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Concocting Bougainvillea *(Bougainvillea Spectabilis)* Petal Cookies With Cacao *(Theobroma Cacao L.)* Pod Husk Powder And Nibs

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Abstract

This study was conducted to determine the potential benefits of bougainvillea (Bougainvillea spectabilis) petals, cacao (Theobroma cacao l.) pod husk powder, and nibs and to promote affordable healthy snacks for consumers' wellness. Four treatments were utilized as follows: Treatment 1 (APF 350g, Bougainvillea Petals 25g, Cacao Nibs 15g, CPHP 5g), Treatment 2 (APF 350g, Bougainvillea Petals 50g, Cacao Nibs 15g, CPHP 10g), Treatment 3 (APF 350g, Bougainvillea Petals 75g, Cacao Nibs 15g, CPHP 15g), Treatment 4 (APF 350g, Bougainvillea Petals 100g, Cacao Nibs 15g, CPHP 20g). The 9-point Hedonic Scale was used for sensory evaluation to determine the acceptability of the Bougainvillea (Bougainvillea spectabilis) Petals Cookies with Cacao (Theobroma cacao l.) Pod Husk Powder and Nibs. The quality attributes tested were color/appearance, texture/crunchiness, odor/aroma, taste/flavor, and general acceptability. Thirty (30) respondents were selected as judges, with some from the faculty and staff of Cagayan Valley Cacao Development Center, Isabela State University, Echague Campus, and others from residents of Liwayway, Diffun, Quirino, with age ranging from 18 to 60. Treatment 4 was rated "like very much" in terms of color/appearance and "like extremely" in terms of odor/aroma by the respondents. The statistical analysis showed no significant differences in taste/flavor and odor/aroma of cookies between treatments. However, Treatment 3 received the highest rating from the respondents in terms of texture/crunchiness, taste/flavor, and overall acceptability, with a qualitative description of "like very much." Hence, among all treatments, Treatment 3 was the most acceptable. The Return on investment per 100 pieces of bougainvillea (Bougainvillea spectabilis) petals cookies with cacao (Theobroma cacao l.) pod husk powder and nibs revealed that Treatment 1 provided the best ROI and that production was more profitable for a business venture.

Keywords: *Cookies, Bougainvillea, Cacao, Pod Husk, Nibs*

INTRODUCTION

Food is a necessary aspect of existence, supplying us with the nutrition we require to survive, but the pandemic has thrown the entire food chain into turmoil. Lack of enough food, along with labor constraints, fragmented supply chains, and anxiety of health risks, could lead to the lack of proper nutrition and food scarcity. This is why the COVID-19 pandemic has brought attention to the need for improved eating habits and has prompted food manufacturers to develop new products and alleviate the negative effects on the food chain.

Existing observatories, both globally and nationally, are aware of these changes to assist businesses in re-directing their manufacturing operations. As a result, this provides a wonderful opportunity for researchers to develop and innovate new food products through research and development that will address the current situation. This study focused on increasing consumer health and wellness through goods fortified with high biological value proteins, vitamins, minerals, and, most importantly, dietary fiber. Indeed, micronutrient-rich meals (vitamins and minerals), functional foods containing bioactive molecules (antioxidants, anti-inflammatory chemicals, and immune boosters), herbs, spices, dietary fibers, and probiotics help enhance the immune system and fight viral infections. Introducing this new study of cookies concocted with Bougainvillea petals and cacao pad husk powder and nibs promotes a quality product containing health boosters.

Bougainvillea, also known as bugambilia or bougies, is a prominent ornamental plant in some countries, specifically in the Philippines, which can be found in public areas. Sometimes it is within house front yards and used as a fence. Bougainvillea glabra is indicated for the treatment of coughing and is recommended for asthma. It is also used in other respiratory conditions, including lung pain, flu, and bronchitis. The most acknowledged health benefit is the ability to deal with respiratory problems like relieving sore throat, and many more (Vargas et al. 2018).

In addition, the page of Dr. Farrah MD accentuated the medicinal uses of the bougainvillea flower. It helps treat cough since bougainvillea has an expectorant property that helps get rid of mucus from the respiratory tract, thereby boosting cough recovery. For this purpose, the flower and bracts are allowed to steep in boiling water for several minutes and then consumed to promote normal breathing. Also, since bougainvillea has antipyretic effects, the consumption of tea made from its flowers can be an effective remedy for reducing fever.

On the other hand, cacao, or *Theobroma cacao*, is a small evergreen tree with a trunk diameter of 30 cm and a height of 8 meters. Cacao beans are the seeds that are used to manufacture chocolates, while the fruit pulp can either be eaten raw or turned into juices. Cacao is mostly grown for food, but it also has medicinal properties. It stimulates the neurological system, lowers blood pressure, dilates coronary arteries, and soothes and softens damaged skin, among other things. Anemia, angina, bruising, chapped skin, burns, diarrhea, and leprosy spots are all treated. However, many of us are still unaware of the possible uses of cacao pod husk and nibs. Typically, after getting cacao seeds, these pod husks and nibs are used as compost to provide nutrients for crops or livestock.

This development of Bougainvillea *(Bougainvillea spectabilis)* Petals Cookies with Cacao *(Theobroma cacao l.)* Pod Husk Powder and Nibs contribute to the achievement of the United Nations' Sustainable Development Goals, which aid in the reduction of poverty and hunger and the attainment of food security, increased nutrition, and the creation of sustainable agriculture. Food insecurity is one of the global challenges we are facing. The sudden cause of the increase in food insecurity is due to job losses caused by the pandemic, so this research is also a great opportunity for livelihood and in support of farmers' cacao production. Raising Bougainvillea plants and cacao trees provides an additional source of income, and the ingredients produced by these raw materials have the potential to compete in large categories where the researchers can offer healthier options and have the greatest impact on consumer

wellness and for our loved ones.

Statement of the Problem

This study was conducted to determine the potential benefits of bougainvillea *(Bougainvillea spectabilis)* petals cookies with cacao *(Theobroma cacao l.)* pod husk powder and nibs through cookies and to promote a healthy daily food chain.

Specifically, it aimed to answer the following questions:

1. What is the process of developing bougainvillea *(Bougainvillea spectabilis)* petals cookies with cacao *(Theobroma cacao l.)* pod husk powder and nibs?
2. What is the level of acceptability of bougainvillea *(Bougainvillea spectabilis)* petals cookies with cacao *(Theobroma cacao l.)* pod husk powder and nibs in terms of color/appearance, taste/flavor, crunchiness/ texture, odor/aroma, and general acceptability?
3. How much profit can be derived from the product when sold to market?

Literature Review

The present study was taken to thoroughly standardize the weed in compliance with criteria and standard lab protocols of the World Health Organization (WHO). "The qualitative and quantitative parameters of the Bougainvillea glabra were evaluated for extraction, standardization, and phytochemical screening. In order to examine their dominance, protection, and standardization for their healthy usage, the whole plant in Bougainvillea glabra was extensively researched on its organoleptic character, physical-chemical characteristics, and main active constituents. Each parameter value has been found to be within limits prescribed by the WHO. The plant extracts of bougainvillea glabra have been contained in chloroform, ethyl acetate, and methanol extracts, as shown in phytochemical tests and TLC. The research findings also suggest that the Bougainvillea glabra leaves of the plant may be used to cure different diseases, such as cancer and cardiac diseases, among others. The knowledge produced by the present study shall provide details that will help recognize, authenticate, and prevent adulteration of this medicinal plant (Tiwari et al., 2020).

According to Katz et al. (2011), cocoa, or cacao, is the dried and fully fermented fatty seed of the fruit of the cocoa tree, Theobroma cacao. Cocoa liquor is the paste made from ground, roasted, shelled, and fermented cocoa beans called nibs. It contains both nonfat cocoa solids and cocoa butter. Cocoa liquor is referred to as "percent cacao" on food packaging. Cocoa powder is made by removing some cocoa butter from the liquor. Chocolate is solid food that combines cocoa liquor with cocoa butter and sugar. The proportion of cocoa liquor in the final product determines how dark the chocolate is. Milk chocolate is made with the addition of condensed or powdered milk to the chocolate mixture. The type of chocolate consumed most in the United States is milk chocolate, typically containing 10%–12% cocoa liquor. Semisweet or bittersweet chocolate is often referred to as dark chocolate and must have no less than 35% by weight of cocoa liquor. White chocolate contains only cocoa butter (at least 20% by weight) combined with sweeteners and dairy ingredients.

According to Ospina (2021), the cocoa pod husk powder is considered a source of dietary fiber with a high content of water-soluble pectins, and bioactive compounds, which

should be viewed as a by-product with the potential to be incorporated into food. This study aimed to investigate the effect of adding different cocoa pod husk flour (CPHF) levels as a starch replacement for reformulating frankfurters. Results showed that the addition of 1.5 and 3.0% pod husk proportionally increased the frankfurter's fiber content by 0.49 ± 0.08 and 0.96 ± 0.19 g/100 g, which is acceptable for a product that does not contain fiber. Textural properties and sensory characteristics were affected when substituting the starch with CPHF, either totally or partially, although these samples had higher water content, hardness, and adhesiveness while springiness decreased. Non-adverse effects of nitrite on polyphenolic compounds content were evidenced in samples enriched with CPHF. The incorporation of CPHF did not significantly affect the color parameters (ΔE < 3). Finally, the panelists indicated a sensation of the unsalted sausage, suggesting that CPHF may have natural mucoadhesion properties. In conclusion, in formulated meat products such as sausages, plant co-products such as cacao pod husks could be a valid new ingredient to improve technological parameters, functional characteristics, and stability.

METHODOLOGY

Equipment Tools and Utensils

In preparing the bougainvillea *(Bougainvillea spectabilis)* petals cookies with cacao *(Theobroma cacao l.)* pod husk powder and nibs, the following equipment, tools and utensils were used: oven, baking sheet, portioning bowl, mixing bowl, strainer/shifter, measuring spoon, measuring cup, liquid measuring cup, hand mixer, and wooden ladle.

Collection and Preparation of Materials

Bougainvillea *(Bougainvillea spectabilis)* petals were collected fresh from Liwayway, Diffun, Quirino while Cacao *(Theobroma cacao l.)* Pod Husk Powder was collected from Cagayan Valley Cacao Center, ISU- Echague, Echague, Isabela Province.

Ingredients and Materials

Table 1 shows the proportion of ingredients used in concocting bougainvillea petal cookies with cacao pod husk powder and nib.

Table 1. Proportion of Ingredients Used in Concocting Bougainvillea *(Bougainvillea spectabilis)* Petals Cookies with Cacao *(Theobroma cacao l.)* Pod Husk Powder and Nibs

INGREDIENTS	T1	T2	T3	T4
All Purpose Flour	350g	350g	350g	350g
Butter	150g	150g	150g	150g
Brown Sugar	150g	150g	150g	150g
White Sugar	120g	120g	120g	120g
Egg	106g	106g	106g	106g
Bougainvillea Petals	25g	50g	75g	100g
Cacao Nibs	15g	15g	15g	15g
Cacao Pod Husk Powder	5g	10g	15g	20g
Vanilla	10g	10g	10g	10g
Baking Powder	5g	5g	5g	5g
Salt	5g	5g	5g	5g

Formulation of Bougainvillea Cookies

The first step in making bougainvillea *(Bougainvillea spectabilis)* petals cookies with cacao *(Theobroma cacao l.)* pod husk powder and nibs is to collect bougainvillea petals, wash these, and prepare all the materials. Measure the ingredient's proportion using the weighing scale. Preheat the oven to 300-350°F and prepare the baking sheet by brushing it with butter/shortening and finely covering it with wax or parchment paper. After prepping the oven and baking sheet, wash and chop the bougainvillea petals into small pieces. Next, sift together measure all the dry ingredients, including the cacao powder, and combine them in a large mixing bowl (dry ingredients should be combined thoroughly in one bowl before adding liquids). Now, one at a time, add the eggs and combine them with the dry ingredients. Fold in the bougainvillea petal and place the mixture in cling wrap to form a ball and chill for 15-30 minutes. After chilling, scoop the mixture into a flat circle before placing on a baking sheet and sprinkle the cacao nibs on top before baking for 8-10 minutes or until done.

Treatments of the Study

The different proportional levels of Concocting Bougainvillea *(Bougainvillea spectabilis)* Petals Cookies with Cacao *(Theobroma cacao l.)* Pod Husk Powder and Nibs used as a treatment in this study were as follows:

T1= APF (350g), Bougainvillea Petals (25g), Cacao Nibs (15g), CPHP (5g)
T2= APF (350g), Bougainvillea Petals (50g), Cacao Nibs (15g), CPHP (10g)
T3= APF (350g), Bougainvillea Petals (75g), Cacao Nibs (15g), CPHP (15g)
T4= APF (350g), Bougainvillea Petals (100g), Cacao Nibs (15g), CPHP (20g)

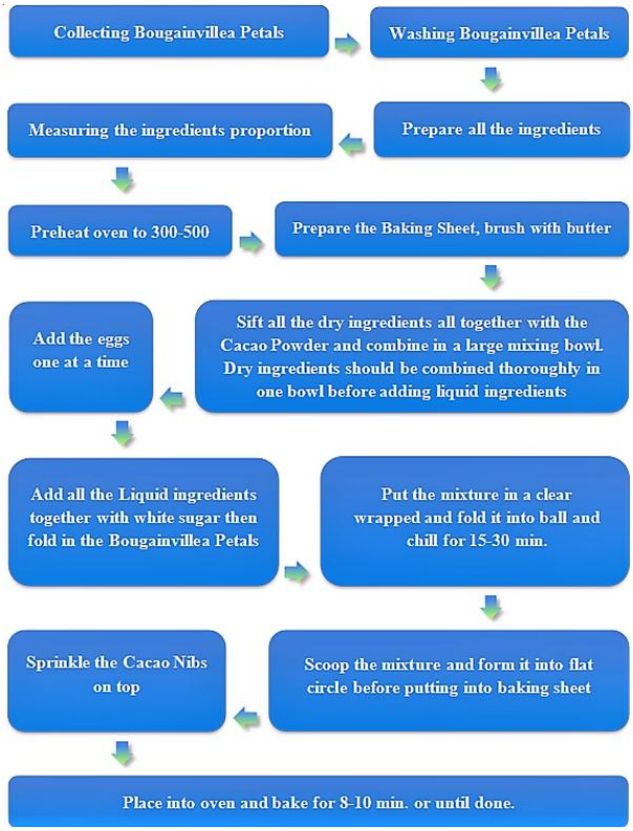

Figure 1. Flow Chart in Concocting Bougainvillea *(Bougainvillea spectabilis)* Petals Cookies with Cacao *(Theobroma cacao l.)* Pod Husk Powder and Nibs

Sensory Evaluation

Sensory evaluation was conducted at the Cagayan Valley Cacao Development Center, Isabela State University, Echague Campus, and Purok 2, Liwayway, Diffun, Quirino to determine the acceptability of the concocting bougainvillea *(Bougainvillea spectabilis)* petals cookies with cacao *(Theobroma cacao l.)* pod husk powder and nibs in terms of color/appearance, taste/flavor, odor/aroma, and general acceptability of concocting bougainvillea *(Bougainvillea spectabilis)* petals cookies with cacao *(Theobroma cacao l.)* pod husk powder and nibs. The instrument for data gathering used a score sheet of the 9-Point Hedonic Scale.

A sensory respondent of thirty (30) individuals was selected at random from the faculty and staff of the Cagayan Valley Cacao Development Center, Isabela State University, Echague Campus, and the residents of Liwayway, Diffun, Quirino. The qualified respondents ranged from 18 to 60 years old, composed of 13 males and 17 females. They were screened during the sensory evaluation to ensure that they were not smokers, did not consume alcohol, and were in good health.

The respondents performed the sensory evaluation of one (1) piece of each treatment sample. They were asked to sensory evaluate and rate the treatment samples based on their color/appearance, taste/flavor, crunchiness/texture, odor/aroma, and overall acceptability using the Hedonic scale ratings. The respondents were required to rinse their mouths before tasting each sample, which was strictly enforced as a standard procedure to ensure the study's credibility and validity.

Statistical Data Analysis

Results of the sensory evaluation were statistically analyzed using a one-way classification analysis of variance (ANOVA). The F test, mean, and descriptive statistics were used to determine if there is a significant difference between treatments in terms of color/appearance, taste/flavor, odor/aroma, and overall acceptability.

RESULTS AND DISCUSSION

Color/Appearance

The color/appearance of cookies with bougainvillea *(Bougainvillea spectabilis)*, cacao *(Theobroma cacao l.)* pod husk powder, and cacao nibs is presented in Table 2. Statistically, significant differences are recorded in which cookies in Treatment 4, Treatment 3, and Treatment 2 obtained a more vibrant color and appearance with mean values of 8.00, 7.97, and 7.77, respectively. However, the latter treatment (T_2) is comparable with the color/appearance of cookies from Treatment 1 with a mean of 7.37. Treatment 4 has the highest score perceived by the panelists with a qualitative description of "Like very much". Treatment 1 has the lowest score with a mean of 7.37 and a qualitative description of "Like moderately". This means that the panelists perceived that Treatment 4 has the vibrant color/appearance of the other treatment.

Table 2. Acceptability and Differences of the Three Treatments in Terms of Color/Appearance, Taste/Flavor, Odor/Aroma, and General Acceptability

Criteria	Treatments	Mean	Desc.	C.V. (%)	LSD	Interpretation
Color/ Appearance	T1	7.37b	Like Moderately	11.75	0.47	Significant
	T2	7.77ab	Like Very Much			
	T3	7.97a	Like Very Much			
	T4	8.00a	Like Very Much			
Taste/Flavor	T1	7.87	Like Very Much	10.68	-	Not Significant
	T2	7.97	Like Very Much			
	T3	8.03	Like Very Much			
	T4	7.97	Like Very Much			
Odor/Aroma	T1	8.13	Like Very Much	7.90	-	Not Significant
	T2	8.20	Like Very Much			
	T3	8.27	Like Very Much			
	T4	8.53	Like Extremely			
Crunchiness/ Texture	T1	7.50b	Like Very Much	9.82	0.53	Highly Significant
	T2	7.87ab	Like Very Much			
	T3	8.23a	Like Very Much			
	T4	8.13a	Like Very Much			
General Acceptability	T1	7.73b	Like Very Much	8.71	0.48	Highly Significant
	T2	8.17ab	Like Very Much			
	T3	8.40a	Like Very Much			
	T4	8.13ab	Like Very Much			

The results strengthen the statement of Sharif et al. (2017) that appearance is the first characteristic perceived by the human senses and play an important role in the identification and final selection of food. This visual perception of food comprised color, shape, size, gloss, dullness, and transparency. The appearance of a meal has shown an impact on appetite stimulation or depression, resulting in pleasure or total depression. This shows that appearance is important in the final selection of food since it influences the consumer's appetite stimulation. Before the product ever touches the lips, the appearance of a meal or beverage influences craveability and acceptability. This is due to the fact that we consume with our eyes before we smell or taste.

Taste/Flavor

Table 2 also shows the taste/flavor of cookies with bougainvillea *(Bougainvillea spectabilis)*, cacao *(Theobroma cacao l.)* pod husk powder, and cacao nibs. The statistical analysis shows no significant differences in the taste/flavor of cookies among the treatments, with mean values ranging from 7.87 to 8.03. Treatment 3 has the highest score perceived by the panelists with a qualitative description of "Like very much". However, the four treatments have shown no significant difference in terms of taste/flavor.

This finding supports Harper (2019) who stated that the top consideration for today's consumer across the bakery, patisserie and chocolate segments is taste. The experience and personalization around food are also crucial, and leading an ethical lifestyle is of growing importance. Taste is the first consideration for consumers when selecting or consuming baked goods. That is why taste is so important in food selection.

Odor/Aroma

The odor/aroma of cookies with bougainvillea *(Bougainvillea spectabilis)*, cacao

(Theobroma cacao l.) pod husk powder and cacao nibs is shown in the same table. The analysis shows no differences in the odor/aroma of cookies among the treatments, with means ranging from 8.13 to 8.53. Treatment 4 has the highest score perceived by the panelists with a qualitative description of "Like extremely". Treatment 1 has the lowest score with a mean of 8.13 and a qualitative description of "Like very much". This means that the panelists perceived that Treatment 4 has the most acceptable odor/aroma than the other treatment.

Sharif et al. (2017) cited that aroma is the first cousin of taste. A pleasant smell makes food delicious. To provoke a sensation of smell, the stuff must be in a gassy state. Furthermore, aroma is valuable in perceiving fresh, rancid, or intermittently poisonous food. It can aid in stimulating consumers' taste preferences as well as in determining whether a product is poisonous or rotten.

Crunchiness/Texture

The crunchiness/texture of cookies with bougainvillea *(Bougainvillea spectabilis)*, cacao *(Theobroma cacao l.)* pod husk powder, and cacao nibs is presented in the same table. The analysis of variance recorded significant variations among treatments wherein Treatment 3, Treatment 4, and Treatment 2 are crunchier in texture with means of 8.23, 8.13, and 7.87, respectively. Yet, the texture of the latter treatment (T_2) is comparable with Treatment 1, with a mean value of 7.50. Treatment 3 had the highest score perceived by the panelists with a qualitative description of "Like very much". Treatment 1 has the lowest score with a mean of 7.50 and a qualitative description of "Like very much". This means that the panelists perceived that Treatment 4 is crunchier than the other treatment.

This supports the statement of Blanchard (2019) that texture is the manifestation of structural, mechanical, and surface properties of a material. It represents a key characteristic of food materials. It reflects food quality and freshness perception influencing consumer acceptance. Studies encountered in the scientific literature devoted to cereal-based foods texture are foremost based on bread and biscuits, scarcely on cakes.

General Acceptability

In general, cookies out of Treatment 3, Treatment 2, and Treatment 4 are more accepted by the participants with means of 8.40, 8.17, and 8.13, respectively. However, the acceptability of cookies made from Treatment 2 (8.17) and Treatment 4 (8.13) is comparable with Treatment 1 with a mean value of 7.73. Treatment 3 has the highest score perceived by the panelists with a qualitative description of "Like very much". This means that Treatment 3 is the most acceptable among the treatments.

The findings support Maina (2018), who stated that the structure of food acceptability is both variable and dynamic among individuals in different groups and the same individuals in different periods and contexts. In other words, general acceptability is directly proportional to its interaction with the consumer at any given time. The sensory characteristics of food are important factors in determining general acceptability because consumers seek foods with specific sensory properties. Consumer characteristics and food enjoyment are two other critical factors directly influencing meal or overall acceptability.

Cost and Return Analysis

Table 3. Cost and Return Analysis of Cookies with Bougainvillea *(Bougainvillea spectabilis)*, Cacao *(Theobroma cacao l.)* Pod Husk Powder, and Cacao Nibs

TREATMENTS	COST OF PRODUCTION	GROSS INCOME	NET INCOME	ROI (%)
Treatment 1	222.35	300.00	77.65	34.92
Treatment 2	243.35	300.00	56.65	23.28
Treatment 3	264.35	300.00	35.65	13.49
Treatment 4	285.35	300.00	14.65	5.13

The return on investment per 100 pieces of bougainvillea *(Bougainvillea spectabilis)* petals cookies with cacao *(Theobroma cacao l.)* pod husk powder and nibs were calculated, summarized, and shown in Table 7. Based on the table, Treatment 1 has a return on investment of 34.92%, while Treatment 2 has a return on investment of 23.28%. Treatment 3 has a return on investment of 13.49 %, while Treatment 4 has a return on investment of 5.13%. This suggests that Treatment 1 provides the highest ROI and that production is more profitable for a business venture. However, given the customer preferences, we will use Treatment 2 to meet the general acceptability of Treatment 3.

This strengthens the statement of Parker (2021) that the use of plant-based ingredients in the cookie category and many other categories is growing. This past August, Ingredion completed a proprietary study with free-from consumers. In the cookie category, 83 percent of consumers showed interest in a plant-based cookies. According to this study, baking cookies with plant-based ingredients like bougainvillea, cacao pod husk powder, and nibs is a good idea, especially since consumers are interested in plant-based cookies.

Conclusions

Based on the results of the study, the following conclusions are delivered:

1. In terms of color/appearance, Treatment 4 was the most acceptable. In terms of taste/flavor, Treatment 3 was the most acceptable. In terms of odor/aroma, Treatment 4 was the most acceptable. In terms of crunchiness/texture, Treatment 3 was the most acceptable. Treatment 3 was the most acceptable in terms of general acceptability among the four treatments.
2. In terms of color/appearance, there was a significant difference among the treatments. There were no significant differences among the treatments in terms of flavor/taste and odor/aroma.
3. In terms of crunchiness/texture, the analysis of variance recorded significant variations among treatments. Furthermore, in terms of profit, the production of Treatments 1 and 2 was more profitable for business ventures.

Recommendations

Based on the results of the study, the following recommendations are given:

1. Shelf-life analysis is advised to be conducted to determine the stability of the products.

2. Microbial analysis is encouraged to be conducted to determine the microbial content of the

finished products.

3. Nutrient content of the product is highly recommended to be analyzed to determine the nutrition facts of the products.

4. Further research is recommended to be conducted on the production of bougainvillea petals cookies with cacao pod husk powder and nibs.

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