INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 26, No. 3, p. 121-128, 2025

RESEARCH PAPER OPEN ACCESS

Formulation and sensory evaluation of coconut pulp (*Cocos nucifera*) cookies

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Key words: Coconut pulp, Cookies, *Cocos nucifera*

http://dx.doi.org/10.12692/ijb/26.3.121-128 Article published on March 08, 2025

Abstract

Coconut pulp is the by-product of the extraction of coconut milk. It is often derived from mature coconut meat from which the coconut milk has been removed. This study aimed to determine the acceptability level of coconut pulp cookies among the three different treatments. Researchers also determine if there is a significant difference in the acceptability level of Coconut Pulp Cookies in terms of color, aroma, taste, texture, flavor and general acceptability in the three different treatments such as 50 grams of Coconut Pulp, 100 grams of Coconut Pulp and 150 grams of Coconut Pulp. A descriptive method was used with the aid of survey questionnaires. Tasting of the products using three treatments were provided to 30 respondents. The one-way ANOVA was used to determine the difference of the acceptability of the different treatments of Coconut pulp cookies. It was found out that the level of coconut pulp added does not significantly affect the acceptability of coconut pulp in terms of color, aroma, taste, texture, flavor and overall acceptability of the product. Furthermore, the three treatments were generally acceptable thus can be produced as an alternative product. Future researchers may also be conducted to develop more products out of Coconut Pulp.

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Introduction

Coconut, also known as the "tree of life", is one of the well-known versatile trees as the whole coconut tree maybe utilized. It has been grown in tropical regions for more than 4,500 years but recently increase in popularity for its flavor, culinary uses, and potential health benefits (Caliskan *et al.*, 2020).

Coconut pulp is normally obtained from mature coconut meat where the coconut milk has been extracted out. As the oil and milk of the coconut have become increasingly popular, this shows that there is a large volume of leftover coconut pulp being thrown away. The leftover coconut pulp is still having high dietary fibre and it is gluten free. Utilization of such by-product which poses a major disposal problem for the coconut industry and its economic potential is an approach towards solving environmental pollution (Ng *et al.*, 2010).

Coconut pulp is from coconuts, so it's going to have the same nutrient profile as a coconut. If you used coconut to make coconut milk then some of the flavor and nutrients from the coconut will be in your milk. But quite a lot of the nutrients will be leftover in the coconut pulp. The coconut pulp has fibre – not much fibre will have transferred from the coconut flakes or coconut meat to your milk. Instead, the good stuff (the fibre) is what's left in the pulp. Fibre is such a key nutrient for overall health, and specifically digestion (Elizabeth, 2020).

The researchers are motivated to conduct a study using the coconut pulp to make a cookie. To raise the value and image of coconut pulp in our society since, we currently discard the coconut pulp after extracting its coconut milk. Why not to use it to make a something delicious such as cookies made from coconut pulp? We not only use increase its value, but we also gain knowledge and ideas about what we are going to do with it or what are other uses there for coconut pulp.

Food is essential in our life, without food, we cannot survive. It is the need of every living organism. Therefore, it is important that we should not waste food. Just like what the researcher does to a coconut pulp. Instead of wasting it, the researchers improvise or use the coconut pulp to make a product or food that is very affordable and most of all the ingredients are not that expensive to acquire in order to produce delicious delicacies like cookies. With that, we avoid wasting food, instead we discover a new product and lessen the chance of having a coconut pulp as a wasted food, and this study would be acceptable in the market. Aside of its benefits they can get a new idea of what other product they can make out of coconut pulp.

Statement of the problem

The main purpose of this study was to determine the acceptability levels of coconut pulp added to the acceptability of cookies as the basis for the proposed extension program during the school year 2022-2023 in Bohol Island State University Calape, Bohol.

Specifically, this study sought to answer the following questions:

1. What is the cost description of coconut pulp cookies with different amount of coconut pulp added in the following treatments?
   - 1.1 50 grams of coconut pulp
   - 1.2 100 grams of coconut pulp
   - 1.3 150 grams of coconut pulp
2. What is the acceptability level of coconut pulp cookies in terms of
   - 2.1 Color;
   - 2.2 Aroma;
   - 2.3 Taste;
   - 2.4 Texture;
   - 2.5 Flavor; and
   - 2.6 Overall acceptability?
3. Is there a significant difference in the acceptability level of the three treatments of Coconut pulp Cookies in terms color, aroma, taste, texture, flavor and overall acceptability?
4. What product promotion can be proposed based on the result of the study?

Statement of hypothesis

There is no significant difference in the acceptability level of the three treatments of Coconut pulp Cookies

in terms color, aroma, taste, texture, flavor and overall acceptability.

Materials and methods

Design

The researchers used the descriptive survey and experimental design in conducting the study. Descriptive survey used rating sheet in gathering the data and describes acceptability level of Coconut pulp Cookies. The sensory evaluation sheet determined any significant difference of the color, aroma, taste, texture, flavor and overall acceptability of the three treatments such Treatment 1, 50 grams of coconut pulp, Treatment 2, 100 grams of coconut pulp and Treatment 3, 150 grams of coconut pulp.

Environment and respondents

This study was conducted in the Municipality of Calape and Loon, Bohol, Philippines. In selecting the respondents purposive sampling was used. This study was composed of 30 respondents. The selected respondents were the Bakers (12), Bohol Province Institute TLE Teachers (3), MARTNSF Teachers (5), Students of BSIT-Food Technology (6) and CTAS Instructors (4) who have the capacity to give the necessary data regarding the study. The respondents were classified as food experts whom they have a high degree of skills and knowledge of food that would greatly contribute to a just assessment the product sample.

Research Instrument

In order to make this research work possible, the researchers used the constructed questionnaire to determine the color, aroma, taste, texture, flavor and overall acceptability of the Formulation and Sensory Evaluation of Coconut Pulp Cookies in three different treatments.

The constructed questionnaires were provided with nine options in which the respondents can answer in neutrality over an indicator asked. Rating scale interpretation such as (9) like extremely, (8) like very much, (7) like moderately, (6) like slightly, (5) neither like nor dislike, (4) dislike slightly, (3) dislike moderately, (2) dislike very much, (1) dislike extremely. The highest descriptive made like extremely and the lowest is dislike extremely. Rating scale allowed the researchers to measure the options and behaviour of respondents in a quantitative manner. Without the proper survey scaling information runs the risk of containing bases and negatively impacts the survey results.

Research procedure

1. *Approval of the study and preparation of the questionnaires to be used*

The researchers asked permission to the Dean of the College of Technology Allied Sciences, Research Development and Extension (RDE) Director with the approval of Campus Director, then to the Principals of MARTNSF, BPI, Bakers before conducting this study. Researchers prepared the questionnaires before the sensory activity.

2. *Preparation of ingredients tools and equipment, and procedure*

In preparation of Coconut Pulp Cookies, the following were the treatments: T1-50 grams of Coconut pulp, T2-100 grams of Coconut pulp, T3-150 grams of Coconut pulp. Its ingredients were coconut pulp, flour, baking powder, egg, sugar, vanilla, butter. All these ingredients were used in the treatments and carefully demonstrated by the researcher.

3. *Steps in making coconut pulp cookies*

1. Gather coconut pulp.
2. Remove the unnecessary coconut shell that is being included in the coconut pulp during the grating process.
3. Then prepare all the ingredients.
4. Separate the liquid ingredients like 50 grams of butter, 200 grams of sugar, 15ml vanilla, and 1 pc of egg to the dry ingredients like 375 grams of all- purpose flour, 15 grams baking powder and the coconut pulp.
5. In a mixing bowl, mix the 50 grams butter and 200 grams sugar. Then, pour the 1 pc of egg and 15ml vanilla. And mix it well.

6. In the other mixing bowl, sift the flour and baking powder. Then, gradually, add the dry ingredients and the coconut pulp T1 50 grams, T2 100 grams then T3 150 grams to the liquid ingredients. Then mix.
7. Knead the dough thoroughly until it becomes soft and smooth.
8. Rest the dough for at least 5 minutes. After that, flatten the dough using rolling pin. Then mold it, to the cookie molder.
9. Place the cookies in the baking pan.
10. Preheat the oven in about temperature of 350˚F (177˚C).
11. Then put the cookies in the oven and bake for 8-10 minutes.
12. When cooked, get the cookies out from the oven and let it cool for about 3-5 minutes.
13. Pack the coconut pulp cookies.

4. *Testing the product for the development and distribution of questionnaires on the coconut pulp cookies*

The Coconut Pulp Cookies was presented to the respondents for tasting who were the CTAS Instructors in BISU- Calape, Bohol Province Institute TLE Teachers, Mayor Anunciacion R.

Tuazon National School of Fisheries Teachers, Bakers, Student of BSIT- Food Technology. The researchers provided bottled water to all respondents' right after tasting for each treatment and gave an interval time of 5 minutes to distinguish the different taste of the products.

Upon the distribution of the sample of the products, the sensory evaluation sheet was given to the respondents in order to identify the respondent's response to Coconut Pulp Cookies with different treatments in terms of color, aroma, taste, texture, flavor and general acceptability. To ensure that the respondents answered the rating sheets sincerely, clear instruction and enough time were given to the respondents.

The sensory evaluation sheet was then retrieved immediately, tallied, computed and interpreted for the conclusion of the study.

Statistical treatment

To be able to attain scientific evidence and answers to the research problems, the following statistical tools were used.

Frequency (f) and percent (%) were used to determine the sensorial description of the Coconut pulp Cookies such as color, aroma, taste, texture, and flavor.

Mean (M) was used to describe the acceptability of Coconut pulp Cookies in terms of color, aroma, taste, texture, flavor, and overall acceptability. It is interpreted as follows:

One-way factorial Analysis of Variance (ANOVA) applying bootstrapping with 95% Bias corrected to test if there is significant difference on the acceptability of the three treatments of Coconut Pulp Cookies in terms of color, aroma, taste, texture and general acceptability.

Bootstrapping is robust estimation method for reducing bias associated with normality, homogeneity of variance, and sampling. The sample data are treated as a population from which smaller samples (called bootstrap samples) are taken, putting each score back before a new one is drawn from the sample available. Probability values are compared at 0.05 level of significance used IBM SPSS Statistics Trial Version (Duncan, 1955).

Results and discussion

General acceptability

Table 1 shows the general acceptability evaluation is essential in sensory analysis, as it provides valuable information about consumer preferences and can help manufacturers optimize product formulations to meet these preferences (Jaeger *et al.*, 2018). In color, it shows that 50 grams of coconut pulp (M = 8.00), 100 grams of coconut pulp (M = 8.00), and 150 grams of coconut pulp (M = 8.03) are liked very much by the respondents since the color of the cookies is just right.

Table 1. Acceptability of coconut pulp cookies (n = 30)

Sensory attributes	Treatment					
	1		2		3	
	50 grams of coconut pulp		100 grams of coconut pulp		150 grams of coconut pulp	
	Acceptability		Acceptability		Acceptability	
	M	Inter.	M	Inter.	M	Inter.
Color	8.00	LV	8.00	LV	8.03	LV
Aroma	7.97	LV	7.80	LV	7.87	LV
Taste	7.93	LV	7.93	LV	8.00	LV
Texture	7.60	LV	7.63	LV	7.93	LV
Flavor	7.77	LV	7.77	LV	7.90	LV
General	8.03	LV	7.90	LV	8.13	LE

One of the factors that affect the color of the baked goods is sugar. During baking, sugar, amino acids, peptides and proteins go through a process known as the Mallard Reaction. Heat breaks the sucrose into the simple sugar's glucose and fructose, giving each cookie a shiny, light brown crust (Helmenstine, 2019). Therefore, the increasing of coconut pulp added did not affect the color of the cookies and there are no compound elements of Coconut pulp that can affect the color of the cookies. This means that the three treatments have the same color and both acceptable to the respondents.

In aroma, it shows that 50 grams of coconut pulp (M = 7.97), 100 grams of coconut pulp (M = 7.80), and 150 grams of coconut pulp (M = 7.87) are liked very much by the respondents. Early studies have shown that the key aroma compounds of coconut meat are δ-lactones, δ-octalactone and δ-decalactone. The lactone which dominates the fragrance of coconut is gamma-nonalactone but more commonly referred to as coconut lactone (Lin and Wilkens, 1970). Therefore, the aroma of the coconut pulp cookies was influenced by the lactones that are found in the coconut pulp. The results revealed that the higher the coconut pulp added, the more it will develop a creamy coconut aroma making the cookie more acceptable.

In taste, the 50 grams of coconut pulp (M = 7.93), 100 grams of coconut pulp (M = 7.93), and 150 grams of coconut pulp (M = 8.00) are liked very much by the respondents since the taste of the coconut pulp cookies is not too sweet and just meet the taste preferences of the respondents.

Coconut can be described as slightly sweet and nutty. It has a rich, creamy texture and a delicate flavor that is distinctively tropical. The sweetness can vary depending on the maturity of the coconut. Mature coconuts have firmer flesh and a slightly more pronounced nutty flavor (Seasonal and Savory, 2023). As a result, the more coconut pulp added the more acceptable and sweeter the taste will be.

In texture, the 50 grams of coconut pulp (M = 7.60), 100 grams of coconut pulp (M = 7.63), and 150 grams of coconut pulp (M = 7.93) are liked very much by the respondents. The fiber content can enhance the texture of the product. Therefore, the fiber level of the coconut pulp influences the texture of the cookies made with it. As a result, the higher the amount of coconut pulp added the softer the coconut pulp cookies will be.

In flavor it shows that the 50 grams of coconut pulp (M = 7.77), 100 grams of coconut pulp (M = 7.77), and 150 grams of coconut pulp (M = 7.90) are liked very much by the respondents. The class of compounds which responsible for this is the lauric acid. Lauric acid is a saturated fatty acid that is abundant in coconut pulp. It contributes to the creamy and rich taste of coconut. In addition, short-chain lactones in the solid endosperm of coconut that have been reported to be responsible for the flavour of coconut flesh (Lin, 1970). Therefore, the flavor of the coconut pulp was influenced by the lauric acid and the lactones in the solid endosperm of the coconut pulp. This means that the more coconut pulp added, the more pleasant the flavour is.

Table 2. Test of hypotheses on the differences of the acceptability of coconut pulp cookies (n = 30)

Sensory attributes	F	p	Decision	Result
Color	.016	.984	Retain Ho	Insignificant difference
Aroma	.258	.773	Retain Ho	Insignificant difference
Taste	.067	.935	Retain Ho	Insignificant difference
Texture	1.157	.319	Retain Ho	Insignificant difference
Flavor	.244	.784	Retain Ho	Insignificant difference
General acceptability	.585	.559	Retain Ho	Insignificant difference

F-value is determined with 2 degrees of freedom between groups and 87 degrees of freedom within groups. F-value is based on Bias corrected and accelerated bootstrap 95% confidence intervals. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples. If "Reject *Ho*", statistic is significant since $p \leq 0.05$. If "Failed to Reject *Ho*", statistic is insignificant since $p > 0.05$.

In terms of general acceptability, Treatment 2 (M = 7.90) are described as "Like Very Much" and was least acceptable. Moreover, Treatment 3 got the highest mean of (M = 8.13) described as "Like Extremely" and the most acceptable. This means that the higher the level of coconut pulp the more desirable and acceptable it is, compared to other treatments.

Test of significant difference on the acceptability of the formulation and sensory evaluation of coconut pulp cookies

Cookie is a baked or cooked food that is small, flat and sweet. It usually contains flour, sugar and type of oil and may include other ingredients such as raisins, oats chocolate chips and nuts (Libby, 2015). The Table 2 shows the results of One-way analysis of variance test of significant difference on the Formulation and Sensory Evaluation of Coconut Pulp Cookies in terms of color, aroma, taste, texture, flavor and overall acceptability.

The respondents' ratings on the three treatments were tabulated and subjected to the one-way ANOVA. Table 2 reveals the test of hypothesis, analysis, and interpretation of results based on the evidence gathered in terms of color, aroma, taste, texture, flavor and overall acceptability. The results revealed that color, the F (2,87) = .016, p = .984; aroma, F (2,87) = .258, p = .773; taste F (2,87) = .067, p = .935; texture, F (2,87) = 1.157, p = .319; flavor, F (2,87) = .244, p = .784; general acceptability F (2,87) = .585, p = .559 exhibited no statistically significant differences among the three treatments of coconut pulp cookies. Thus, the null hypothesis was accepted. This implies that the amount of coconut pulp in the three treatments did not affect the acceptability of coconut pulp cookies across all sensory attributes such as color, aroma, taste, texture, flavor and general acceptability. The p-value indicates the probability that an observed result (or one more extreme) could have occurred by chance, assuming that the null hypothesis is true. If the probability is ≤ the pre-decided significance level (e.g., ≤1 in 20, P ≤0.05), the null hypothesis is rejected, which supports the complementary hypothesis that there is a true difference between the groups (Myles, 2002).

Conclusion

From the findings, the researchers concluded that the three treatments were acceptable with respect to the overall acceptability of coconut pulp cookies specifically in terms of Color, Aroma, Taste, Texture and Flavor. Furthermore, since the three treatments are generally acceptable, the researchers believed that the study will be useful in reducing the amount of coconut pulp that is discarded after extracting the milk from it. Extension program could be implemented to inform of its viability for home consumption as well as additional source of income.

Recommendations

Based on the conclusion/findings drawn from the study, the researchers will recommend the following:

1. Any of the three treatments can be used in making a coconut pulp cookie since they are equally acceptable.
2. The product can be introduced in both school and community for entrepreneurial activities.

3. To also encourage everyone to utilize the Coconut pulp that is being wasted in the environment, this product could be introduced to the consumers to develop their way of preparing the coconut pulp cookies.
4. Future researchers may conduct an extension study to create more recipes out from coconut pulp.

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