Research Article

Acceptability of coconut *(Cocos nucifera)* apple tart filling recipe: Techno guide for Extension program

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Abstract

Coconut apple, commonly known as *buwa sa lubi* which is the coconut (*Cocos nucifera*) cotyledon, is known to have contained nutritional value, but unfortunately, it is considered a waste product in the Philippines during copra production or even in the market where only coconut flesh is utilized. The present study aimed to use coconut apple as a tart filling using the descriptive - quantitative research method. This experimental study used four tart recipes with varying concentrations of coconut apple, such as 0 g, 100 g, 150 g, and 200 g, added to the tart recipe. The study determined the most preferred concentration of coconut apple added to the filling recipe based on sensory evaluation using descriptive testing of the product's color, taste, aroma and texture and acceptability rating of the four formulations using 15 food experts and 35 consumers. Out of the four varying concentrations of coconut apple, treatment with 200 g of coconut apple added to the tart filling recipe obtained the highest sensory acceptability of 15 food experts and 50 consumers. The product had a dark brown color, extremely noticeable aroma, extremely tasty and extremely crunchy texture. The most preferred coconut apple tart had a sensory acceptability rating of "like extremely" with the highest mean score of 8.74. The product's nutritional value was composed of 1.27 % crude ash, 19.8 % total fat, 6.16 % crude protein, 21.3 % moisture and 51.7 % carbohydrates. Based on findings, 200 g of coconut apple as one of the ingredients in tart fillings was adopted as the techno-guide for the extension program.

Keywords: Acceptability test, Sensory analysis, Techno-guide, Vocational education

INTRODUCTION

The Philippines is one of the countries in the tropics endowed with rich natural biodiversity. Still, few plant species are being fully utilized today for food, income, and environmental conservation and enhancement (Moreno *et al*., 2020). Coconut apple is a healthy food source that contains nutrients and phytochemicals with health benefits. Germinated coconuts are underutilized presently and it can be considered the only waste in the coconut industry, though it is a rich source of nutrients (Senarath *et al*., 2018).

The coconut tree (*Cocos nucifera* L.) is one of the most useful and beautiful trees in the tropics. It is grown in more than 90 countries, with world production concentrated in Asia and the Pacific, such as Philippines, Indonesia, India, Sri Lanka, Thailand, Malaysia, and Papua New Guinea, together account for about 80% of the total area planted to coconuts worldwide (Pham, 2016). The palm is well-known for the diversity of its products, particularly within the realms of food, drink, structural material, and energy supply (Dayrit and Nguyen, 2020). A wide range of industrial and edible products derived from the oil, its desiccated kernel, coconut water, nectar, sugar, charcoal, fiber, and coco peat is produced in many locations wherein there has been investment in processing technology (Gurbuz and Manaros, 2019). In the Philippines, coconut milk is usually collected from the flesh of the mature coconut and used as one ingredient in every menu (Alejandro, 2015). When the mature coconut is ready to shoot some leaves, one can see white and sponge-like cotyledons. This thing is called *buwa or buha (Ilonggo)*– an edible, soft predecessor known to be coconut cotyledon, sometimes called the "coconut embryo" or "coconut apple", that is suspended in germination and can be eaten raw (Biddle *et al*., 2020)

The coconut *(Cocos nucifera)* apple contains nutritional value. Unfortunately, it is considered a waste product during copra production or even in the market where

only coconut flesh is utilized. According to Biswas *et al.* (2020), coconut apples have many health advantages. It is good immune system health support, it reduces the chance of getting diabetes and cancer, it removes free radicals that cause premature degenerative disease and ageing, and it improves the absorption of nutrients (Kannaian *et al.*, 2020; Korrapati *et al.*, 2019). Thus, innovating a new tart recipe filled with coconut apples will cater to this effect. Nonetheless, how the combination of ingredients perfectly coincides is a query that will be unravelled through this study.

Promoting national food control systems is specifically vital for developing countries as they continually seek improvement in food safety, quality, and nutrition which is the prior interest of the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO). One of the most used raw materials in food preparation is coconut, which is widely known to have high value in human nutrition. According to Burgess (2016), coconut by-products are one of the most used ingredients for food preparation globally, and its usage was known since time immemorial. In the sweets industry, dishes like tarts and other kinds of desserts are being promoted by united bakers worldwide.

Reinventing tart recipes is familiar to the Filipino people as they are known as innovative in many aspects, much more in food. It warns of the urgency for the public to change their way of living and use natural resources to combine an ingredient with lots of health benefits in their baking recipe. However, the pressing health issue in the Philippines is still rampant. According to World Health Organization Western Pacific Region, Philippines (2016), diabetes, a non-communicable disease, is considered a significant public health concern for 6 of the top 10 causes of mortality in the Philippines.

Coconut, an essential crop in the Philippines and many Asia Pacific countries and is called the tree of life, bears the Filipino people's livelihood up to 60% of the coconut products traded in the world market (Ap, 2015). In Cebu, Philippines, it is prevalent to use coconut since one can get it from their place quickly. It is a natural thing to consider including coconut as one of the ingredients in their food.

All these capsulated the importance and positive impact of coconut as the main ingredient for a tart recipe on food production. This study could help bring a dual effect to the economy pertaining to the businesses and health issues that can be alleviated through the coconut. However, to ascertain the preference of the target consumers of the coconut apple tart, there is a need to conduct a sensory test. This gap needs to be addressed in this study. Therefore, the present research aimed to develop a tart fortified with coconut *(C. nucifera)* apple filling and its acceptability as the basis for a techno guide for an extension program.

MATERIALS AND METHODS

Research design
The study used descriptive - a quantitative research method following the experimental design, which involves an experimental approach using a recipe of tart with coconut *(Cocos nucifera)* apple filling using different formulations. The standardized 9-point Hedonic Scale method was used to identify the level of acceptability of the respondents (Sharif *et al.*, 2017). Descriptive and inferential statistics were used to test significant differences in the level of acceptability of the respondents on the different tart formulations.

Standard recipe and procedure
For the pastry dough, 2 cups of all-purpose flour, ½ cup icing sugar, and ½ teaspoon salt were mixed well in a mixing bowl. ¾ cup unsalted chilled butter cubes were added and rubbed into the flour until the mixture resembled a sandy mixture or breadcrumbs. 2 large egg yolks were added and cut into the flour-butter mixture with a dough scraper until the dough started to come together. Then it was kneaded by hand until the dough became smooth and evenly colored after incorporating the yolks. In a separate mixing bowl for the filling, 2 pieces of medium eggs, ½ cup sugar, 1 cup milk, 2 tablespoon cornstarch, and 1 tablespoon all-purpose flour were combined. Whisked by hand until the sugar was dissolved, added in ½ cup melted butter, and whisked to combine well. It was tipped in the 200 g of grated coconut apple and stirred to combine well. The pastry dough was pressed into tart molds. If the tart molds are not non-stick, generously grease the base and sides with butter. The oven was pre-heated for 30 minutes at 170 ^{0}C. The tart shells were prebaked in a preheated oven for 10 to 15 min. or until baked to a light golden brown. Then the coconut apple filling was done into the tart shells and baked for 25- 30 minutes or until the coconut apple tart was brown evenly.

Respondents
The study's respondents were selected from the Faculty and Staff of Cebu Technological University Danao Campus, Cebu, Philippines. There were 50 respondents selected, wherein 15 were Faculty members of the BSHM and considered experts using purposive sampling, while the 35 respondents were the staff representing the consumers using simple random sampling technique.

Methodology
This study employed an adopted questionnaire from iRubric and was modified by the researcher for sensory evaluation of edible products as a primary instrument in identifying the level of acceptability of the four tart formulations. The methodology consisted of two (2) major

parts. The first part of the questionnaire aimed to determine the level of acceptability regarding the sensory analysis of the tart with coconut apple filling in terms of aroma, color, flavor, taste, and texture. The questionnaire used the five–point Likert scale to rate each of the four different formulations of coconut apple tart in a rubric form. The second part of the questionnaire consists of the sensory acceptability test using the 9-point Hedonic Scale and gathering the data that helped identify the most preferred recipe of tart with coconut apple filling among the two groups of respondents: the expert and the consumers. The questionnaires were validated and evaluated by the research adviser prior to fielding.

Data gathering procedure

Before conducting the study, the letters were written and ethical approval was taken from the office of the Campus Director. The four tart formulations were prepared and baked in the researcher's home. The respondents were identified and individually approached for their availability to taste the tarts. They were asked to respond to the questionnaire to determine their level of acceptability of the different tart formulations. During the study, the research methodology was distributed and administered to the respondents as well as the retrieval of the questionnaires. It was ensured that health protocols were observed. The respondent's responses to the questionnaire were collated and tallied in the tables for analysis and interpretation.

Data analysis

Data were systematically treated and analyzed using descriptive and inferential statistics to achieve a correct and reliable result. To analyze and interpret the data on descriptive test results of coconut apple tart, the re-

searcher computed the weighted mean of the responses and categorized them according to the range of criteria. The data on the sensory analysis of the tart with coconut apple filling in terms of aroma, color, taste, and texture and the data on the sensory acceptability test of the coconut apple tart using the 9-point Hedonic Scale were analyzed using weighted mean.

To test the null hypothesis, Analysis of Variance (ANOVA) was used to test any significant difference between the levels of acceptability of the respondents on the four tart formulations based on the sensory test. SPSS was used for ANOVA for correct computation and appropriate interpretation of results.

RESULTS AND DISCUSSION

Formulations of Tart Recipe using Different Amounts of Coconut Apple Filling

The different formulations of the tart recipe with varying concentrations of coconut apple as tart fillings, are shown in Table 1. This revealed that the first formulation, which was the F0 as the control recipe, had no coconut apple used for its filling. The second formulation was the F1 which had 100 g of coconut apple, F2 had 150 g of coconut apple and F3 had 200 g of coconut apple as one of the ingredients for the tart filling. Hence, all the formulations had the same ingredients for its tart crust except the amount of coconut apple for its filling.

Sensory analysis of the Tarts with different amounts of coconut apple filling based on the sensory attributes

The formulated coconut apple tarts with varying concentrations of coconut apple as one of the ingredients

Table 1. Formulation of four Tart recipes using different amounts of Coconut apple filling

Materials	Control recipe F0	Formulations of Tart Recipe		
		F1	F2	F3
For the pastry crust				
Unsalted Butter, chilled	¾ cup	¾ cup	¾ cup	¾ cup
Icing sugar	2 cups	2 cups	2 cups	2 cups
All-purpose flour	2 cups	2 cups	2 cups	2 cups
Egg yolk	2 pcs	2 pcs	2 pcs	2 pcs
Salt	½ tsp	½ tsp	½ tsp	½ tsp
For the coconut filling				
Sugar	¼ cup	¼ cup	¼ cup	¼ cup
Eggs	2 pcs	2 pcs	2 pcs	2 pcs
Milk	1 cup	1 cup	1 cup	1 cup
Butter, melted	¼ cup	¼ cup	¼ cup	¼ cup
Coconut apple	0	100g	150g	200g
Cornstarch	2 tbsp	2 tbsp	2 tbsp	2 tbsp
All-purpose flour	2 tbsp	2 tbsp	2 tbsp	2 tbsp

of tart filling were subjected to sensory analysis on color, aroma, taste, and texture as reflected in Table 2.

Color

Table 2 shows that the color of the coconut apple tart as the control sample (F0), with 100 g coconut apple (F1) and 150 g coconut apple (F2) had a brown color with a mean score of 3.92, 4.06 and 4.16, respectively, followed by tart recipe with 200 g coconut apple (F3) which had a mean score 4.88, that is dark brown. This implies that coconut apple concentration can affect the color of a tart recipe, from brown to dark brown.

Aroma

The aroma of the tart recipe without coconut apple (F0), tart recipe with 100 g (F1) and 150 g (F2) coconut apple had mean scores of 3.92, 4.04, and 3.76, respectively, with very noticeable aroma while the tart recipe with 200 g of coconut apple (F3) had a mean score of 4.78 which meant extremely noticeable aroma. This implies that the aroma of the coconut apple tart was affected by the concentration of the coconut apple. Furthermore, Zoon *et al*. (2016) indicated that laboratory shreds of evidence show foods with a delightful aroma attract consumers as it stimulates salivation. It also promotes consumption prospects and appetite increases.

Taste

The taste of the tart recipe without coconut apple (F0), tart recipe with 100 g of coconut apple (F1), and tart recipe with 150 g of coconut apple (F2) had taste mean scores of 3.78, 4.02 and 4.02, respectively, had a mean descriptive rating of very tasty. In comparison, the tart recipe with 200 g of coconut apple as fillings (F3) had a mean score of 4.90, with a descriptive taste rating of extremely tasty. It meant that the taste of the coconut apple tart can be affected by the concentration of coconut apple as one of the ingredients of the tart filling.

Texture

The texture of the tart recipe without coconut apple (F0), tart recipe with 100 g of coconut apple (F1), and tart recipe with 150 g of coconut apple (F2) had mean scores of 3.66, 3.96, and 4.16, respectively, which meant very crunchy, while samples containing 200 g of coconut apple (F3) as one of the ingredients of tart filling had a descriptive rating of extremely crunchy texture, which had a mean score of 4.94.

It implies that the concentration of coconut apple as one of the ingredients of tart filling can affect its texture. Laureati *et al*. (2020) indicated that texture encompasses many sensory dimensions, from tactile to visual and auditory sensations, thus making it a complex sensory property. It implies that taste, texture, aroma, and appearance (color) are the sensory characteristics that have distinct and influential effects on food acceptability (Piqueras-Fiszman and Spence, 2015).

Sensory acceptability test of the respondents' most preferred formulation among the four Tart recipes

As presented in Table 3, the sensory acceptability test as perceived by the 15 experts for F0 had a mean sensory analysis of 6.33, which was Like Slightly, F1 and F2 had the same general acceptability rating of "Like Moderately" with the mean sensory analysis of 7.07 and 6.93, respectively. F3 had a mean sensory analysis of 8.80, which is Like Extremely. The consumer's sensory acceptability for Fo is 6.29 with a preference rating of like slightly; F1 and F2 had the same preference rating, which was Like Moderately, with a mean sensory analysis of 7.37 and 7.43, while for tart samples containing 200g of coconut apple (F3) had the highest acceptability rating of 8.71 which had the preference rating of "Like Extremely". Thus, coconut apple, as one of the tart recipe fillings, can significantly affect the acceptability test of the product. Moreover, the F3, which had the highest amount of coconut apples, was the best formulation because even ordinary consumers and food experts had the same preference. According to the IFT (Institute of Food Technologists), sensory evaluation is a scientific method used to evoke, measure, analyze and interpret those responses to products as perceived through the senses of sight, hearing, touch, smell and taste (Stone and Sidel, 2004; IFT 2007).

Analysis of variance in the respondents' level of acceptability of the four Tart formulations

The Analysis of Variance (ANOVA) used to treat the data statistically, indicated the significant mean difference in the respondents' level of acceptability of the four tart formulations. The results of the ANOVA on the sensory evaluation preference results of the different formulations as evaluated by consumers and food experts using the Hedonic evaluation are mentioned in Table 4.

This showed that the p-value was 0.000, less than 0.05, which statistically means the null hypothesis is rejected. Therefore, there was a significant difference in the respondents' level of acceptability of the four different tart formulations. The first formulation, which was the tart with no coconut apple content, had a 6.300 level of acceptability, which meant Like Slightly, the 2nd formulation with 100 g and 3rd formulation containing 150 g have the same level of acceptability which was 7.2800 which had a rating of Like Moderately. The 4th formulation has an 8.74 level of acceptability with a rating of Like Extremely. Notably, the tart with 200 g of coconut apple had the highest acceptability level. Thus, the higher the content of coconut apple filling in the tart, the higher the acceptability. Moreover, the coconut apple

filling served its purpose to add flavor to the tart. According to Romagny *et al.* (2017), even the least alteration of its flavor might largely affect the whole food quality and its consumers' acceptability level.

Proximate composition of the most generally acceptable of the four Tart formulations

The coconut apple tart with 200g of coconut apple filling as the most acceptable formulation was subjected to a laboratory test to determine the crude ash, total fat, crude protein, and moisture, as shown in Table 5. The most preferred coconut apple tart formulation, which was the F3, contained 1.27% ash, 19.8 % fat, 6.16 % protein, 21.3 % moisture, and 51.7 % carbohydrates. The carbohydrate content of the product was determined by the difference of 100 from the % of moisture, fat, protein, and ash contents. Based on its proximate composition, the product was high in nutritional value

and can be categorized as energy-giving food as it contains high amount of carbohydrates. According to De (2019) and Saqib and Whitney (2011), coconut apple contained carbohydrates of around 66%. A high concentration of carbohydrates, specifically monosaccharides, infers a sweet taste. In comparison, savoury tastes like salty are associated with electrolytes and proteins (Salles *et al.*, 2021).

Conclusion

Among the four Tart recipes with varying concentrations of coconut (*Cocos nucifera*)apple, the formulation with 200 g of coconut apple as one of the ingredients of tart filling was the most preferred. The higher the amount of coconut apple used as a tart filling, the higher the acceptability level of the tart. The amount of coconut apple can significantly affect the tart's aroma,

Table 2. Sensory analysis of Tarts with different amounts of Coconut apple filling based on aroma, color, taste and flavor

Sensory Attributes	Mean	Verbal Description	Mean	Verbal Description	Mean	Verbal Description	Mean	Verbal Description
	0 g		100 g		150 g		200 g	
Aroma	3.92	Very Noticeable	4.06	Very Noticeable	4.16	Very Noticeable	4.88	Extremely Noticeable
Color	3.92	Brown	4.04	Brown	3.76	Brown	4.78	Dark Brown
Taste	3.78	Very Tasty	4.02	Very Tasty	4.02	Very Tasty	4.90	Extremely Tasty
Texture	3.66	Very Crunchy	3.96	Very Crunchy	4.16	Very Crunchy	4.94	Extremely Crunchy
TOTAL	3.82		4.02		4.03		4.88	

Table 3. Sensory Acceptability Test Using the 9-Point Hedonic Scale on the Four Tart Recipes Using Different Amount of Coconut Apple Filling

	MEAN 0 g Fo	Verbal Description	Mean 100 g F1	Verbal Description	Mean 150 g F2	Verbal Description	Mean 200 g F3	Verbal Description
Expert Consumers	6.33	LS	7.07	LM	6.93	LM	8.80	LE
Consumers	6.29	LS	7.37	LM	7.43	LM	8.71	LE
MEAN	6.31	LS	7.22	LM	7.18	LM	8.76	LE

Legend: 5.50-6.49 - Like Slightly (LS); 6.50-7.49 - Like Moderately (LM); 7.50-8.49- Like Very Much (LVM); 8.50-9.00 - Like Extremely (LE)

Table 4. Acceptability rating of Tart recipe with varying concentrations of Coconut apple

	N	Mean	Verbal Description	Std. Deviation	p-value
0 g	50	6.3000	LS	.64681	
100 g	50	7.2800	LM	.99057	
150 g	50	7.2800	LM	.83397	0.000
200 g	50	8.7400	LE	.59966	
Total	200	7.4000	LM	1.16912	

*Significant (P≤0.05).

Table 5. Proximate composition of the most preferred coconut Apple tart formulation

Analysis	Test Method	Result
Crude Ash, g/100g	Ignition-Gravimetric	1.27
Total Fat,g/110g	Mojonnier Extraction	19.8
Crude Protein (N x 6.25) g/100 g	Kjeldahl	6.16
Moisture, g/100 g	Air Oven Drying -Gravimetry	21.3
Carbohydrates		51.7

color, taste, and texture. The coconut apple tart is very rich in carbohydrates but less in fat. Therefore, it is an energy-giving food as it contains more carbohydrates. Based on the findings, the tart recipe with 200 g of coconut apple as one of the ingredients of tart filling is highly recommended. The CTU Extension Program should adopt the Techno-Guide designed in the present study to implement a sustainable community empowerment program, disseminate food processing technology information, and promote the adoption of coconut apples used as filling for a tart or any other pastry products. Technology and Livelihood Education teachers should adopt the Techno-guide to augment the knowledge and skills of food experts for possible entrepreneurial activities.

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Conflict of interest
The author declares no conflict of interest.

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