

THE ACCEPTABILITY OF COCONUT (*COCOS NUCIFERA*) FLOUR INTO INNOVATIVE TWISTED DOUGHNUT WITH AND WITHOUT *MORINGA OLEIFERA*

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ABSTRACT: Food innovation is happening rapidly because consumer demands and expectations are constantly evolving. And because there is a growing donut market development, the donuts have become a canvas for innovation. This study developed an innovative, wholesome, and delicious doughnut variant, particularly twisted doughnut, which contains coconut (*Cocos nucifera*) flour with and without *Moringa oleifera*. Thus, the main objective of this study is to determine the level of acceptability of coconut (*Cocos nucifera*) flour into twisted doughnuts with and without *Moringa* in terms of (a) appearance, (b) color, (c) texture, (d) aroma, and (e) palatability. This study utilized the descriptive research design and involved a total of 30 semi-trained panelists composed of faculty members and students of Balubal National High School, Philippines, using the purposive sampling technique. The 9-point hedonic rating scale sensory evaluation questionnaires were utilized in data collection, and the mean and standard deviation were used to analyze the data. The study's findings revealed that the overall acceptability of twisted doughnuts with moringa ($M= 8.52$ SD 0.6) and without moringa ($M= 8.57$ SD 0.55) are both highly acceptable. However, in terms of texture, the twisted doughnut with moringa ($M= 8.73$ $SD= .52$) is only very acceptable compared to without moringa ($M= 8.43$ SD .62), which is highly acceptable. In conclusion, *Cocos nucifera* and *Moringa oleifera* can be used in the production of wholesome enriched bakery products, such as twisted doughnuts, with significant effects on the final product's composition and high consumer acceptability. Recommendations to further enhance the innovative baking product for future research are included in this study.

Keywords: Acceptability, *Cocos Nucifera*, Food Innovation, *Moringa Oleifera*, Twisted Doughnut

INTRODUCTION

The impact of innovation on the food industry is substantial. Hence, the ability to innovate is critical to the food industry's survival and profitability. The production practices in the agro-food industry have the potential to significantly impact both the environment and the issue of resource inequality on the planet [1]. This is another reason why food and innovation are two important subjects when talking about sustainability.

Since there is a growing donut market development, doughnuts have become a canvas for innovation [2]. There are many types of donuts, and one of those is the twisted donut. Twisted donuts are typically made from a yeast-raised dough, deep-fried in oil, and rolled in sugar [3]. This donut uses a length of dough twisted into a distinctive rope-like shape before being fried.

Donuts are in intense competition because consumers have a wide range of taste and texture preferences, and bakeries are stepping up to match those demands [4]. Consumers want products with multi-sensory appeal; enhanced aromas, colors, and textures can reinforce freshness cues and help to differentiate bakeries. The way a doughnut is displayed in-store or online might influence customers to buy a novel style and flavor and can distinguish one bakery from another [4]. As a result, donuts, such as twisted donuts, call for creative and innovative solutions to satisfy the customers' and consumers' sensory needs.

The Philippines is the world's second-largest producer of coconut products. Coconut flour is one of the numerous food items derived from the fruit of the *Cocos nucifera* palm tree. Typically, leftover coconut pulp after coconut milk and oil production is used to make coconut flour [5]. After producing coconut milk, some merchants in the Philippines just discard any leftover or wasted coconut pulp. Through waste management or recycling, collecting and turning these coconut wastes and turned into coconut flour, might contribute to saving the environment and natural resources. With that, the purported coconut waste can also be turned into cash.

Additionally, the nutritional profile of coconut flour is impressive. Some studies found that coconut flour contains more fiber, plant-based protein, and specific vitamins and minerals, like potassium and iron, and is relatively low in carbohydrates compared to wheat flour [6]. Hence, substituting or adding coconut flour to make bakery products may have health advantages. On the other hand, the *Moringa oleifera*, or "malunggay" in the Philippines, has long been a mainstay in Filipino backyard gardens due to its nutritional advantages and capacity to adapt to local circumstances. The prevalent variant in the Philippines and other tropical parts of Asia is known as a miracle tree, the queen of Philippine vegetables, and a superfood because every component of the plant—from the fruit to the stem to the trunk—is edible and has a different function [7]. In fact, *moringa* is reported to contain 25 times more iron than spinach and seven times more vitamin C than oranges. It also has ten times more vitamin A than carrots, seventeen times more calcium than ordinary milk, and 9 times more protein [8]. Preliminary research indicates that the economically significant tree and vegetable *Moringa oleifera* possesses reasonable antioxidant and anti-inflammatory properties [9]. Hence, *moringa oleifera* (malunggay) is a very rich source of vitamins, minerals, and other essential phytochemicals that has the potential to be a successful preventative measure for a variety of ailments and malnutrition [8].

Malnutrition and poverty are still rampant in the Philippines. Malnutrition is one of the major barriers that the country faces, despite the fact that there are other causes that contribute to perpetuating poverty cycles [10]. According to UNICEF Philippines, malnutrition kills an estimated 95 Filipino children every day. Out of 1,000 Filipino children, 27% do not live to see their fifth birthday. A third of Filipino youngsters are short for their age or stunted. Stunting that occurs after age two can be lethal, permanent, and irreversible because of this disease. Thus, ensuring to promote of nutritious and healthy food and helping eliminate malnutrition is one of the Department of Education's implemented

guidelines on operating and managing schools' canteens in public elementary and secondary schools [11]. This is the reason why innovative food products are essential in the issue of malnutrition because food innovation presents chances to sustain food security and may potentially eradicate malnutrition or hunger.

Furthermore, the Balubal National High School, founded in 2003, is known for its urban gardening initiatives, such as the propagation of coconut (*Cocos nucifera*) and "malunggay" (*Moringa oleifera*). The school is located in barangay Balubal of Cagayan de Oro City, where areas are devoted to producing animals, various foods, and commercial crops (e.g., coconut and moringa) as the locals' primary source of income. In this light, the researcher decided to conduct this study to investigate the level of acceptability of coconut (*Cocos nucifera*) flour into twisted doughnuts without and with *Moringa oleifera*, specifically at Balubal National High School. Thus, this study seeks to answer the question: What is the level of acceptability of coconut (*Cocos nucifera*) flour into twisted doughnut with and without *Moringa* in terms of (a) appearance, (b) color, (c) texture, (d) aroma, and (e) palatability?

METHODOLOGY

This study aimed to assess the acceptability of coconut (*Cocos nucifera*) flour into twisted doughnuts with and without *Moringa* in terms of (a) appearance, (b) color, (c) texture, (d) aroma, and (e) palatability. To attain this objective, this study employed a descriptive research design. Descriptive research design is used to summarize or describe the characteristics of a data set, which can either represent the whole population or a sample of a population [12]. It is also represented numerically in the manuscript text and tables or graphically in figures [13].

Thirty (30) semi-trained panelists composed of faculty members handling food subjects and students taking food subjects at Balubal National High School (BNHS) school year 2022-2023 were employed as respondents of the study. Semi-trained respondents typically have knowledge of several food categories and must be able to recognize distinctions and convey them clearly [14]. In addition, the purposive sampling technique in determining the study's sample size was used. This technique depends on the researchers' judgment in deciding whom to ask to participate [15]. As a result, the researchers could either choose a representative sample to meet their objectives or approach individuals with specific features.

The following are the inclusion and exclusion criteria used to participate in the study:

Inclusion Criteria

1. Must be a faculty member handling food subjects at Balubal National High School.
2. Must be a bona fide student taking food subjects at Balubal National High School.
3. Must approve the consent letter in answering the questionnaire.

On the other hand, the following criteria are the basis for participation disqualification:

Exclusion Criteria

1. A faculty member who is not handling food subjects.
2. A student who is not enrolled in any food subjects.
3. The consent letter for answering the questionnaire was

ignored, rejected, or denied.

The research instrument in the study was the 9-point hedonic rating scale sensory evaluation questionnaire, developed by the Quartermaster Food Institute for the Military, which measures how much people like food products [16]. It is the most widely used scale for measuring food acceptability [17]. Each item in the questionnaire was measured where 1 as the lowest, which means "Didn't like it at all" and 9 as the highest which means "Like it a lot".

To guarantee the validity of the research instrument, copies were handed over to the research expert. The research expert, referred to as a person of authority, was the one who evaluated and validated the research instruments used in the study. Once the instruments were validated, the researcher interviewed them to find out their assessments of the instruments and if the contents were relevant to the research question and free from bias and ambiguity. Afterward, the items or contents in the instruments were edited or revised for more clarity and definiteness.

During the data collection, the researcher first secured the approval of the School Principal of Balubal National High School using a letter to conduct the study. After that, consent letters were issued for the respondents qualified to test the acceptability of the innovative twisted doughnut. When the respondents confirmed to participate in the study, they were requested to come to the culinary building of the school on a specified schedule.

The time for the evaluation was one hour before or after lunch timings. The environment's ambient temperature should be comfortable, and the surroundings should be quiet and odor-free. The temperature and relative humidity for the sensory evaluation area should be 72-75 degrees F (22-24 degrees Celsius) and 45-55%, respectively [18]. The color and lighting in the sensory environment should be planned to permit adequate viewing of samples while minimizing distractions [19].

Then, two servings of innovative twisted doughnuts were presented to each respondent [20]. The samples were distributed to all the panelists at the same time of the day so that the quality of the products to be tested was the same among all of them. The food samples were neutrally coded to keep them anonymous when panelists evaluated them [21]. When a test involves more than one sample, the order of serving was randomized to avoid bias due to the order of presentation [22]. The temperature of food samples was preferably at room temperature for testing, and it was suggested to serve them at the common serving temperature [14]. Samples were presented in containers or on plates that were the same size, shape, and color. White or clear containers were usually chosen so as not to influence panelists' perceptions of the foods' color [22]. Along with the food samples were the napkin, sensory analysis questionnaire (evaluation form), and pen. The evaluation form was printed clearly and should be easily comprehensible to the panelists. It should not create any confusion [14]. The evaluation forms were explained prior to the actual food testing. The respondents were asked to rate the samples for aroma, texture, color, palatability, and appearance using a modified 9-point hedonic rating scale evaluation form with 1 representing dislike extremely to 9 representing like

extremely [20].

Room temperature water or plain bread or cracker was made available for panelists to eat between samples for cleansing or refreshing the palates to prevent carryover [23], and a rest period of 30 seconds was scheduled between samples. Paper towels were also provided, and because swallowing food samples influences subsequent samples' taste, small containers into which samples may be spit were provided [22]. Furthermore, there was a clear prohibition on the usage of pan, tobacco, or alcohol at least half an hour before the test [14]. The evaluation forms should not be visible to other evaluators to prevent them from copying. And the panelists were not allowed to sit next to each other and not allowed to talk to other evaluators as well. Respondents were also given the option to write their comments about the products [20]. Furthermore, after a respondent finished the evaluation, he/she was requested to exit the area immediately to avoid conflict with the judgment of others.

After that, the evaluation forms were collected, and all the data were tallied. The data were analyzed using Mean and Standard Deviation. Table 1 was used to score the level of acceptability of the innovative products.

Table 1- Scoring and Verbal Interpretation of the Level of Acceptability of the Innovated Products

Scale	Range	Remarks	Verbal Interpretation
9	8.50-9.00	Like it a lot	Highly Acceptable
8	7.50-8.49	Like it very much	Very Acceptable
7	6.50-7.49	Like it moderately	Moderately Acceptable
6	5.50-6.49	Like it slightly	Slightly Acceptable
5	4.50-5.49	Neither like nor dislike it	Neither Acceptable/Unacceptable
4	3.50-4.49	Didn't like it slightly	Slightly Unacceptable
3	2.50-3.49	Didn't like it moderately	Moderately Unacceptable
2	1.50-2.49	Didn't like it very much	Very Unacceptable
1	1.00-1.49	Didn't like it at all	Highly Unacceptable

RESULTS AND DISCUSSION

Mean and Standard Deviation were used to determine the level of acceptability of coconut (*Cocos nucifera*) flour into twisted doughnut with and without *Moringa* in terms of (a) appearance, (b) color, (c) texture, (d) aroma, and (e) palatability. Results revealed that both the twisted doughnut with and without *moringa* got a highly acceptable level, while in terms of texture, the twisted doughnut with *moringa* ($M= 8.73$ $SD= .52$) is only very acceptable compared to without *moringa* ($M= 8.43$ $SD .62$) which is highly acceptable. Overall, the acceptability of twisted doughnuts with *moringa* ($M= 8.52$ $SD 0.6$) and without *moringa* ($M= 8.57$ $SD 0.55$) are both highly acceptable. The key factors that determine twisted doughnut acceptability are the sensory characteristics of the doughnut since respondents tasted twisted doughnuts with specific sensory properties. Presented in Table 2 is the summary of the results.

Table 2- Level of Acceptability of Coconut (*Cocos nucifera*) Flour into Twisted Doughnut with and without Moringa

Criteria	WITH MORINGA			WITHOUT MORINGA		
	Mean	SD	Description	Mean	SD	Description
Appearance	8.70	0.59	Highly Acceptable	8.80	.040	Highly Acceptable
Color	8.73	0.52	Highly Acceptable	8.60	0.62	Highly Acceptable
Texture	7.97	0.61	Very Acceptable	8.43	0.62	Highly Acceptable
Aroma	8.63	0.61	Highly Acceptable	8.50	0.50	Highly Acceptable
Palatability	8.60	0.67	Highly Acceptable	8.53	0.62	Highly Acceptable
Overall	8.52	0.60	Highly Acceptable	8.57	0.55	Highly Acceptable

This finding is supported by Ramya & Anitha's (2020)[24] investigation into the incorporation of coconut flour into a specific baking product. The researchers found that a specific amount of coconut flour added to the ingredients made the baking product samples more acceptable in terms of their sensory and physicochemical properties [24]. Coconut flour has a delicious, distinctive flavor and scent and is a great source of vitamins, minerals, and dietary fibers, all of which might be used in baked goods and human nutrition. In comparison, baking products containing dried *moringa* leaf powder have higher protein, moisture, crude fiber, and total ash values while having lower levels of lipids and carbohydrates. Researchers have concluded that these baking products have better color, flavor, and aroma [25]. However, adding large concentrations of *moringa* to any food product causes changes in the mechanical qualities, such as texture, hardness, chewiness, volume, and sponginess, which have an adverse effect on consumer acceptability [9]. The overall acceptability of twisted donuts with and without moringa was highly acceptable.

CONCLUSION

The researcher investigated the acceptability of coconut (*Cocos nucifera*) flour into innovative twisted doughnuts with and without *Moringa Oleifera*. Based on the findings of this study, there is evidence to suggest that it is possible to develop baking products based on coconut (*Cocos nucifera*) flour with and without *Moringa oleifera* with highly acceptable sensory properties. The present study confirmed that incorporating coconut flour with and without *Moringa oleifera* into the twisted doughnut formulation improved the products' sensory quality characteristics: appearance, color, texture, aroma, and palatability. However, there is a slight difference between the textures of twisted doughnuts with and without *Moringa oleifera*. This is because the higher the concentration of dried *moringa* leaf powder added to the product, the lower its texture quality is produced. But it does not negatively impact the overall acceptability of the final product investigated in this study. Furthermore, weighing all factors relating to the degree of plant utilization, this study reported that *Cocos nucifera* and *Moringa oleifera* can be

used in the production of nutrient-enriched bakery products, such as twisted doughnut, with significant effects on the final product's composition and high consumer acceptability. With these results obtained, it is clear that the study's tested recipes can be successfully used as an innovative approach to enhance people's nutritional status and health, especially in areas where there is severe poverty or malnutrition.

RECOMMENDATION

It is recommended that these innovative products be made or sold in locations like school canteens where it is acceptable to display affordable, wholesome food. It is also recommended to explore other baking products into which *Cocos nucifera* and *Moringa oleifera* can be incorporated or try other plant ingredients to be used for twisted doughnut making. It is also necessary to carry out more studies to determine the innovative twisted doughnut's salability or business potential and its application on the industrial scale. Finally, qualitative research could be undertaken to understand the consumers' opinions and experiences as to how to improve the product further.

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