Research Article

Acceptability of malunggay (*Moringa oleifera*) and squash (*Cucurbita moschata*) cookies

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Abstract

The dried leaf powder of malunggay (*Moringa oleifera*) contains an excellent nutritional value, and this tropical plant is widely available in the Philippines. On the other hand, squash (*Cucurbita moschata*) is an incredibly beneficial food with high amounts of vitamins. The nutrients from Malunggay and squash can help prevent deficiencies in children. The main focus of the research was to determine the acceptability of the different formulations of *M. oleifera* and *C. moschata* cookies. The study determined the most preferred cookie formulation based on sensory evaluation using descriptive testing of the product's appearance, aroma, taste, sweetness, texture, and acceptability rating of the formulations. The respondents were 20 food experts and 40 non-experts. The Analysis of Variance was used to examine the statistical significance of mean differences among the distinct groups. Subsequently, Tukey's Honest Significant Difference (HSD) test was employed to ascertain the significance of differences between pairs of group means, providing a more nuanced understanding of the variations observed within these groups. Results showed that among the three cookie formulations, F3 got the highest mean score of the different attributes, namely appearance ($\bar{x}$= 4.45; $\bar{x}$= 4.6) aroma ($\bar{x}$ = 4.9; $\bar{x}$= 4.7), taste ($\bar{x}$= 4.95; $\bar{x}$= 4.93), sweetness ($\bar{x}$= 4.9; $\bar{x}$=4.75), and texture ($\bar{x}$= 4.8; $\bar{x}$= 4.68), as perceived by the expert and non-expert, respectively. This implies that respondents prefer cookie formulation F3 over the two other formulations.

Keywords: Cookie, *Cucurbita moschata*, Malnutrition, *Moringa oleifera*, Sensory analysis

INTRODUCTION

The health status of children in the Philippines has been a topic of concern and study over the years. Several factors have influenced their well-being, including socioeconomic conditions, healthcare access, and nutrition. According to Reyes *et al.* (2019), the health status of Filipino children has been linked to socioeconomic disparities, with children from lower-income households facing a higher risk of malnutrition and associated health issues. Poverty remains a significant determinant of children's health, affecting their access to proper nutrition, clean water, sanitation, and healthcare services. Moreover, studies such as Werner and Smith (2019) have highlighted the persistent issue of stunting among Filipino children, a critical indicator of long-term malnutrition and developmental delays. According to the report by Food Security and Nutrition (2019), malnutrition, which includes not only hunger but also micronutrient deficiencies, overweight, and obesity, is a critical challenge in both developing and developed countries. A report by UNICEF (2023), WHO (2023), and the World Bank (2023) revealed that in 2022, 148.1 million children under five were stunted, while 45.0 million suffered from wasting at any given time during the year. The number of children under-five- who are overweight globally has increased from 33.0 million in 2000 to 37.0 million in 2022. Additionally, the critical impact of malnutrition is the leading cause of illness and death globally (McVeigh, 2020). Undernutrition accounts for 45% of fatalities in children under five, while obesity and poor diet increase the risk of noncommunicable diseases and cause mortality and disability globally.

Moreover, the National Nutrition Council (NNC) in the Philippines has been instrumental in coordinating efforts to combat malnutrition. They implement programs such as the "Nutrition Month" campaign, which promotes awareness and education about proper nutrition and healthy lifestyles. Also, the Department of Education (DepEd) implements the School-Based Feeding Program (SBFP) to address undernutrition among school children (USDA, 2023). The department recently introduced Nutribun to provide students with a convenient and accessible source of essential nutrients. DepEd's utilization of Nutribun plays a pivotal role in breaking the cycle of malnutrition and improving overall health. It can be noted that the Philippine government has already initiated various programs to combat malnutrition. In consonance with the aims of the government to end malnutrition, this research develops a food product that is affordable and enticing to children.

Malunggay (*Moringa oleifera*) and Squash (*Cucurbita moschata*) have been chosen to enhance the nutritional content of the cookies due to their affordability, accessibility, and ingredient richness. Also, a study by Nuzzo *et al.* (2021) shows that adding Moringa leaf powder to cookies has potential benefits for children at risk of malnutrition. Dried leaf powder of *M. oleifera* contains more excellent nutritional value and, in some instances, up to ten times more specific nutrients when compared to fresh *M. oleifera* leaves (Islam *et al.*, 2021). It is revealed that *M. oleifera* is an excellent source of minerals such as iron and calcium and vitamins A, B, B1, B2, B3, B, and E. On the other hand, *C. moschata* has the potential ability to induce anti-obesity, anti-diabetic, antibacterial, and anticancer effects, making it valuable in the medical field (Men *et al.*, 2021). The nutrients and bioactive compounds present in *C. moschata* have important effects on human health. Also, the optimal blending of *M. oleifera* and *C. moschata* would yield a product with sufficient amounts of nutrients, increasing hemoglobin levels and the size of the upper arm circumference in the diet of pregnant and lactating women as an effort to prevent stunting, which would help in the fight against malnutrition (Sudaryati *et al.*, 2023). A study by Shukla *et al.* (2022) reveals that malunggay brings a unique earthy and slightly bitter note to dishes, while squash contributes sweetness and a pleasant nutty undertone, enhancing the overall flavor profile of the food product. Duguma *et al.* (2023) stated that finely ground or pulverized ingredients such as malunggay can contribute to a smoother mouthfeel, improve uniformity by distributing themselves evenly throughout the product, and even serve as thickening agents or binders, thereby altering the overall consistency and cohesion of the food. As to appearance, consumers prefer green foods, such as green vegetables, are often chosen by consumers due to their association with being nutritious and healthy (Arshad *et al.*, 2020.)

The popularity of cookies, particularly among children, has led to commercialization as they are served at high tea or as snacks worldwide (Doğan and Meral, 2019). It is a sweet concoction of flour, eggs, sugar, butter, and flavoring agent. There are different innovative flavors of cookies, such as chocolate chip cookies (Aleman *et al.*, 2022) and gingerbread cookies (Saras, 2023). Cookies have a competitive edge over baked goods due to their low water content, longer shelf life, and inexpensive cost (Ekin *et al.*, 2021). Because cookies can be coupled with various food items or supplements, the potential of enriching cookies with fruit additives to improve their nutritional value and health-promoting properties (Krajewska and Dziki, 2023). Several factors, including overall health, the balance of essential and nonessential nutrients, and the inclusion of potentially dangerous additives, impact consumer preferences for cookies (Pinto et al, 2021). While some consumers may not like cookies that are too sweet because of their own taste preferences, health concerns, a desire for balanced flavor experiences, a desire to avoid sugar

crashes, dietary restrictions, appreciation for culinary variety, or influences from their culture or region, the availability of health-promoting information can influence consumers' preferences for cookies that are less sweet, making them a more enjoyable and appropriate snack (Lee *et al.* 2021).

Several studies have used sensory evaluation to determine consumer preferences (e.g Drake, 2023; Fiorentini *et al.*, 2021; Stone, 2020;). Sensory evaluation is a scientific discipline that uses the senses of sight, smell, touch, taste, and hearing to elicit, measure, analyze, and interpret responses to products (Stone, 2020). According to Fiorentini *et al.* (2021), sensory analysis is a scientific method used to evaluate and measure the sensory attributes of a product, such as taste, smell, texture, and appearance. Hence, sensory evaluation's primary purpose is to clarify that sensory evaluation encompasses all the senses. It involves measuring all of a product's properties to provide an interpretation of the responses based on the objectives.

Grading methods for food products traditionally involved one or two trained experts assigning quality scores on appearance, flavor, and texture based on the presence or absence of predetermined defects (Kumar and Chambers IV., 2019). According to Singh and Kaur (2020), these traditional judging methods have several shortcomings: they cannot predict consumer acceptance; their quality assessments are subjective; assigning quantitative scores is difficult; and they do not combine analytically oriented attribute ratings with effectively oriented quality scores. However, Mihafu *et al.* (2020) stated that grading methods may provide guidelines for preparing and serving samples in controlled conditions to minimize biasing factors. In this method, sensory evaluation becomes an invaluable tool in which sensory science reduces the risk of product failure. Identifying these particular sensory and chemical markers also significantly impacts customer preferences and purchase intent when this sensory information is linked to marketing strategy (Stone, 2020). A study by Świąder and Marczewska (2021) highlights the popularity of descriptive analysis and consumer acceptance testing as the two most common types of sensory analysis methods. In the descriptive analysis, the panelists evaluate the flavor of the food. At the same time, consumer testing involves the selection of samples of consumers from the marketplace to determine their acceptance, preference, and degree of liking for a product. The primary consideration in selecting and eating a food commodity is the product's palatability and other quality parameters, such as nutrition and wholesomeness (Singh and Kaur, 2020).

The present study aimed to test the acceptability of three formulations of *M. oleifera* and *C. moschata* cookies, particularly the sensory analysis of the cookie's attributes i.e. appearance, aroma, taste, sweetness,

and texture). This *M. oleifera* and *C. moschata* cookie was developed to help address malnutrition among children since malunggay and squash are rich in nutrients.

MATERIALS AND METHODS

Research design
The study used a quantitative research method following the experimental design, which involves an experimental approach using a recipe of Malunggay and Squash cookies with a variation in the preparation of ingredients. This experimental research design is a structured framework of protocols and procedures created to conduct experimental research with clarity and transparency (Sirisilla, 2023). The standardized 5-point Hedonic Scale method was utilized to determine the acceptability level of respondents. This scale is commonly employed due to its cost-effectiveness, simplicity, ease of use, and understanding by students and participants in various studies related to sensory evaluation and consumer acceptance testing (Addo-Preko *et al.*, 2023). Descriptive and inferential statistics were used to test significant differences in the level of acceptability of the respondents on different samples.

Standard recipe and procedure
For the malunggay (*M. oleifera*) and squash (*C. moschata*) cookies, 2 ¼ cups of all-purpose flour, 1 cup white sugar, 1 cup chocolate chips, 2 tablespoons malunggay powder, 2 teaspoons baking soda, 1 teaspoon baking powder, and 1 teaspoon salt were mixed well in a mixing bowl. After mixing the dry ingredients, ¾ cup softened mashed squash, 1 large egg, 1 cup milk, 1 cup melted butter, and 2 teaspoons vanilla essence wee added. Mixed the mixture using a rubber scraper until adequately combined. The cookie dough was scooped or spooned into mounds and placed on parchment paper-greased baking sheets. The oven was preheated for 30 minutes at 180° C. The cookie was baked at 150° C in a preheated oven for 15-20 minutes or until golden brown. Afterward, let it stand on a cookie sheet for two minutes before removing it to cool on wire racks. In making *M. oleifera* powder, remove the fresh leaves from the stalk. The *Moringa* leaves were dehydrated using a dehydrator. Once dried, the *M. oleifera* leaves were pulverized in a blender. After grinding, sift and set aside. Washed the squash when making mashed squash. Sliced the squash into cubes and boiled until it became soft. Let it be cooled and mashed using a fork. Using a blender, the squash was blended until it became a paste.

Respondents
The study's respondents were categorized as expert and non-expert. The experts were faculty members in a state university, teaching culinary arts, and individuals

who worked as bakers in different bakery stores. In comparison, the non-experts were general consumers such as students and parents. Twenty experts and 40 non-experts were randomly selected.

Methodology

This study utilized an instrument adopted from the study of Singh-Ackbarali and Maharaj (2014) on sensory evaluation to assess the acceptability of innovative food products. The methodology was structured into three key components. The initial segment of the questionnaire gauged the sensory attributes of commercial cookies. The second part was for the Malunggay powder and pulverized Squash, and the last was for Malunggay powder and mashed Squash, encompassing factors such as appearance, aroma, taste, sweetness, and texture. Respondents used a five-point hedonic scale to rate the sensory characteristics of the distinct Malunggay and Squash cookie formulations presented in a rubric format.

Data gathering procedure

Before conducting the study, the Malunggay and Squash cookies were prepared and baked in the production area on state university premises. Respondents were selected through a purposive random sampling. Respondents were individually approached for their willingness to participate in the tasting evaluation of Malunggay and Squash cookies. Subsequently, they were provided with a structured questionnaire designed to assess the acceptability of various cookie formulations. Throughout the study, strict adherence to health protocols was maintained to ensure the safety of both respondents and researchers, with measures including hand sanitization. The research methodology was distributed and administered to the respondents, and upon completion, the questionnaires were carefully retrieved and checked for completeness. Subsequently, respondents' responses were meticulously collated and tallied in tables, setting the stage for comprehensive data analysis and interpretation of the findings.

Data analysis

Data treatment was done using descriptive and inferential statistics for a correct and reliable result using the Statistical Package for the Social Sciences (SPSS) software. The sensory analysis of the Malunggay and Squash cookies in terms of appearance, aroma, taste, sweetness, and texture and the data on the sensory acceptability test using the 5-point hedonic scale were analyzed using a weighted mean. Also, the research employed Analysis of Variance (ANOVA) to examine the statistical significance of mean differences among the distinct groups. Subsequently, Tukey's Honest Significant Difference (HSD) test was employed to ascertain the significance of differences between pairs of group means, providing a more nuanced understanding of the variations observed within these groups.

RESULTS AND DISCUSSION

Formulations of cookie recipe

The formulation of cookie recipes using mashed and pulverized squash and Malunggay powder is shown in Table 1. The table revealed that F1 is a formulation without Squash and Malunggay; the same ingredients are used in making almost all of the cookies available in the market. The second formulation was F2, which contained ¾ cup of pulverized squash and two tablespoons of Malunggay powder, while the third formulation, F3, had ¾ cup of mashed squash and two tablespoons of Malunggay. Hence, all formulations contain all the primary ingredients needed to make a commercial cookie.

Sensory analysis of the three cookie formulations based on sensory attributes

This underscores the importance of considering consumer preferences and health-related factors when developing food products like cookies. By addressing

Table 1. Formulations for different cookie recipes

Materials	Formulation of malunggay and squash cookie recipe		
	F1	F2	F3
For the cookie dough			
All-purpose flour	2 ¼ cups	2 ¼ cups	2 ¼ cups
White sugar	1 cup	1 cup	1 cup
Chocolate chips	1 cup	1 cup	1 cup
Malunggay powder		2 tbsp	2 tbsp
Squash (mashed)			¾ cup
Squash (pulverized)		¾ cup	
Baking soda	2 tsp	2 tsp	2 tsp
Baking powder	1 tsp	1 tsp	1 tsp
Salt	1 tsp	1 tsp	1 tsp
Egg	1 pc	1 pc	1 pc
Milk	1 cup	1 cup	1 cup
Butter, melted	1 cup	1 cup	1 cup
Vanilla essence	2 tsp	2 tsp	2 tsp

Table 2. Sensory analysis of F1

Attributes	Expert			Non-Expert		
	Mean	SD	VD	Mean	SD	VD
Appearance	4.05	1.05	Liked a 'little'	4.03	0.83	Liked a 'little'
Aroma	3.95	0.83	Liked a 'little'	4.05	0.9	Liked a 'little'
Taste	3.95	1.36	Liked a 'little'	4.1	0.96	Liked a 'little'
Sweetness	4	1.08	Liked a 'little'	4.1	0.98	Liked a 'little'
Texture	4.1	1.12	Liked a 'little'	4.38	0.63	Liked a lot

Legend: 1-1.80-Dislike A lot, 1.81-2.60-Disliked a 'little', 2.61-3.40-Neither liked nor disliked, 3.41-4.20-Liked a 'little', 4.21-5.0 Liked a lot

concerns about sugar content, offering a variety of flavors, and incorporating nutritious ingredients, the study contributes to the creation of cookies that are not only tasty but also align with modern dietary trends and consumer demands for healthier snack options.

Sensory analysis of the first cookie formulation
Table 2 shows the sensory analysis of the cookie without squash and Malunggay, or the F1, as perceived by experts and non-experts. The appearance had a mean score of 4.05 (*sd*=1.05) for the expert and non-expert 4.03 (*sd*=0.83)with a verbal description of liked a ''little''. For the second attribute, the aroma, the experts' responses($\bar{x}$ =3.09. *sd*= 0.83) were liked a 'little'; this concurs with the response of the non-experts ($\bar{x}$ =4.05. *sd*= 0.9), who said that they liked the smell of the first cookie formulation a 'little'. For the third variable, both the expert ($\bar{x}$ =3.95. *sd*= 1.36) and non-expert ($\bar{x}$ =4.1. *sd*= 0.96) agreed that they liked the taste of the cookie a 'little'. As to sweetness, the experts responded with a mean of 4.0 (sd= 1.08), while the non-expert's response got a mean score of 4.1 (sd= 0.98), which was interpreted as like a 'little'. For the last attribute, the texture, the mean score garnered from the expert was 4.1 (*sd*= 1.12), which was interpreted as liked a 'little', while for the non-expert, the mean score was 4.38 (*sd*= 0.63), which has a verbal description of liked a 'little'. In totality, most of the attributes from the first formulation got a verbal description of liked a 'little' except for texture.This outcome agrees with findings of Pinto *et al.* (2021), which indicate that a product's nutritional content significantly impacts consumer choices. Also, consumers tend to prefer nutritious cookies or those with innovative nutritious ingredients over commercial cookies.

Sensory analysis on the second formulation of cookie
Table 3 presents the sensory analysis of F2, a cookie that contains pulverized squash and Malunggay powder. The appearance has a mean score of 4.5 (*sd*=0.83) with a verbal description of liked a lot for the expert and non-expert 4.15 (*sd*=0.86) with an interpretation of liked a 'little'. Mahmoud and Mehder (2022) state that finely powdered squash can produce a creamier consistency. This study looks at how different cooking methods affect the texture of squash, which can influence its visual appeal and generate a thicker, more sumptuous texture. The impact of pulverized squash on appearance can be leveraged to enhance the visual appeal and texture of various food products; however, when squash powder is used in larger quantities, it can introduce a gritty or grainy texture to the final product, which may not be well-received by consumers who expect a smooth or homogeneous appearance. This alteration in texture could result in a less visually pleasing product, affecting consumer perception (Pramudya and Seo, 2019). For the second attribute, the aroma, experts ($\bar{x}$=4.5, *sd* = 0.51) and non-experts ($\bar{x}$=4.43, *sd* = 0.81) agreed that the formulation had a pleasant smell. For the third variable, taste, experts' ($\bar{x}$=4.85, *sd* = 0.37) and non-experts' ($\bar{x}$=4.48, *sd* = 0.91) responses were liked a lot. For the following variable, the product's sweetness, the experts' ($\bar{x}$=4.75, *sd* = 0.44) responses were liked a lot, and the non-experts ($\bar{x}$=4.28, *sd* = 0.72) gave the same answers. On the product's texture, it is evident that the experts' ($\bar{x}$=4.5, *sd* = 0.61) and non-experts' ($\bar{x}$=4.43, *sd* = 0.9) responses were liked a lot because pulverized ingredients can significantly influence the consistency of a food product. Finely ground or pulverized ingredients contribute to a smoother

Table 3. Sensory analysis of F2

Attributes	Expert			Non-Expert		
	Mean	SD	VD	Mean	SD	VD
Appearance	4.5	0.83	Liked a lot	4.15	0.86	Liked a 'little'
Aroma	4.5	0.51	Liked a lot	4.43	0.81	Liked a lot
Taste	4.85	0.37	Liked a lot	4.48	0.91	Liked a lot
Sweetness	4.75	0.44	Liked a lot	4.28	0.72	liked a lot
Texture	4.5	0.61	Liked a lot	4.43	0.9	Liked a lot

Legend: 1-1.80-Disliked A lot, 1.81-2.60-Disliked a 'little', 2.61-3.40-Neither liked nor disliked, 3.41-4.20-Liked a 'little', 4.21-5.0 Liked a lot

mouthfeel (Duguma *et al.*, 2023). Thus, the study's focus on utilizing pulverized squash in combination with Malunggay powder showcases how these ingredients impact not only the sensory attributes but also the overall quality and consumer acceptability of the cookies. The findings underscore the importance of texture, appearance, aroma, taste, sweetness, and overall consistency in shaping consumer preferences for innovative food products enriched with nutritious ingredients like squash and Malunggay powder.

Sensory analysis of the third cookie formulation
Table 4 shows the sensory analysis of the third formulation, the cookie, which contains mashed squash and Malunggay powder. The appearance has a mean score of 4.45 (*sd*=0.69) and 4.6 (*sd*=0.59) subsequently, both for expert and non-expert, which was interpreted as a lot. The product's appearance is green-liked because of the presence of Malunggay powder. A literature review by Arshad *et al.*, 2020 shows that most consumers prefer green foods due to their association with being nutritious and healthy. The idea is that green is often linked with freshness, nature, and health, influencing consumers' perceptions of products. For the aroma, experts and non-experts agreed that they liked the smell of the cookie; in fact, the mean score for the expert was 4.9 (*sd*=0.31), and for the non-expert, 4.7 (*sd*=0.61). For the third attribute, taste, experts' (x̄= 4.95, *sd*= 0.22) and non-experts' (x̄= 4.93, *sd*= 0.27) responses were liked a lot. On the product's sweetness, experts (x̄= 4.9, *sd*= 0.31) and non-experts (x̄= 4.75, *sd*= 0.59) said they liked the cookie's sweetness a lot. On the last attribute, the texture, the mean score from the expert was 4.8 (*sd*= 0.41), while for the non-expert, it was 4.68 (*sd*=

0.76), which has the verbal description of liked a lot. The findings of the study support the result of (Shukla *et al.*, 2022), which reveals when Malunggay and squash are incorporated, it will add complementary taste profiles as Malunggay brings a unique earthy and slightly bitter note to dishes, while squash contributes sweetness and a pleasant nutty undertone. Combining these two ingredients can create the rich and diverse taste they bring to a plate and elevate its overall flavor profile, making it a preferred choice for those who enjoy a more complex and satisfying culinary experience. Hence, the innovative cookie recipe incorporating mashed squash and Malunggay powder surpasses ordinary cookie recipes by offering a visually appealing, aromatic, flavorful, and well-textured product that caters to consumer preferences for nutritious, complex, and satisfying culinary experiences. The combination of unique ingredients and careful formulation has resulted in a cookie that excels in sensory attributes, making it a preferred choice for those seeking a more elevated and enjoyable snacking option.

Analysis of variance on significant mean differences in respondents' perception
The Analysis of Variance (ANOVA) was used to examine the statistical significance of mean differences among the distinct groups. Subsequently, Tukey's Honest Significant Difference (HSD) test was employed to ascertain the significance of differences between pairs of group means, providing a more nuanced understanding of the variations observed within these groups. The results of the ANOVA on the significance of mean differences among the cookie formulations are presented in Table 5.

Table 4. Sensory analysis of F3

Attributes	Expert			Non-Expert		
	Mean	**SD**	**VD**	**Mean**	**SD**	**VD**
Appearance	4.45	0.69	Liked a lot	4.6	0.59	Liked a lot
Aroma	4.9	0.31	Liked a lot	4.7	0.61	Liked a lot
Taste	4.95	0.22	Liked a lot	4.93	0.27	Liked a lot
Sweetness	4.9	0.31	Liked a lot	4.75	0.59	Liked a lot
Texture	4.8	0.41	Liked a lot	4.68	0.76	Liked a lot

Legend: 1-1.80-Disliked A lot, 1.81-2.60-Disliked a 'little', 2.61-3.40-Neither liked nor disliked, 3.41-4.20-Liked a 'little', 4.21-5.0 Liked a lot

Table 5. Analysis of variance on significant differences in respondents' perception of the different sensory attributes of cookie formulations

Characteristics	F-value	p-value	Comparison Groups	Post Hoc p-value
Appearance	6.208	0.002*	f1 vs f3	0.002*
Aroma	16.264	0.00**	f1 vs f2	0.004*
			f2 vs f3	0.046*
			f1 vs f3	0.00**
Taste	19.041	0.00**	f1 vs f2	0.001*
			f1 vs f3	0.00**
Sweetness	13.989	0.00**	f1 vs f2	0.024*
			f2 vs f3	0.024*
			f1 vs f3	0.00**
Texture	4.822	0.009*	f1 vs f3	0.07**

*significant at 0.05; **significant at 0.001

Table 5 shows the significant differences in the respondents' perception of the 3 formulations in the different characteristics. Statistical evidence was found to conclude that there is a significant difference between the appearance (F-value=6.208, *p=0.002*), aroma (F-value=16.264, *p=0.000*), taste (F-value=19.041, *p=0.000*), sweetness (F-value=13.989, *p=0.000*) and texture (F-value=4.822, *p=0.009*). Therefore, there were significant mean differences in the respondents' perception of the characteristics among the varying formulations of cookies. In the Tukey's Honest Significant Difference (HSD) test, F1 and F3 are statistically different among all characteristics. Notably, respondents "liked a 'little'" formulation 1 (F1) while respondents "liked a lot" formulation 3 (F3). This further implies that respondents would prefer F3 over the two other formulations. These findings have important implications for product development and consumer preferences. Understanding how different formulations impact sensory attributes can guide manufacturers in creating products that align with consumer tastes and preferences (Stone *et al.*, 2020). By recognizing which characteristics drive consumer liking, such as appearance, aroma, taste, sweetness, and texture, companies can tailor their recipes to meet consumer expectations and enhance overall product acceptance (Terana, 2023)

Conclusion

Among the three cookie formulations (F1 to F3), F3 got the highest mean score. Also, based on sensory tests conducted on experts and non-experts, the formulation containing mashed squash and Malunggay powder (F3) has the highest acceptability level. Despite the second and third formulations incorporating squash and Malunggay, mashed squash in the third formulation set it apart. Respondents favored formulations with mashed squash, highlighting a preference for this ingredient over pulverized squash used in the second formulation. This preference was particularly evident in the appearance aspect, with non-experts expressing a slight liking for the cookie with pulverized squash, while both experts and non-experts favored the appearance of the cookie containing mashed squash. The cookie recipe that included malunggay and squash, rich in vitamins and minerals, lay in its unique combination of wholesome ingredients that set it apart from traditional cookie recipes. Unlike conventional cookies that typically lack the nutritional benefits of malunggay and squash, these cookies offer a distinct advantage by incorporating ingredients known for their high nutritional value. Malunggay powder infuses the cookies with vibrant green color and a powerhouse of vitamins and minerals, adding a unique nutritional profile that is not commonly found in regular cookies. Additionally, squash introduces a hidden vegetable element that enhances the cookies' nutritional content while contributing to their soft and pillowy texture. The innovative aspect of these cookies extends to their vegan, making them suitable for individuals following specific dietary preferences like veganism.

Conflict of interest
The authors declare that they have no conflicts of interest.

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