Recognizing these differences can guide the formulation process to ensure that the cookies appeal to both age groups, helping to promote healthier eating habits among children while satisfying adult tastes.

Gender

Gender variability in food choices, medical characteristics, and hormonal pathways has been discovered in recent decades by substantial study in human physiology (Feraco et al., 2024). The data presented in Table 4 indicates that 48% (24) of the respondents are male, while 52% (26) are female.

Table 4. *Profile of the Respondents as to Gender*

Respondent		Frequency		Total	Frequency		Total
		Male	Percentage	Male %	Female	Percentage	Female %
Teachers	10	4	16.66		6	23.08	
Students	20	20	83.34	48%	20	76.92	52%
Total	50	24	100%		26	100%	

Notable and statistically significant differences were observed between men and women. Variations were identified in their views on food and health, ethical considerations related to food production and consumption, nutritional attitudes and choices, dietary changes, food services, and self-perception (Beardsworth et al., 2002). The current survey shows that eating preferences differ between the gender, and these differences vary between elementary, middle and high school.

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According to research, females likes sweet foods while boys prefer fish; however, tastes can alter as children get older (Gimena et al., 2022). Understanding these differences is essential for developing blue mackerel scads-squash cookies, as they can inform product formulation and marketing strategies tailored to both male and female consumers.

Exposure to Cookie Products

This covers the respondents' experience with cookie items so they can compare and gauge the flavors of the cookies.

Table 5 presents the respondents' profile with respect to their interaction with cookie items. They were asked to rank how frequently, occasionally, and never had they come into contact with cookie items. This allows them to have the comparison of their preferences in taste.

Table 5. *Exposure to Cookie Products*

Exposure to Cookies	Male	Percentage	Female	Percentage	Total	Percentage
Always	1	4	8	32	9	18
Sometimes	21	84	14	56	35	70
Never	3	12	3	12	6	12
Total	25	100%	25	100%	50	100%

Results shows that majority of the participants were sometimes expose to eating cookie products. This implies that not all people always eat cookies however, they eat sometimes or occasionally. In terms of gender categorization of exposure to cookies results discloses that 21 or 84 percent males were sometimes exposed to eat this product as compared to 14 or 56 percent of female participant that comprised 70 percent of the total participant. This means that more men sometimes eat cookies than women. There are gender variations in the purchasing, preparing, and consuming of food, according to conventional knowledge derived from observations and experience.

The eating habits, dietary preferences, and nutritional strategies of the sexes differ, and these variations are influenced by both extra- and intra-individual (social and cultural) and biological (biological or psychological) variables in addition to evolution. It is observed that women have a stronger belief in the benefits of a healthy diet, are more actively involved in managing their weight, prefer to eat in social settings and in groups, and are often frustrated by their own eating habits, which is a reflection of increased social pressure and an attempt to lessen the pleasure associated with eating. However, men tend to be more pushed by the pleasure of consumption and favor fatty, strongly-flavored foods; they used greater nutritional supplements, always restaurants in fast foods, and sneak candies in while watching TV (Grzymisławska, 2020). However, the abstract provided do not specifically mention whether males and females eat more cookies.

Sensory Evaluation And Features On The Different Recipe Treatments Based On Descriptive And Acceptability

Numerous facets of daily living include sensory analysis (Lewkoska et al., 2015). Of all the instruments employed in the field of sensory analysis, descriptive analysis is without a doubt the most advanced, versatile, and popular (Kemp et al., 2018). Respondents to this test must describe the product under study's color, flavor, odor, and texture. The sensory attributes of the five Blue Mackerel Scads-Squash Cookies recipe treatments were rated by the responders using descriptive tests.

Color

Food quality is largely determined by its color, which is arguably the most significant sensory component. Researchers are now better understanding the ways in which what we see can modulate the multisensory perception of flavor and change our eating behaviours by understanding the sensory and hedonic expectations that food color elicits in different groups of people (Spence et al., 2016). During a complimentary tasting test, the participants were requested to rank the color characteristic of five distinct recipe treatments.

Table 6. *Descriptive Rating of Color Attributes of the Five Treatments*

Categories	Scale	Treatment Recipe				
		T0	T1	T2	T3	T4
Golden Brown	5	16	11	12	11	31
Light Golden Brown	4	19	29	13	17	6
Moderately Brown	3	9	6	14	16	8
Dark Brown	2	6	4	8	3	2
Chocolate Brown	1	3	0	3	3	3
Mean		3.72	3.94	3.46	3.60	4.20
Description		Light Golden Brown	Light Golden Brown	Light Golden Brown	Light Golden Brown	Golden Brown

Legend: (4.20-5.00) Golden brown; (3.40-4.19) Light golden brown; (2.60-3.39) Moderately brown; (1.80-2.59) Dark yellow brown; (1.00-1.79) Chocolate brown

Table 6 shows the descriptive rating of the color attributes (chocolate brown, dark brown, moderately brown, light golden brown and golden brown) of Blue Mackerel Scads-Squash Cookies.

The results indicate that T0 to T3 exhibit similar light golden brown color characteristics, while T4 shows a distinct golden brown color. This difference is attributed to the higher consistency of squash in treatment T4, which contains 80 grams. This indicates that the golden-brown color, which is selected as the perfect color for the mackerel scads-squash cookies, is highly favored by the majority

of responders. However, there was also acceptance for other color classifications.

According to Wang (2021) Food color has a tremendous influence on appetite, and research has shown that certain color combinations can alter brain responses that influence appetite. This implies that the cookies are more appetizing the more squash there is.

Odor

Considering the emotional responses triggered by food samples, along with their sensory attributes, is essential because consumers often make purchasing decisions based on the immediate emotional reactions that products evoke (Seo et al., 2009). In this attribute the respondents rated their personal odor perception to five different treatments presented. Odor attributes are important on the treatment formulations.

Table 7 clearly shows the descriptive odor ratings of the five formulations rated by the respondents.

Table 7. *Descriptive Rating of Odor Attributes of the Five Treatments*

Categories	Scale	Treatment Recipe				
		T0	T1	T2	T3	T4
Extremely Noticeable	5	10	17	18	14	31
Very Noticeable	4	16	11	12	15	3
Moderately Noticeable	3	8	7	13	7	14
Slightly Noticeable	2	7	14	5	9	2
Unnoticeable	1	9	1	5	5	0
Mean		3.22	3.58	3.78	3.48	4.26
Description		Moderately noticeable	Very noticeable	Very noticeable	Very noticeable	Extremely noticeable

Legend: (4.21-5.00) Extremely Noticeable (3.41-4.20) Very Noticeable; (2.61-3.40) Moderately Noticeable; (1.81-2.60) Slightly Noticeable; (1.00-1.80) Unnoticeable

As can be seen from the chart, T4 received the highest descriptive rating of extremely pleasant and the highest average mean of 4.26 which means that the odor of the fish with squash is not noticeable. Meanwhile T3, T2 and T1 got an average mean of 3.48, 3.78 and 3.58 with the descriptive rating of very pleasant which means that the odor of the fish with squash is slightly noticeable. Conversely, T0 had a mean average rating of 3.22 having moderately pleasant as its descriptive rating which means that the odor of the fish with squash is noticeable.

It is crucial to understand how food fragrances influence behavioral reactions since we are continually exposed to sensory cues concerning food, including smells, which can lead to (un)conscious decisions or even overeating. The phenomenon known as sensory-specific appetite has been shown to boost appetite for foods with similar attributes when exposed to food scents. It indicates that humans have evolved the power to utilize their awareness of smell to find out the nutritional value of food items according to the past interactions with food. (Morquecho-Campos, 2020). Thus, this implies that incorporating squash in a cookie recipe can make odor of the fish not noticeable.

Flavor

Taste preferences shift as people age. Newborns favor sweet tastes and avoid bitter ones, while adults often develop a liking for both. As people age further, however, taste sensitivity can decline in the elderly, potentially affecting their food choices and overall health (Galindo et al; 2012).

Table 8. *Descriptive Rating of Flavor Attributes of the Five Treatments*

Categories	Scale	Treatment Recipe				
		T0	T1	T2	T3	T4
Extremely Desirable	5	8	16	21	16	22
Very Desirable	4	19	12	14	14	12
Moderately Desirable	3	15	15	7	9	11
Slightly Desirable	2	5	6	7	6	0
Undesirable	1	3	1	1	5	5
Mean		3.22	3.58	3.78	3.48	4.26
Description		Moderately Desirable	Very Desirable	Very Desirable	Very Desirable	Extremely Desirable

Legend: (4.20-5.00) Extremely Desirable; (3.40-4.19) Very Desirable; (2.60-3.39) Moderately Desirable; (1.80-2.59) Slightly Desirable; (1.00-1.79) Undesirable

During the course of the study, respondents were asked to evaluate the taste of the blue mackerel-squash base cookies after tasting the five different recipes. It also allows the researchers assess their taste preferences.

The descriptive assessments of the five recipes' flavors provided by the respondents are shown in Table 8.

The data suggests a positive trend in the flavor profile as the formulations progress from T0 to T4, with increasing average means and more favorable ratings. T0, with the lowest average mean, was less well-received, likely due to the noticeable presence of fish and squash flavors, which some respondents found undesirable. However, as the formulations were refined in T1 through T4, there was a

clear improvement in the acceptability of the cookies, with T2 and T4 particularly standing out as the most desirable.

Interestingly, T4 received no undesirable ratings, indicating that the combination of squash and galunggong in the right proportions can create a well-balanced and appealing flavor. This supports the idea that while unconventional ingredients like fish and squash may initially seem challenging to incorporate into a sweet product like cookies, careful formulation can result in a unique and extremely desirable taste. This outcome highlights the potential for innovative ingredient combinations to create new and appealing products in the food industry, especially when aiming to enhance nutritional value without compromising on taste.

Texture

Texture in food refers to the physical qualities that the senses experience (Tunick 2010). In order to evaluate the acceptability and quality of products, the fresh and processed food industries consider texture as a critical quality feature (Chen et al., 2013). For these attributes, respondents rated the texture of each treatment when tasting different cookie formulations.

Table 9. *Descriptive Rating of Texture Attributes of the Five Treatments*

Categories	Scale	Treatment Recipe				
		T0	T1	T2	T3	T4
Chewy	5	8	16	21	16	22
Crispy	4	19	12	14	14	12
Soft	3	15	15	7	9	11
Crumbly	2	5	6	7	6	0
Gritty	1	3	1	1	5	5
Mean		3.22	3.58	3.78	3.48	4.26
Description		Soft	Crispy	Crispy	Crispy	Chewy

Legend: (4.20-5.00) Chewy; (3.40-4.19) Crispy; (2.60-3.39) Soft; (1.80-2.59) Crumbly; (1.00-1.79) Gritty

Table 9 displays the respondents' feedback regarding the descriptive evaluation of the texture across various formulations. Notably, T4 achieved the highest average mean of 3.92, earning a descriptive rating of chewy. This result suggests that T4's formulation, featuring a lower consistency of blue mackerel (20 grams) and a higher consistency of squash (80 grams), significantly contributes to the cookie's soft and dense texture. The increased squash content likely adds more moisture and natural sugars to the dough, which can soften the gluten network, yielding a chewier consistency. Additionally, the fiber content in squash may enhance the chewiness by creating a more cohesive and tender crumb. The balance between the wet and dry ingredients is crucial in achieving this texture, as the moisture from the squash counteracts the potential dryness from the flour and blue mackerel. Conversely, the reduced blue mackerel content minimizes its influence on texture, allowing squash to dominate in achieving the desired chewiness. This highlights the importance of ingredient ratios in formulating cookies that appeal to different textures.

In contrast, T1, T2, and T3 received descriptive ratings of crispy, indicating that higher blue mackerel content results in a firm, crunchy texture that breaks easily. Their average mean scores were 3.34, 3.70, and 3.46, respectively. This suggests that the presence of blue mackerel in larger quantities contributes to a denser cookie that lacks the moisture necessary for chewiness, leading to a more brittle texture. The crispy texture may appeal to consumers looking for a traditional cookie experience; however, it may not be suitable for those who prefer softer textures.

T0, however, earned a descriptive rating of soft, signifying a moist, tender texture with a hint of chewiness, and an average score of 3.48, typical of a standard cookie recipe. This formulation serves as a baseline, highlighting the textural differences achieved with variations in blue mackerel and squash content. The soft texture of T0 could appeal to consumers who enjoy traditional cookie flavors and textures, making it an important reference point for evaluating other formulations.

Furthermore, squash was shown to have a high dietary fiber and carotenoid content. Unlike many other fruits, it contained minimal oil or total phenolic content. Additionally, the mineral levels in squash were higher than recommended to meet customers' nutritional needs. This nutritional profile not only supports the functional benefits of incorporating squash into cookie formulations but also enhances the overall health appeal of the cookies, potentially attracting health-conscious consumers (Jacobo-Valenzuela et al., 2011)

Overall, these findings suggest that while varying ingredient ratios significantly impact texture, they also hold implications for consumer preferences, which could be explored further in future research. Understanding how these textural differences affect consumer choices may provide valuable insights for product development, allowing for the creation of cookies that meet specific market demands. Additionally, sensory evaluations could be expanded to assess other sensory attributes, such as flavor and aroma, to provide a more comprehensive understanding of how these factors interact to influence overall consumer satisfaction. Future studies could also investigate the potential health benefits of incorporating blue mackerel and squash into cookie formulations, further enhancing their appeal in a health-conscious market.

General Acceptability

Food selections are greatly influenced by consumer acceptability, which is characterized by likeability, palatability, and perceived quality. Food goods must be accepted by consumers in order to succeed on the market, and new products that promote health can only work if they are eaten.

The intrinsic qualities of food, such as its color, odor, flavour, texture and general acceptability all affect how palatable it is to the senses. The way these variables interact is also crucial to take into account, since different parameters like temperature and portion size can have an impact on how sensory qualities appear (Murray et al., 2003). Foods are often consumed during meals, and customers bring a range of expectations to the table based on information from packaging, product and nutrition labels, and prior experiences, all of which might affect their preferences. The measuring of food acceptability's sensory and emotional characteristics is made more difficult by these circumstances (Meiselman et al., 2003).

A 9-point hedonic scale is being utilized by the respondents to measure their perceived acceptance of the designed cookie goods.

Table 10. *Mean Sensory Scores for Preferences Test Analysis on the General Acceptability*

Attributes	Treatment Recipe				
	T0	T1	T2	T3	T4
Color	6.80	6.74	7.32	7.52	8.14
Odor	6.10	6.62	7.24	7.40	7.60
Flavor	6.30	6.50	7.34	7.46	7.90
Texture	6.22	6.42	7.10	7.42	7.74
General Acceptability	6.36	6.57	7.25	7.45	7.85
Rating	Like Moderately	Like Moderately	Like Very Much	Like Very Much	Like Very Much

Legend: (8.13 - 9.00) Like Extremely; (7.24 - 8.12) Like Very Much; (6.35 - 7.23) Like Moderately; (5.46 - 6.34) Like Slightly; (4.57 - 5.45) Neither Like nor Dislike; (3.68 - 4.56) Dislike Slightly; (2.79 - 3.67) Dislike Moderately; (1.90 - 2.78) Dislike Very Much; (1.00 - 1.89) Dislike Extremely

Table 10 displays the average sensory ratings for the preferences test analysis on the overall acceptability.

The data shows that T4 achieved the highest average mean of 8.14 for overall acceptability, earning a "Like Extremely" rating. This suggests that T4 stands out not only in color attributes but also in overall sensory appeal. This level of consumer preference indicates that T4 may have a competitive advantage in the market.

T3 and T2 received average means of 7.52 and 7.32, respectively, with both rated as "Like Very Much." This indicates that these formulations also resonate well with consumers, suggesting that they possess appealing sensory qualities that could be leveraged in marketing and product development.

The average means of 6.74 for T1 and 6.80 for T0, both rated as "Like Moderately," imply that while these formulations are acceptable, they may not be as compelling as T4, T3, or T2. This highlights an opportunity for improvement, as enhancing the sensory qualities of T1 and T0 could boost their overall acceptability.

The strong correlation between color attributes and overall acceptability is evident, especially for T4. This reinforces the idea that visual appeal significantly influences consumer preferences, and product developers should prioritize color in formulation and presentation.

The findings suggest that T4's favorable ratings can be effectively utilized in marketing campaigns to attract consumers. Emphasizing its appealing attributes could help increase sales and market presence.

The moderate ratings for T1 and T0 indicate that further research and development are needed to enhance their sensory profiles. Exploring ingredient adjustments, flavor enhancements, or visual improvements could lead to better consumer acceptance.

In addition to highlighting the ways in which tastes and textures affect meal size and the progression of fullness after consumption, people additionally address the importance that visual and olfactory cues have in helping people recognize food in the immediate context, directing food choice, and influencing eating behavior (McCrickerd, 2016). This indicates that the respondents are comfortable with utilizing "galunggong" and squash as the primary components in cookies.

Overall, the results underline the importance of sensory attributes, particularly color, in influencing consumer preferences and overall acceptability. Understanding these dynamics can help guide future product innovations and marketing strategies in the food industry.

Test Of Significant Difference

The Test of Significant Difference is crucial for evaluating the formulated blue mackerel scads-squash cookies across various sensory attributes, including color, odor, texture, flavor, and general acceptability. Significant differences in color ratings emphasize the role of visual appeal in shaping consumer preferences, suggesting that enhancements in color can lead to improved product acceptance. Variations in odor ratings indicate that specific formulations may enhance aroma, which significantly influences taste perception. Additionally, significant differences in texture ratings reveal consumer preferences for various mouthful experiences, guiding necessary adjustments in ingredients and processing methods. Flavor ratings further highlight the critical importance of flavor combinations, as higher ratings indicate formulations that resonate more with consumers. Overall acceptability ratings reflect the cumulative impact of these sensory attributes, suggesting that certain formulations may have greater market potential. Understanding these significant mean differences provides valuable insights into consumer behavior, informing product development and marketing strategies while emphasizing the need for continuous sensory testing to refine formulations and meet consumer expectations.

In Table 10, significant differences between treatments and their qualities were determined using an analysis of variance (ANOVA) as assessed by the participants through hedonic scoring.

Color

From the ANOVA Table, given that the P-value of 0.0000 is smaller than the alpha of 0.05, it was demonstrated that there was a statistically significant difference in color at the 0.05 difference level. The P-value of 0.0000 indicates a highly significant result, suggesting that the differences in color ratings among the cookie treatments are not due to random chance. This reinforces the importance of color as a sensory attribute that influences consumer preferences.

Consequently, the null hypothesis—which asserts that the sensory assessment of the formulated cookies in terms of color attributes shows no discernible mean difference—was rejected. Rejecting the null hypothesis strengthens the validity of the findings, confirming that there are indeed meaningful differences in how consumers perceive the color attributes of the formulated cookies. This underscores the necessity for product developers to focus on visual appeal in their formulations.

Table 11. *Analysis of Variance (ANOVA) on the Five Treatments and Its Attributes as Evaluated by the Respondents*

Parameters	Treatments	Mean Rank	X2-value	P-value	Alpha	Decision	Interpretation
Color	T0	2.41 a	53.53	0.000	0.05	Reject Ho	
	T1	2.34 a					Significant
	T2	2.96 b					
	T3	3.23 b					
	T4	4.06 c					
Odor	T0	1.90 a	59.87	0.000	0.05	Reject Ho	
	T1	2.55 b					Significant
	T2	3.35 c					
	T3	3.50 c					
	T4	3.70 c					
Flavor	T0	2.12 a	57.00	0.000	0.05	Reject Ho	
	T1	2.32 a					Significant
	T2	3.41 b					
	T3	3.41 bc					
	T4	3.74 c					
Texture	T0	2.01 a	68.45	0.000	0.05	Reject Ho	
	T1	2.33 a					Significant
	T2	3.11 b					
	T3	3.61 c					
	T4	3.94 c					

The observation that Treatments 2 and 3 did not show significant variation implies that they may share similar sensory profiles regarding color, which could inform further development strategies. Understanding the characteristics of these treatments can help optimize formulations that meet consumer preferences.

Treatment 4 receiving the highest rating indicates its superior visual appeal compared to the other treatments. This suggests that it may have a competitive advantage in the market, as consumers often associate appealing colors with higher quality.

The lowest rating for Treatment 0 suggests that this formulation may require significant improvements to enhance its color appeal. The lack of significant difference between Treatment 0 and Treatment 1 indicates that both may have similar shortcomings, presenting an opportunity for reformulation to boost consumer acceptance.

These findings emphasize the need for careful consideration of color attributes in the development of cookie formulations. Enhancing color appeal could lead to higher consumer acceptance and increased sales potential.

Odor

The analysis of the odor attribute reveals a statistically significant difference among the cookie treatments, with a P-value of 0.000, which is less than the alpha of 0.05. This indicates that odor is a crucial sensory attribute affecting consumer preferences and highlights its importance in product development. Treatment 4 achieved the highest rating for odor, indicating a strong and favorable odor profile. The lack of significant difference between Treatment 4 and Treatments 2 and 3 suggests that these formulations have similarly appealing odor characteristics, which could be beneficial in guiding further development.

Treatment 1 significantly differed from all other treatments in terms of odor, suggesting that its odor profile is notably different. This may be advantageous or problematic depending on consumer preferences. If the odor of Treatment 1 is less favorable, it might need reformulation to align better with consumer expectations.

Treatment 0 received the lowest rating for odor, indicating that its odor profile is the least favorable among the treatments. This suggests

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a need for significant reformulation to address the factors contributing to its lower rating and improve its overall appeal.

The lack of significant difference between Treatments 2 and 3 in terms of odor suggests that these formulations share similar, favorable odor characteristics. This can inform future product development strategies to enhance or differentiate these successful odor profiles.

The significant difference between Treatments 1 and the others, combined with the low rating for Treatment 0, highlights the need for targeted reformulation efforts. Improving the odor profile of these less favorable treatments will be key to enhancing overall product acceptability.

The results underline the importance of odor in the sensory evaluation of cookies. Conducting additional sensory evaluations or consumer studies to identify which specific odor elements are most appealing can provide valuable insights for refining formulations.

Flavor

For the flavor attribute, given that the P-value being less than the alpha of 0.05 indicates a statistically significant difference in flavor ratings among the cookie treatments. This finding highlights that flavor is a critical sensory attribute influencing consumer preferences and should be a focus in product development.

By rejecting the null hypothesis, the results confirm that there are notable differences in flavor perceptions among the formulated cookies. This suggests that specific formulations can significantly impact how consumers evaluate flavor.

Treatment 4 receiving the highest rating indicates its strong flavor appeal. The lack of significant difference between Treatment 4 and Treatment 3 suggests that both formulations are well-r The finding that Treatments 2 and 3 do not significantly differ indicates that these formulations may share comparable flavor characteristics. This can inform future formulation strategies to enhance or differentiate flavor profiles as needed received by consumers, indicating similar flavor profiles that could be appealing in the market.

The lack of significant difference between Treatments 0 and 1 suggests that both have similar flavor shortcomings. This insight may guide reformulation efforts to improve their flavor appeal and overall acceptability.

The lowest rating for Treatment 0 highlights the need for significant improvements in its flavor formulation. Identifying the specific elements that contribute to its lower appeal can help inform adjustments to enhance consumer satisfaction.

The results underscore the importance of flavor in cookie formulations, suggesting that further exploration and refinement of flavors could lead to higher consumer acceptance. Focusing on enhancing the flavors of Treatments 0 and 1 may be particularly beneficial.

This analysis could lead to further investigations into which specific flavor components resonate with consumers. Conducting additional sensory evaluations or consumer preference studies could provide deeper insights into successful flavor combinations.

Texture

The P-value being smaller than the alpha level of 0.05 indicates a statistically significant difference in texture ratings among the cookie treatments. This finding underscores the importance of texture as a sensory attribute that can significantly influence consumer preferences and acceptance.

By rejecting the null hypothesis, the results confirm that there are meaningful differences in how consumers perceive the texture of the formulated cookies. This highlights the necessity for careful consideration of texture in product development.

Treatment 4 receiving the highest rating indicates its superior texture appeal compared to the other formulations. The lack of significant difference between Treatment 4 and Treatment 3 suggests that both treatments have desirable texture characteristics, making them competitive options in the market.

The finding that Treatment 2 significantly differs from the other four treatments indicates that its texture profile is notably distinct. Understanding the characteristics that set Treatment 2 apart could inform future innovations or refinements to other formulations.

The lack of significant difference between Treatments 0 and 1 suggests they share similar texture attributes, which may not meet consumer expectations. This insight points to the need for reformulation to enhance texture appeal in these treatments.

Treatment 0's lowest rating highlights potential issues with its texture formulation. Identifying the factors contributing to this lower score can guide targeted improvements to enhance its market acceptance.

These findings emphasize the crucial role of texture in cookie formulations, suggesting that further exploration and refinement of textural attributes can lead to higher consumer satisfaction and acceptance.

The results pave the way for additional studies on consumer preferences regarding texture, including sensory evaluations to determine the most desirable texture characteristics in cookie products.

Features Of The Most Preferred Treatment Recipe

Treatment 4 emerged as the most preferred recipe, showcasing the highest average mean across all sensory qualities, indicating its

overall appeal to consumers. This strong preference suggests that Treatment 4 effectively combines desirable attributes, making it highly marketable. The interest expressed by respondents to try this recipe can be leveraged in marketing strategies to boost sales and brand recognition. Its success provides a benchmark for future cookie formulations, guiding product development by identifying key components that contribute to its appeal. Additionally, this positive reception opens opportunities for further research into consumer demographics and sensory evaluations to refine Treatment 4's attributes.

Microbial Analysis

The composition of Treatment 4 were 20 grams of blue mackerel scads ''galunggong'' and 80 grams squash, 115 grams of unsalted butter, 104 grams of brown sugar, 125 grams of white sugar, 50 grams of whole egg, 150 grams of all-purpose flour, 10 grams of cornstarch, 3 grams of baking soda, 1. 425 grams of salt, and 4.34 grams of vanilla extract. Less than 10Est was the overall spread count of mold and yeast (CFU/g) in the preferred recipe. (Estimated colony-forming units) following a few days of preservation. The F.A.S.T. Laboratories microbiological standard for food safety was satisfied by this bacterial load.

The combination of blue mackerel and squash in Treatment 4 not only enhances nutritional value—providing healthy fats and vitamins—but also contributes unique flavors and textures. This balance can attract health-conscious consumers looking for innovative cookie options.

The low level of mold and yeast (less than 10 CFU/g) is a strong indicator of the product's freshness and safety. This is crucial for consumer trust and can be a selling point in marketing, highlighting the attention to quality and safety in the product's formulation. Meeting the microbiological safety standards set by F.A.S.T. Laboratories reinforces the product's credibility in the market. It assures consumers that the product is safe for consumption and produced under strict hygiene conditions. The microbial count suggests that the product is likely to have a reasonable shelf life, which is important for both retailers and consumers. A longer shelf life without compromising safety and quality can enhance marketability.

Proximate Composition

Moisture content, crude fat, ash, crude protein, calories, and crude fiber are all components of the proximate composition. The food business may find certain food ingredients useful for developing new products, ensuring product quality, or meeting regulatory requirements.
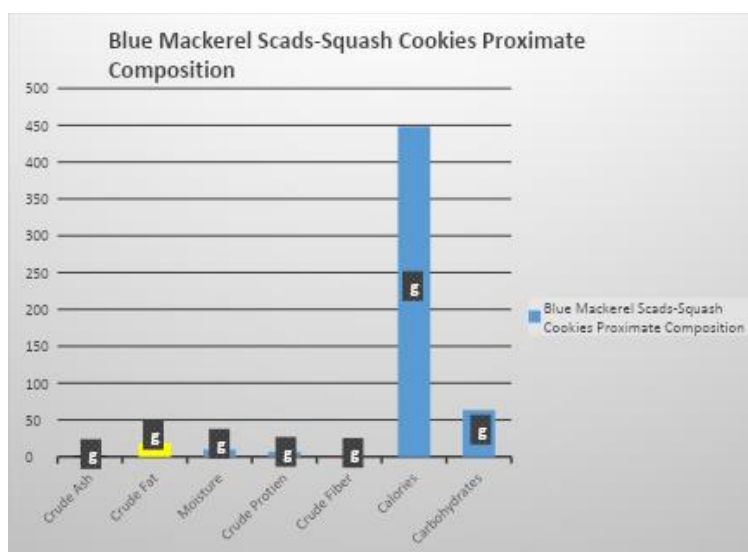

Figure 1. *Proximate Composition of the Treatment 4*

The proximate composition of the most preferred recipe includes the following values per 100 grams: 1.42 grams of crude ash, 18.70 grams of crude fat, 9.80 grams of moisture, 6.54 grams of crude protein, less than 0.60 grams of crude fiber, 448 calories, and 63.50 grams of carbohydrates. This composition provides a comprehensive overview of the recipe's nutritional profile.

The crude ash content (1.42 grams) indicates the mineral content of the cookies. The crude fat level (18.70 grams) contributes to the texture and flavor richness, enhancing overall palatability. The moisture level (9.80 grams) is relatively low, suggesting a potential for a longer shelf life, as lower moisture content typically reduces the risk of microbial growth. This can enhance the product's marketability as a longer-lasting snack. The crude protein content (6.54 grams) indicates a moderate protein level, which can be beneficial for consumers seeking snacks that provide some protein intake. With less than 0.60 grams of crude fiber, this recipe may not be suitable for consumers looking for high-fiber options. This presents an opportunity for product developers to consider adding ingredients that can increase fiber content, appealing to health-conscious consumers. At 448 calories per 100 grams, the cookies are quite calorie-dense, which may appeal to consumers seeking indulgent snacks. The high carbohydrate content (63.50 grams) suggests that the cookies are

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energy-dense, making them appealing to consumers looking for quick energy sources.

Understanding proximate composition is essential for ensuring that the product meets regulatory requirements and quality standards within the food industry. This knowledge can guide formulation decisions and labeling practices.

Figure 1 shows the approximate composition of the most popular recipe.

Shelf life

The shelf life of a product is the length of time it can be stored before losing its fitness for consumption. The shelf life of the unique product is determined by its degrading mechanism. The majority can be impacted by a variety of circumstances, such as vulnerability to moisture, heat, and light; mechanical stressors; gas transfers; and microorganisms' contamination (Tanner, 2016).

Ninety-five (95) pieces of 662.74 (7 grams per piece) grams of the most acceptable cookies were baked, fifty (50) pieces was given to each respondent for the sensory evaluation, thirty-five (35) pieces for chemical analysis and ten (10) pieces for the shelf-life assessment.

Cold Storage Shelf Life (30 Days). The cookies demonstrated an impressive shelf life of 30 days under cold storage conditions, with no visible mold growth throughout this period. This suggests that cold storage is highly effective in preserving the cookies, maintaining their safety and extending their usability. Although the texture of the cookies became slightly less moist over time, the structural integrity and overall palatability were retained. This textural change likely results from the gradual loss of moisture, which causes the cookies to become firmer. Despite this, the core flavor profile remained intact, with consumers still finding the cookies satisfactory in taste. However, the diminishing aroma over time could be a drawback, as it may reduce the overall sensory appeal, even though it does not directly impact flavor.

Room Temperature Shelf Life (7 Days). In contrast, the cookies stored at room temperature showed a significantly shorter shelf life of just seven days, with mold growth becoming apparent by the end of this period. This rapid onset of spoilage highlights the vulnerability of the cookies to microbial growth in a non-refrigerated environment. The ambient temperature and humidity at room temperature likely contribute to the accelerated deterioration, making it unsuitable for long-term storage. Additionally, the cookies' texture at room temperature might change more rapidly, potentially becoming either too soft or too dry, depending on the storage conditions, which can further impact consumer satisfaction.

Texture of Cookies over Time. The texture of the cookies is a crucial aspect of their overall sensory experience. Initially, the cookies likely exhibit a balance of moisture, providing a tender yet firm bite. Over time, particularly in cold storage, the gradual moisture loss leads to a firmer texture, which, while still acceptable, might differ from the original product's softness. This change in texture could influence the perception of freshness, as consumers often associate a softer, moister texture with freshly baked goods. At room temperature, the texture might degrade more unpredictably—either becoming too soft due to moisture absorption from the air or drying out, leading to a crumbly or stale texture. Such changes can significantly affect the cookies' appeal, as texture is a key determinant of consumer preference.

Impact of Moisture and Aroma Changes. The reduction in moisture content during cold storage leads to a firmer texture, which, while still acceptable to consumers, indicates a change from the cookies' initial state. This moisture loss can affect the perceived freshness and could potentially influence consumer preference over longer storage periods. Additionally, the loss of aroma, while not critically impacting taste, may detract from the overall sensory experience, particularly for consumers who associate smell with freshness and quality.

Storage Recommendations and Consumer Education. To optimize the shelf life and maintain the best possible texture, it is essential to provide clear storage instructions to consumers. Labels should strongly recommend refrigeration to preserve both the texture and overall quality of the cookies for up to 30 days. For those who prefer to store the cookies at room temperature, the labeling should caution that the shelf life will be limited to one week, with potential changes in texture and a higher risk of spoilage. This information will help consumers make informed decisions and enjoy the cookies at their best.

Opportunities for Product Enhancement. Given the shelf life and textural changes observed, there are opportunities for further product development. Investigating natural preservatives could help extend the room temperature shelf life without compromising texture or flavor. Additionally, advanced packaging technologies, such as vacuum sealing or modified atmosphere packaging, could help maintain moisture levels, preserve texture, and extend the cookies' shelf life in various storage conditions. Enhancing the product's ability to retain moisture and aroma could also contribute to a more consistent texture and a prolonged fresh-baked feel, further increasing consumer satisfaction.

Consistency and Product Quality. The fact that all cookies were baked simultaneously, properly sealed, and stored under controlled conditions ensures that these findings are consistent and reliable. The absence of mold in cold-stored cookies and the low microbial count indicate that the production process adheres to high safety and quality standards. Maintaining these standards will be essential as you scale up production and distribute the cookies to a broader market.

Cost and Return Analysis

Faster is not necessarily better when it comes to developing new products. Theoretically, cutting development costs and enhancing product quality can lead to a quicker time to market and better financial performance (MacNally et al., 2011). Profitability or feasibility is always considered in every entrepreneurial project of product development.

For every batch of formulation of mackerel scads and squash cookies may have a total cost of Php 119.954. To obtain the selling price, the formula is Total Cost divided by 35% reasonable margin; the result is Php 342.7257. The total number of yields is 95 pieces per formulation.

Cost-conscious management requires access to information on product profitability and expenses. Only once cost data is accessible can management make the different choices that consider the cost perspective (Sievanen et al., 2004). This highlights the importance of understanding both production and operating costs in determining the financial viability of the cookie products. By analyzing these costs and comparing them with local market prices, you can set a competitive and profitable price point for the cookies.

Moreover, the availability of financial and material resources plays a crucial role in both the production process and the ability to capture consumer interest. For a product to be economically efficient and viable for commercial production, it is essential to thoroughly assess the costs involved in its manufacturing. This ensures that the product can be produced at a scale that meets consumer demand while remaining profitable.

Conclusions

In conclusion, Treatment 4, which combines 20 grams of blue mackerel scads and 80 grams of squash, has proven to be the most favorable recipe for blue mackerel scads-squash cookies based on sensory and chemical evaluations. The appealing yellowish-brown color, mild flavor, and chunky texture, along with the unnoticeable fish odor, make this cookie a palatable option for consumers. Additionally, its high nutritional value, rich in vitamins and minerals, underscores the health benefits of incorporating these unique ingredients.

The development of a technological guide is strongly advised for the commercialization of Blue Mackerel Scads-Squash cookies, based on the results and recommendations. For food makers and entrepreneurs hoping to make the most of this cookie product's distinctive components, this techno-guide will be a vital resource. The technological guide can provide step-by-step instructions on recipe formulation, production methods, and quality control, making it easier for entrepreneurs to replicate and scale their operations.

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