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TALISAY (TERMINALIA CATAPPA) FRUIT FLOUR DEVELOPMENT AND INCORPORATION IN COOKIES: ASSESSMENT ON ITS GENERAL ACCEPTABILITY

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ABSTARCT: Talisay (Terminalia Catappa) is a versatile tropical tree that was well-known for its edible seeds, leaves, and numerous potential applications in traditional medicine and culinary endeavors. The study had a primary focus on the development of Talisay (Terminalia Catappa) cookies, with the goal of achieving a desirable taste by determining the right proportions of ingredients. The study employed both quantitative and qualitative approaches, with sensory evaluation and statistical analysis revealing that the cookies were well-received by consumers and food experts. An analysis of Talisay extract conducted in the study demonstrated the presence of various compounds, suggesting potential health benefits. Furthermore, the physicochemical composition of Talisay fruit flour was found to be favorable for use as an ingredient. The study recommended further research to explore the pharmacological effects and antioxidant properties of the extract, as well as the utilization of Talisay fruit powder in various food products. It was also suggested that continuous sensory evaluation and formulation refinement could enhance consumer preference, and effective packaging and branding were deemed crucial to promote the unique qualities and health benefits of Talisay.

Keywords: *Talisay (Terminalia Catappa), development, cookies, assessment*

INTRODUCTION

The food industry is currently experiencing a new consumption pattern. It follows more sustainable processes and uses innovative ingredients that are not only natural but also value-added and from more environmentally friendly sources. People today have higher standards for the food they eat. They feel responsible for the resulting environmental impact and are fully aware of the human body's need for healthy foods. For this reason, it is essential to start with the use of ingredients that add value to the food, improving its taste and nutritional content.

Nuts are extremely nutritious (Agatemor & Ukhun, 2018). They are among the most advantageous plant sources of protein that are cholesterol-free. Furthermore, they are high in fiber, minerals, and fat, as well as folacin, vitamin E, and other B vitamins. Nuts provide nutrients in addition to those found in cereals, vegetables, and legumes (Brundage, 2019).

Terminalia catappa, often known as the "Talisay" tree in the Philippines, is one of the many species that can provide nuts. Terminalia catappa fruit seed could give necessary nutrients to humans. Furthermore, its nut is more sensitive than that of an almond (Lee, 2016). It has been shown to contain a chemical that could lower low-density lipoprotein (LDL), which is considered bad cholesterol in the blood that causes heart disease; hence, consuming it may minimize the danger of developing blood clots, which could result in a fatal heart attack (Lee, 2017).

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Matos et al. (2016), as reported by Stuart (2018), investigated the chemical composition and nutritional qualities of Terminalia catappa seeds in order to identify their suitability for human and/or animal feeding. The seed included 4.13% moisture, 23.78% crude protein, 4.27% ash, 4.94% crude fiber, 51.80% fat, 16.02% carbohydrate, and 548.78 Kcal Calorific value, according to preliminary analysis. Furthermore, sun dried mesocarp of fruits had approximately 12.65% ash, 84.93% carbohydrate, 0.37% oil, 316 mg/g glucose, 0.1% protein, 1.30 mg/g tannin, and 1.95% moisture, with a calorific value of 3434.5 kcal/kg.

Talisay fruit has a lot of carbs, although the existence of starch hasn't been proven (Dikshit and Samudrasuk, 2018). Talisay fruit is commonly seen as litter and is not given the attention it deserves as a possible source of flour. In comparison to other sources that must be farmed, such as wheat, potato, maize, and rice, Terminalia catappa fruit is abundant during the months of June and July and may be picked easily without incurring any additional costs.

Bermosa (2016) listed several uses for starch, including the production of jellies, gum, and candies, as a food thickening, and in the production of yogurts and puddings. Other specialty food starches enhance the flavor, texture, shelf life, and processing of a wide range of baked goods. It's also utilized in bakery fillings such as cream, fruit pies, and doughnuts. Furthermore, it is highly useful as a dry mix for cakes, muffins, brownies, and cookies, as well as a key element in icings and frostings.

Currently, there is a food supply shortfall, novel food products made using indigenous resources found in the area, and the seeming inconvenience of litter (Thornley, 2018). The call for environmental conservation drew the attention of the international community (Parry, Rosenzweig, & Livermore, 2016). There is a worldwide push to preserve the conditions that resulted in the three-Rs program: reduce, reuse, and recycle (Vidal, 2017).

Hence, this study aimed to establish the potential of Terminalia catappa fruit flour as a substitute for commercial flour in some baked products as in cookies. Towards the end, this study aims to establish the nutritional composition and acceptability of the baked product (cookies) from the Terminalia catappa fruit flour.

RESEARCH PROBLEMS

This study generally aimed to develop a flour from Talisay (*Terminalia catappa*) fruit and formulate a cookie from it. Further, the developed cookie assessed on its acceptability, nutritional composition, and physical properties. Specifically, it sought to answer the following questions:

1. What is the Phytochemical analysis of the Talisay seed?
2. What is the physico-chemical composition nutritive value of Talisay flour?
3. What are the procedures and processes of making Talisay flour (Sun drying, Dry Roasting and Dehydration) and formulation of talisay cookie?
4. What is the sensory acceptability of the develop Talisay seed flour as used in cookie product in terms of?
   4.1 Appearance/Color;
   4.2 Aroma/Odor;
   4.3 texture; and
   4.4 Flavor/Taste?
5. What is the overall acceptability of the cookie product?
6. Is there a significant difference between the acceptability of experimental treatments of cookie product?

METHODOLOGY

The research design employed an experimental approach to investigate the relationship between nutritional composition, physical properties, and sensorial evaluation of cookies made from isolated Talisay fruit flour. The study was conducted at Surigao del Norte State University, Philippines, over an 8-month period. The research involved 20 randomly selected students and staff from Tag-abaca National High School as respondents. The methodology included the isolation of starch from Talisay fruit mesocarp and seeds, followed by the preparation of cookies using different methods (sun drying, dry roasting, and dehydrating). The sensory properties of the cookies were evaluated by 20 individuals using a 9-point hedonic scale. Nutritional composition analysis involved proximate content determination using official methods, water activity measurement, and physical properties determination. Statistical analysis, including ANOVA and Duncan's Multiple Range Test, was applied to the generated data using

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SPSS (version 20). The study aimed to provide insights into the potential use of Talisay fruit flour in cookie production.

RESULTS AND DISCUSSION

Phyto-chemical result of the Talisay Fruit Seed.

Table 2. *Phyto- chemical result of talisay fruit seed.*

Sample Code	Sample	Parameter	Result
CHE-0134	Talisay Seed	Volume of Extract Obtained	45mL
		Flavonoids Bate-Smith & Metcalf Method: For Leucoanthocyanins	+
		Phenolic compounds Thin-Layer Chromatography (TLC)	+
		Sterols Gas Chromatography (GC)	+
		Tannins Ferric Chloride Test *Brownish-green Color indicates the presence of condensed tannins *Blue-black color indicates the presence of hydrolysable tannins	+ Brownish-green

Table 2 presents the phytochemical results of Talisay fruit seed, providing valuable information about various chemical constituents present in the seed. The sample code CHE-0134 corresponds to the Talisay seed being analyzed. The first parameter, "Volume of Extract Obtained," indicates that 45 mL of extract was obtained from the Talisay seed. The subsequent parameters focus on specific phytochemical components: Flavonoids (Bate-Smith & Metcalf Method): The symbol '+' indicates the presence of flavonoids in the Talisay seed, determined using the Bate-Smith & Metcalf Method for Leucoanthocyanins.

Flavonoids are a group of plant metabolites with various biological activities. Phenolic Compounds (Thin-Layer Chromatography - TLC): The symbol '+' suggests the presence of phenolic compounds, detected using Thin-Layer Chromatography (TLC). Phenolic compounds are known for their antioxidant properties and potential health benefits. Sterols (Gas Chromatography - GC): The symbol '+' indicates the presence of sterols in the Talisay seed, determined through Gas Chromatography (GC). Sterols are a class of compounds that play a role in various physiological functions. Tannins (Ferric Chloride Test): The presence of tannins is confirmed through the Ferric Chloride Test.

The specific results indicate the type of tannins present: Brownish-green color: Presence of condensed tannins. Blue-black color: Presence of hydrolysable tannins. Tannins are polyphenolic compounds with potential health benefits and are known for their astringent properties. In summary, the phytochemical analysis of Talisay fruit seed (sample CHE-0134) reveals the presence of flavonoids, phenolic compounds, sterols, and tannins. These findings contribute to the understanding of the seed's chemical composition and its potential applications in various fields, including medicine, nutrition, and food science.

This implies the presence of antioxidant properties and many other important bioactive agents that have long been interesting due to their benefits for human health in curing and preventing many diseases.This result aligns with the study of Katiki et.al., (2017), which reiterated that Phytochemical tests of Talisay Fruit seed have determined that all extracts contain alkaloids, flavonoids, saponins, phenols, and terpenoids. Besides tannins, other phytochemicals such as flavonoids, alkaloids, triterpenes, and coumarins may also have anthelmintic activity.

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Physico-chemical composition and nutritive value of the develop Talisay seed flour

Table 3. *Physico- chemical composition and nutritive value of the develop Talisay seed flour*

PARAMETERS	Talisay Flour	Method
Moisture, %	4.77	Air Oven Drying
Ash, %	4.60	Ignition-Gravimetric
Crude Fat, %	48.8	Mojonnier Extraction Method
Crude Protein, %	25.2	Kjeldahl
Crude Fiber, %	12.0	ANKOM Fiber Analyzer
Carbohydrates, %	16.6	By Computation

Table 3 presents a detailed analysis of the physicochemical composition and nutritive value of the developed Talisay seed flour, showcasing essential parameters and the corresponding analytical methods employed for evaluation. The moisture content of the Talisay flour is determined to be 4.77%, utilizing the Air Oven Drying method, which signifies the extent of water present in the flour. The ash content, representing the mineral residue after combustion, is measured at 4.60% through the Ignition-Gravimetric method, providing insights into the inorganic components of the flour. The crude fat content, a key indicator of the energy content and lipid composition, is found to be 48.8%, determined by the Mojonnier Extraction Method, shedding light on the fat content in the flour. The protein content, a critical nutritional component, is quantified at 25.2% using the Kjeldahl method, indicating the presence of nitrogen-containing compounds. Crude fiber, an important dietary component reflecting plant cell wall material, is assessed at 12.0% through the ANKOM Fiber Analyzer, offering information on the fiber content in the flour. Lastly, the carbohydrate content, a major energy source, is computed to be 16.6%, calculated by the difference method (By Computation), outlining the portion of the flour consisting of carbohydrates. These comprehensive analyses of Talisay seed flour's various components contribute valuable insights into its nutritional profile, aiding in the understanding of its potential applications in the realms of food, nutrition, and health. The use of diverse analytical methods ensures a thorough examination of the flour's composition, providing a holistic view of its nutritive value and facilitating informed decision-making for its utilization in diverse food products and formulations.

This corresponds to the findings of Prayitno et al., (2022) Ketapang Seed Malay term for Terminalia catappa locally known as Talisay tree is a good source of minerals. Based on an analysis, KS contains 4.13% water, 23.78% crude protein, 51.80% fat, 4.94% crude fiber, 16.02% carbohydrates, 548.78 kcal calorific value, and 4.27% ash, potassium (9280 ± 0.14 mg/100 g), calcium (827.20 ± 2.18 mg/100 g), sodium (27.89 ± 0.42 mg/100 g), and magnesium (798.6 ± 0.32 mg/100 g). Other than that KS contains high levels of unsaturated fatty acids, especially oleic (31.48%) and linoleic (28.93%). The dominant saturated acids are palmitic (up to 35.96%) and stearic (up to 4.13%). Matos et.al., (2009) as cited in Katiki et.al., (2017) determined the chemical composition and nutritional properties of the Terminalia catappa seeds to establish the possibility of using them for human and/or animal consumption. Proximate analyses showed that the seed contained 4.13% moisture, 23.78% crude protein, 4.27% ash, 4.94% crude fiber, 51.80% fat, 16.02% carbohydrate, and 548.78 Kcal Calorific value.

Procedures and Processes of making Talisay flour and formulation of making Talisay cookie.

The following are the raw materials used in making the Talisay flour including its step-by-step procedures and processes. The raw materials used for this project include Talisay seeds, a knife, baking sheet, pan, water, grinder, net, and dehydrator. The procedure for processing Talisay seeds was broken down into several steps. First, the Talisay fruits were collected and thoroughly washed before being allowed to dry. In the next step, the fruits were opened using a sharp-edged knife, and the seeds were carefully peeled, washed, and air-dried. The drying process involved three methods: sun drying, where the seeds were cut in half, thinly sliced, and placed on a baking sheet, and dried under the sun for at least 14 days at a temperature of not less than 30°C. The seeds were then ground using a grinder. Another drying method was roasting, where the seeds were similarly cut and thinly sliced, but this time they were roasted at a temperature ranging from 120-160°C for 15 minutes before being allowed to cool and subsequently ground. The final drying method was

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dehydration, where the seeds were cut into halves and thinly sliced, then oven-dried using a dehydrator for 12 hours at a temperature of 60-70°C. After cooling, the dried seeds were ground using a grinder. The moisture content of the resulting Talisay flour was determined using these three different drying methods: sun drying, dry roasting, and dehydration.

The formulation and ingredients for the Talisay cookies consisted of the following raw materials: 1 ¼ cup Talisay flour, ½ cup brown sugar, ½ cup white sugar, ½ tsp baking soda, 1 whole egg, ½ cup butter, and ¼ tsp salt. The process involved the step-by-step procedures and methods in combining these ingredients to create the Talisay cookies.

Perceptions of the respondents on the sensory acceptability of the develop Talisay Cookies.

Table 4. *Sensory acceptability of the cookies from the different treatments in terms of Appearance/Color*

APPEARANCE	**Variants**			
Characteristics	**Var1 Sun drying**	**Var2 Dry Roasting**	**Var3 Dehydration**	**Control**
Color (hue, chroma, uniformity, depth)	8.5	7	6.5	9
Surface texture (shine, smoothness/roughness)	8.5	6.5	7.5	8.5
Size and shape (dimensions and geometry)	9.5	6.5	6.5	9
Average mean	8.83	6.67	6.83	8.83
Ranks	2	4	3	1
Qualitative Description	**like very much**	**like slightly**	**like moderately**	**like extremely**

Legend: *Nine-point hedonic scale (1 to 9), where 1 = dislike extremely; 2 = dislike very much; 3 = dislike moderately; 4 = dislike slightly; 5 = neither like nor dislike; 6 = like slightly; 7 = like moderately; 8 = like very much; 9 = like extremely.*

Table 4 presents a comprehensive evaluation of the sensory acceptability of cookies subjected to different treatments, specifically focusing on the appearance and color attributes. The variants, labeled Var1 (Sun drying), Var2 (Dry Roasting), Var3 (Dehydration), and the Control, are assessed based on characteristics such as color (hue, chroma, uniformity, depth), surface texture (shine, smoothness/roughness), and size and shape (dimensions and geometry). The numerical ratings indicate the perceived quality of each variant, with higher values suggesting greater acceptability. The average mean scores for appearance are 8.83 for both Var1 (Sun drying) and the Control, 6.67 for Var2 (Dry Roasting), and 6.83 for Var3 (Dehydration). The corresponding ranks are 2nd, 4th, 3rd, and 1st, respectively. These results are further detailed with qualitative descriptions, revealing that respondents "like very much" the appearance of cookies from the Control and Var1, "like moderately" for Var3, and "like slightly" for Var2. These findings provide valuable insights into the sensory preferences of individuals, emphasizing the importance of appearance in determining overall acceptability. The ranking and qualitative descriptions facilitate a nuanced understanding of the visual appeal of cookies produced through different methods, guiding potential improvements in formulations or processes to enhance consumer satisfaction and market acceptance.

This supports the findings of Reyes et.al.,(2020), who substitutes commercial flour for Talisay fruit starch in making crinkles. The significant difference in color between the two baked products is due to the small amount of Talisay fruit starch that was incorporated into the commercial flour, which affects the color of the baked product. One of the factors that contributes to variation in baked product qualities is color, which depends on the ingredients and their qualities, formulation and ingredient ratios, and processing technologies.

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Table 5. *Sensory acceptability of the cookies from the different treatments in terms of Odor/Aroma*

Odor/Aroma Characteristics	Variants			
	Var1 Sun Drying	**Var2 Dry Roasting**	**Var3 Dehydration**	**Control**
Olfactory sensations (vanilla, fruity, floral, skunky)	8.5	6.5	6	9
Nasal feeling factors (cool, pungent)	8.5	6	6.5	9
Aromatic taste	9	7.5	5	9
Average mean	8.67	6.67	5.83	9
Ranks	**2**	**3**	**4**	**1**
Qualitative Description	**like very much**	**like slightly**	**like slightly**	**like extremely**

Legend: *Nine-point hedonic scale (1 to 9), where 1 = dislike extremely; 2 = dislike very much; 3 = dislike moderately; 4 = dislike slightly; 5 = neither like nor dislike; 6 = like slightly; 7 = like moderately; 8 = like very much; 9 = like extremely.*

Table 5 presents a comprehensive analysis of the sensory acceptability of cookies under different treatments, focusing on Odor/Aroma characteristics. The results indicate that the Control group, representing cookies undergoing dehydration, emerges as the most favored variant, receiving the highest rank (1) and an impressive average mean of 9, suggesting an extremely positive reception in terms of Olfactory sensations, Nasal feeling factors, and Aromatic taste. Cookies subjected to Sun Drying (Var1) also exhibit high acceptability with an average mean of 8.67 and the second-highest rank (2). In contrast, cookies from Dry Roasting (Var2) and Dehydration (Var3) show comparatively lower acceptability, reflected in their lower average mean scores (6.67 and 5.83, respectively) and higher ranks (3 and 4). The qualitative descriptions align with the quantitative findings, emphasizing the Control group's cookies being "liked extremely." These results collectively suggest that the dehydration treatment significantly contributes to favorable sensory attributes, particularly in terms of odor, aroma, and taste, making it a promising method for enhancing the overall sensory experience of cookies.

These findings conform to the study of Reyes et.al., (2020), which observed that the aroma of the crinkle's product is affected by the formulation and ingredient ratios similar to its color. According to Sokol, flours made from nuts may not be true flours, but if they are used in combination with wheat flour in different proportions, they can enhance the flavor, aroma, and texture of various baked goods.

Table 6. *Sensory acceptability of the cookies from the different treatments in terms of Texture.*

Oral Texture Characteristics	Variants			
	Var1 Sun Drying	**Var2 Dry Roasting**	**Var3 Dehydration**	**Control**
Mechanical parameters; reaction ofthe product to stress (hardness, viscosity, deformation/fracturability)	8	6	6.5	8.5
Geometrical parameters, i.e., size, shape, and orientation of particles in the product (gritty, grainy, flaky, stringy)	7.5	7	5.5	9
Fat/moisture parameters, i.e., presence, release and adsorption of fat, oil, or water (oily, greasy, juicy, moist, wet)	8.5	6.5	6.5	9
Average mean	8.00	6.50	6.17	8.83
Ranks	**2**	**3**	**4**	**1**
Qualitative Description	**like very much**	**like slightly**	**like slightly**	**like extremely**

Legend: *Nine-point hedonic scale (1 to 9), where 1 = dislike extremely; 2 = dislike very much; 3 = dislike moderately; 4 = dislike slightly; 5 = neither like nor dislike; 6 = like slightly; 7 = like moderately; 8 = like very much; 9 = like extremely*

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Table 6 presents a comprehensive analysis of the sensory acceptability of cookies from different treatments, specifically focusing on texture characteristics. The variants, including Var1 (Sun Drying), Var2 (Dry Roasting), Var3 (Dehydration), and the Control, are evaluated based on various oral texture parameters, including mechanical parameters (hardness, viscosity, deformation/fracturability), geometrical parameters (gritty, grainy, flaky, stringy), and fat/moisture parameters (oily, greasy, juicy, moist, wet). Numerical scores indicate the perceived quality of each variant, with higher values suggesting greater acceptability. The average mean scores for oral texture are 8.00 for Var1 (Sun Drying), 6.50 for Var2 (Dry Roasting), 6.17 for Var3 (Dehydration), and 8.83 for the Control. The corresponding ranks are 2nd, 3rd, 4th, and 1st, respectively. Qualitative descriptions reveal that respondents "like very much" the texture of the Control, "like slightly" for Var1, and "like slightly" for both Var2 and Var3.

These results provide valuable insights into the nuanced preferences related to the texture of cookies. The Control variant, characterized by certain mechanical, geometrical, and fat/moisture parameters, stands out as the most preferred in terms of texture. These findings can guide potential adjustments in processing techniques or ingredient formulations to enhance the overall sensory appeal of cookies, particularly in terms of their oral texture characteristics. Understanding and optimizing texture preferences can contribute to the development of cookies that align with consumer expectations and preferences. This supports the findings of Reyes et.al., (2020), observed in the texture of baked goods may be due to the gelatinization of starch and the rising dough giving rise to carbon dioxide, which makes the baked product light and spongy. More carbon dioxide is produced if more Talisay fruit starch is added to the cooked product. The same explanation given by Shewfelt et.al. states that during cooking, there is expansion of carbon dioxide, gelatinization of starch, coagulation of proteins, and evaporation of water, all of which contribute to the texture of the cooked product.

Table 7. *Sensory acceptability of the cookies from the different treatments in terms of Oral Flavor/Taste.*

Flavor/Taste Characteristics	**Variants**			
	Var1 Sun Drying	**Var2 Dry Roasting**	**Var3 Dehydration**	**Control**
Olfactory sensations (vanilla, fruity, floral, chocolate, skunky, rancid)	8.5	7	6.5	9
Taste sensations (salty, sweet, sour, bitter)	8	5	7.5	9
Oral feeling factors (heat, cool, burn, astringent, metallic)	7.5	6.5	6.5	9
Average mean	8.00	6.17	6.83	9
Ranks	**2**	**4**	**3**	**1**
Qualitative Description	**like very much**	**like slightly**	**like moderately**	**like extremely**

Legend: *Nine-point hedonic scale (1 to 9), where 1 = dislike extremely; 2 = dislike very much; 3 = dislike moderately; 4 = dislike slightly; 5 = neither like nor dislike; 6 = like slightly; 7 = like moderately; 8 = like very much; 9 = like extremely*

Table 7 provides a detailed examination of the sensory acceptability of cookies from different treatments, with a specific focus on oral flavor and taste characteristics. The variants, including Var1 (Sun Drying), Var2 (Dry Roasting), Var3 (Dehydration), and the Control, are evaluated based on olfactory sensations (vanilla, fruity, floral, chocolate, skunky, rancid), taste sensations (salty, sweet, sour, bitter), and oral feeling factors (heat, cool, burn, astringent, metallic). Numerical scores indicate the perceived quality of each variant, with higher values suggesting greater acceptability. The average mean scores for oral flavor and taste are 8.00 for Var1 (Sun Drying), 6.17 for Var2 (Dry Roasting), 6.83 for Var3 (Dehydration), and 9.00 for the Control. The corresponding ranks are 2nd, 4th, 3rd, and 1st, respectively. Qualitative descriptions reveal that respondents "like very much" the oral flavor and taste of the Control, "like slightly" for Var1, "like moderately" for Var3, and "like slightly" for Var2.

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These findings offer valuable insights into the nuanced preferences related to the flavor and taste of cookies. The Control variant, characterized by specific olfactory sensations, taste sensations, and oral feeling factors, stands out as the most preferred in terms of oral flavor and taste. Understanding and optimizing these sensory attributes can guide further refinements in processing techniques or ingredient formulations to enhance the overall sensory appeal of cookies. Consumer preferences for specific flavor and taste profiles can play a crucial role in the successful development and marketing of food products.`

Furthermore, Reyes et.al., (2020) observed that during baking, caramelization of sugar occurs, which enhances the flavor of the cooked product. Talisay fruit starch contains sugar in the form of glucose, which is said to have 316 mg of glucose per gram of mesocarp fruit. The sugar contained in it enhances the flavor of baked goods because when sugar caramelizes, it forms diacetyl, esters, lactones, furans, and maltol that give the baked product a delicious flavor.

Overall acceptability of the develop Talisay Cookie

Table 8. *Summary of Overall acceptability of the develop cookie*

Characteristics	Var1 Sun Drying	Var2 Dry Roasting	Var3 Dehydration	Control
Appearance	8.83	6.67	6.83	8.83
Odor/Aroma	8.67	6.67	5.83	9
Texture	8	6.5	6.17	8.83
Flavor/Taste	8	6.17	6.83	9
Grand Mean	8.38	6.50	6.42	8.92
Rank	2	3	4	1
Qualitative Description	**like very much**	**like slightly**	**like moderately**	**like extremely**

Legend: *Nine-point hedonic scale (1 to 9), where 1 = dislike extremely; 2 = dislike very much; 3 = dislike moderately; 4 = dislike slightly; 5 = neither like nor dislike; 6 = like slightly; 7 = like moderately; 8 = like very much; 9 = like extremely (Pimentel et al., 2016)*

Table 8 provides a comprehensive summary of the overall acceptability of cookies developed through various treatments, including sun drying (Var1), dry roasting (Var2), dehydration (Var3), and a control group. The characteristics assessed encompass appearance, odor/aroma, texture, and flavor/taste, each rated on a scale reflecting respondents' preferences. The grand mean, representing the overall acceptability, is highest for the control group at 8.92, followed by sun drying (8.38), dehydration (6.42), and dry roasting (6.50). The rank order aligns with the qualitative descriptions, indicating that the control group is liked extremely, sun drying is liked very much, dry roasting is liked slightly, and dehydration is liked moderately. This summary highlights the preferences of respondents across multiple sensory aspects, providing valuable insights into the most favored treatment method for Talisay seed flour cookies.

Therefore, Reyes et.al., (2020) concluded that if Talisay fruit starch is incorporated into commercial wheat flour in the preparation of bakery products, a higher concentration must be added to render the product acceptable in terms of color, aroma, texture, and flavor. This may be because Talisay fruit starch is an additive that contributes to the delicious taste of baked goods. This is consistent with the idea that in baked goods, a raw or other ingredient must be added to the flour to bring about significant changes in its function.

Significant difference between the Acceptability of experimental treatments.

Table 9. *Significant difference between the Acceptability of experimental treatments.*

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows (Characteristics)	0.98843	3	0.329477	2.179094	0.113623	2.960351
Columns(Variants)	68.83995	9	7.648883	50.58822	1.38E-14	2.250131

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Error	4.08237	27	0.151199
Total	73.91075	39	

Table 9 presents the results of an analysis of variance (ANOVA). The Sum of Squares measures the variability or dispersion within each source of variation. The Degrees of Freedom indicate the number of independent pieces of information available to estimate the variability. The Mean Square is calculated by dividing the Sum of Squares by the Degrees of Freedom and represents the average variability within each source of variation.

The F-value is the ratio of the Mean Squares between groups to the Mean Squares within groups. It is used to test the significance of the differences between groups. The P-value represents the probability of obtaining the observed results by chance. A small P-value suggests that the observed differences are unlikely to be due to random chance. The Critical F-value is a threshold value used to determine whether the observed F-value is statistically significant. The differences between the rows (factors) do not appear to be statistically significant, as indicated by the relatively high P-value (0.113623) compared to the critical F-value (2.960351). However, the differences between the columns (factors) are highly significant, as indicated by the very low P-value (1.38E-14) compared to the critical F-value (2.250131). From the three treatments conducted, it was found that there is a significant difference observed in terms of cookie characteristics such as appearance, odor or aroma, texture, and flavor or taste. Sensory attributes of food are considered the key areas in which food developers can successfully use them to ensure consumer expectations are meet or exceeded, assess the marketability of a product, develop and modify recipes to gain a competitive edge through comparisons to other brands, know the description of product characteristics, and examine storage stability.

Overall, this analysis indicates that the differences between the sample variants in making talisay cookies using talisay flour that are sun-dried, dry-roasted, and dehydrated are statistically significant. It shows that Variants 2 (dry roasting talisay flour) and 3 (dehydration talisay flour) imply a significant difference with respect to the commercial flour, except for Variant 1 (sun dry talisay flour), which shows no significant difference. This means that variant 1 using sun-dried talisay flour in making cookies has the closest characteristics to the cookie made of commercial flour (control) variant.

Cost Benefit Analysis

Poverty in the Philippines has been a challenge for the last four decades, as indicated by the number of households living below the official poverty line, making poverty reduction significantly slower than in neighboring nations. The country's current economic status appears to be serious, with poverty prevalent, particularly in rural areas. Filipinos' primary issue is poverty alleviation, which can be accomplished by lowering the dollar requirements for the importation of raw materials such as wheat flour, which raises the cost of baking items. Another aim is to reduce hunger among the poor by providing an alternate food supply.

In this era, when there is a scarcity of food, new goods and recipes are developed using indigenous materials found in the local community and seemingly annoying litter (Thornley, 2011). In addition, the appeal for environmental conservation drew international attention (Parry, Rosenzweig, & Livermore, 2005). On the other hand, the campaign slogan "May Pera sa Basura" is the Philippines' response to the call for environmental conservation at the grassroots level and as an approach to waste management (Parry, Rosenzweig, & Livermore, 2005; Vidal, 20).

In line with the 2023 Nutrition Month theme, "Healthy Diet Gawing Affordable for All", this study aimed to develop a product out of waste materials and encouraged to lessen the problem of waste while at the same time confronting the problems brought about by poverty, health risks, and environmental degradation.MThe product cost is estimated at 130.00 pesos, including the packaging and fifty percent of the markup price. Considering the tools to measure, the product yields 12 pieces if you use ice cream scoop no. 20. The estimated cost per piece is 10 pesos or less, depending on the size of the cookies.

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CONCLUSION AND RECOMMENDATIONS

Based on the findings, the following conclusion were drawn: The phytochemical analysis of talisay extract revealed the presence of various compounds such as alkaloids, quaternary bases, amine oxides, 2-deoxysugars, flavonoids, saponins, and tannins, indicating its potential pharmacological effects, antioxidant properties, foaming properties, and astringent properties. Talisay fruit flour has notable physicochemical properties, including moisture, ash, crude fat, crude protein, as well as crude fiber and carbohydrates content, making it a valuable ingredient with potential nutritional benefits. The recipe for making the talisay cookies are 1 ¼ cup Talisay flour, ½ cup brown sugar, ½ cup white sugar, ½ tsp baking soda, 1 whole egg, ½ cup butter, ¼ tsp salt, develop using the step-by-step procedures and processes.

The sensory evaluation results of the develop cookie is varied with respect to all the characteristics together, a control variant serves as a reference point and consistently receives the highest score of 9 in all characteristics. The grand mean scores, calculated by averaging the scores across all characteristics, offer an overall measure of acceptability for each variant. The rankings based on the grand mean scores indicate the relative positions of each variant, with the control variant having the highest rank. Subjective descriptions are provided for each variant based on the grand mean scores, reflecting the level of preference or liking.

Based on the conclusion, the following recommendation were drawn: Further explore the potential pharmacological effects and antioxidant properties of talisay extract due to the presence of compounds such as alkaloids, quaternary bases, amine oxides, 2-deoxysugars, flavonoids, saponins, and tannins. Considering the notable physicochemical properties of talisay fruit flour, including oil content, moisture content, crude protein content, and concentrations of phosphorus, manganese, and copper, it can be recommended as a valuable ingredient with potential nutritional benefits. To enhance the sensory evaluation results of the talisay cookies, it is suggested to experiment with the recipe and possibly modify certain ingredients or proportions to improve the overall acceptability. The control variant, which consistently receives the highest scores, can serve as a benchmark for optimizing the taste, appearance, texture, and flavor of the cookies. Continuous sensory evaluation and refinement of the recipe can help achieve a more favorable outcome and increase consumer preference. Utilizing Talisay flour in various food products should be further explored to capitalize on its nutritional composition and potential market demand. Packaging and branding should be developed to highlight the unique qualities and health benefits of Talisay cookies, targeting health-conscious consumers. Market research should be conducted to gauge consumer preferences and potential areas for improvement or diversification. Collaboration with local farmers, suppliers, and manufacturers can establish a sustainable supply chain for Talisay fruits and seeds, supporting local agriculture and promoting sustainability.

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