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# Formulation, Analyses, and Acceptability of Crackers with Medicinal Leaves

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**Abstract**: Snacks provide energy between meals, especially during periods of intense work. Crackers are among the most popular snack foods enjoyed by people of all ages. More than just a convenient treat, they embody versatility, affordability, and innovation in food production. This experimental-developmental research aimed to develop and evaluate a healthier version of crackers fortified with medicinal leaves. Ten semi-trained panelists assessed the sensory qualities of the crackers in terms of appearance, aroma, taste, and texture, while 100 consumers evaluated the general acceptability using a 9-point Hedonic scale. The study employed a Completely Randomized Design (CRD), with data analyzed through mean and ANOVA. In addition, the research examined the microbial safety, shelf-life, and nutritional content of the best treatment. For sensory qualities, three (3) treatments (Treatment A- 10 grams, Treatment B- 15 grams, Treatment C- 20 grams) of each crackers incorporating different medicinal leaves were tested. All treatments were rated from very much to extremely appealing, pleasant, delicious, and crisp. Treatment A of crackers with Alagaw Leaves was the most preferred, also in crackers with Insulin and Tagpo tagpo leaves and showed no significant differences. In terms of general acceptability, crackers with Insulin leaves (Treatment A) were the most preferred among all products. While no significant differences were observed in sensory qualities, overall acceptability showed a significant difference in favor of crackers with Insulin leaves, identifying them as the best product. Microbial analysis revealed that the microbial counts of the best product were within the acceptable limits set by the Department of Science and Technology (DOST) criteria for most parameters. Proximate analysis further confirmed that the product was energy-dense. Regarding shelf life, all treatments remained appealing, crisp, and pleasant in aroma for the first 21 days. Overall, the study demonstrated that crackers fortified with medicinal leaves are viable, nutritious, and sustainable snack foods. They offer a healthier option for consumers while providing economic benefits to local farmers and bakery vendors.

**Keywords:** Medicinal Leaves, Sensory Evaluation, Shelf Life, Microbial and Proximate Analysis

## I. INTRODUCTION

Filipinos are widely recognized as among the most industrious people globally, and snacks play an important role in sustaining daily activities. Among these, crackers stand out as one of the most accessible snack options across age groups, reflecting how simple yet practical food choices contribute to the endurance and productivity required in everyday labor. Defined as small, flat, dry-baked biscuits made primarily from flour, they are typically consumed plain, flavored, or seasoned. Their relevance is especially pronounced among individuals engaged in physically demanding occupations. Historically, crackers were a crucial component of the British sailor's diet until the advent of canned food in the 1800s (Royal Museums Greenwich, n.d.), and they continued to serve as a staple for soldiers during the American Civil War. In contemporary contexts, crackers are widely consumed in the United States, where their popularity transcends cultural and generational boundaries, rendering them a common household item (Mishra, 2025).

Crackers have become increasingly popular in the Philippines to the extent that nearly all major baking manufacturers produce commercial varieties in diverse flavors, packaging, and styles, making them convenient and affordable for consumers. Well-known brands such as Fita, SkyFlakes, and Rebisco exemplify this widespread appeal. This popularity reflects the innate Filipino appreciation for food, as well as the creativity and innovation in utilizing available local resources to encourage healthier choices and reduce reliance on nutrient-poor products by developing more nutritious snack alternatives. Flavoring crackers offers several advantages, particularly in addressing consumer preferences and enhancing market competitiveness. The introduction of diverse flavors—such as cheese, garlic, or local favorites like adobo and barbecue—enables manufacturers to cater to Filipino taste profiles while increasing product appeal (Smith, 2021). Moreover, the integration of indigenous flavors and ingredients into food products underscores the industry's commitment to preserving cultural heritage while simultaneously appealing to global markets (Perez & Santos, 2020). Such innovations also align with public health initiatives to improve dietary quality and reduce the prevalence of chronic diseases (World Health Organization, 2021). In recent years, natural and organic flavorings have gained traction as consumers increasingly seek healthier options with clean-label ingredients (Johnson & Lee, 2020). The town of Maayon in Capiz, renowned for its fertile agricultural land, has long been a source of diverse medicinal plants traditionally

 

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consumed by local communities. This rich natural resource provides a unique opportunity to explore the integration of indigenous herbs into modern food products. Guided by the researcher's professional alignment with the food industry and the availability of medicinal leaves, the present study was conceptualized to examine the potential of incorporating selected herbs into flavored crackers.

Medicinal plants locally known as *Alagaw, Insulin*, and *Tagpo-tagpo* were utilized in this study as flavoring agents in various cracker formulations. These herbs are widely recognized for their health-promoting properties, including antioxidant, anti-inflammatory, and blood sugar-regulating effects. Their incorporation into crackers not only enhances the nutritional profile of a widely consumed snack but also introduces functional ingredients that respond to consumer demand for healthier alternatives.

This initiative is particularly significant in the Philippine context, as it aligns with the nation's commitment to the Sustainable Development Goals (SDGs). Specifically, the study contributes to improving nutrition and food security, promoting healthier dietary practices, and advancing quality education through food research and innovation. Moreover, it underscores the value of utilizing local resources, thereby reducing dependence on artificial additives and preservatives while fostering sustainable food production. By integrating indigenous herbs into a popular snack, the study highlights the potential of culturally grounded innovations to preserve traditional knowledge, promote public health, and strengthen the local food industry's competitiveness in both domestic and global markets.

This study is also aligned with the University's research agenda under MAED TLE, CRAFT. By translating theoretical concepts into practical food experimentation and product development, the research enhances student learning, supports reflective professional practice, and applies systematic evaluation to ensure that the resulting product meets established standards grounded in empirical data.

Furthermore, the study promotes applied technology and knowledge transfer by utilizing locally available materials for food production, thereby demonstrating the application of scientific principles in real-life contexts. It also reflects a flexible, cultural, and global perspective by incorporating indigenous plants while simultaneously considering international trends in functional foods. In addition, the research encourages transformative collaboration and lifelong learning by engaging both the community of learners and the local population in product development, thereby opening pathways for future endeavors in food innovation and sustainable resource utilization.

This study aimed to formulate, evaluate, and assess the acceptability of Crackers with medicinal leaves, providing a functional, nutritious snack for the health-conscious market. The findings of this research could benefit both consumers and the food industry by offering a new approach to creating innovative, healthier, energy-dense snack alternatives.

### *Objectives of the Study*

Generally, this study aimed to determine the acceptability of Crackers with medicinal leaves *alagaw (Premna odorata), insulin (Costus igneus),* and *tagpo-tagpo* (*Ardisia elliptica*).
Specifically, it aimed to:
1. describe the sensory qualities of crackers with medicinal leaves in terms of appearance, aroma, taste, and texture;
2. determine the general acceptability of crackers with medicinal leaves among three treatments in terms of sensory qualities;
3. find out if there is a significant difference in the sensory qualities of crackers with medicinal leaves in terms of appearance, aroma, taste, and texture among treatments;
4. find out if there is a significant difference in the general acceptability of crackers with medicinal leaves in terms of sensory qualities among treatments;
5. determine the shelf life of crackers with medicinal leaves at room and chilling temperature;
6. determine the microbial and proximate analyses of the best treatment.

## II. METHODOLOGY

### *Research Methods*

The study employed the experimental-developmental method of research in the formulation, analysis, and evaluation of crackers fortified with medicinal leaves such as Alagaw, Insulin, and Tagpo. The experimental method was utilized to

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determine the effects of varying quantities of powdered medicinal leaves on the sensory qualities and overall acceptability of the crackers. This method involved manipulating the amount of medicinal leaves incorporated into the formulation while maintaining the same quantity of the other ingredients. The developmental aspect of the study focused on the creation, formulation, and improvement of crackers with medicinal leaves as a healthier snack alternative. The study also assessed the product's shelf life, microbial safety, proximate composition, sensory qualities, and economic feasibility for small-scale production.

***Experimental Design***

The study used a Completely Randomized Design (CRD), wherein the treatments were randomly assigned to evaluators without systematic bias. The design was appropriate because all treatments had equal chances of being evaluated, thereby reducing errors and ensuring reliability of results. The treatments consisted of different quantities of powdered medicinal leaves incorporated into the cracker formulations. The sensory qualities and general acceptability of the products were evaluated by selected respondents through randomized distribution of evaluation sheets.

***Tools and Equipment Used in the Study***

The tools and equipment used in the study included one oven, one dough kneading table, one pasta maker, one weighing scale, one dough shaper, one mixing bowl, one measuring glass, one baking sheet, and one wire whisk. These tools and equipment were essential in accurately measuring, mixing, kneading, shaping, and baking the cracker formulations. Proper utilization of these materials ensured uniformity and consistency in the preparation and production process of the crackers with medicinal leaves.

***Ingredients Used in the Study***

The ingredients used in the preparation of the crackers included all-purpose flour, cassava flour, arrowroot flour, yeast, salt, baking powder, refined sugar, water, milk, vegetable oil, and powdered medicinal leaves. The medicinal leaves utilized in the study were Alagaw, Insulin, and Tagpo leaves.
For every treatment, the quantity of all ingredients remained constant except for the powdered medicinal leaves. Treatment A contained 10 grams of powdered leaves, Treatment B contained 15 grams, and Treatment C contained 20 grams. Each formulation contained 160 grams of all-purpose flour, 160 grams of cassava flour, 160 grams of arrowroot flour, 6 grams of yeast, 4 grams of salt, 3 grams of baking powder, 4 grams of refined sugar, 118.30 milliliters of water, 91.67 milliliters of milk, and 121.25 milliliters of vegetable oil.

***Experimental Treatments***

The experiment consisted of three treatments for each type of medicinal leaf incorporated into the crackers. Product 1 used Alagaw leaves, Product 2 used Insulin leaves, and Product 3 used Tagpo leaves. Each product had three treatments based on the quantity of powdered medicinal leaves used.
Treatment A contained 10 grams of powdered leaves, Treatment B contained 15 grams, and Treatment C contained 20 grams. The other ingredients remained consistent in quantity and proportion across all treatments. The treatments were evaluated to determine which formulation obtained the highest sensory quality and acceptability ratings.
Among the three treatments, Treatment A, which contained 10 grams of powdered medicinal leaves, received the highest mean rating and was selected for consumer acceptability evaluation.

***Experimental Procedures***

*Preparation of Powdered Medicinal Leaves*
The medicinal leaves were collected in Barangay Cabungahan, Maayon. The leaves were thoroughly washed to remove dirt and impurities. After washing, the leaves were air-dried for three hours using a drying net and then dehydrated for eight hours to reduce moisture content. The dried leaves were ground into fine powder and sieved to obtain a uniform texture. The powdered leaves were then stored in clean and dry containers for later use in the cracker formulations.
*Preparation of Crackers with Medicinal Leaves*

All necessary tools, equipment, and ingredients were prepared before the production process. The oven was preheated to 170°F. All ingredients were accurately weighed and measured according to the formulation.

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The ingredients were mixed thoroughly until a uniform dough was formed. The dough was folded repeatedly until evenly blended. Using a pasta maker, the dough was rolled out and flattened to approximately 0.50 cm thickness. The dough was then cut into serrated rectangular shapes measuring about 1 × 1/2 inches.
The shaped dough pieces were transferred to baking sheets and baked in the preheated oven for 20 to 25 minutes or until fully cooked. After baking, the crackers were cooled before evaluation and packaging.

***Scoring of Variables***

The study utilized a 9-point Hedonic Scale to evaluate the sensory qualities and overall acceptability of the crackers with medicinal leaves. The sensory qualities evaluated were appearance, aroma, taste, and texture.
Each numerical rating corresponded to descriptive interpretations. A rating of 9 indicated "Extremely Appealing," "Extremely Pleasant," "Extremely Delicious," or "Extremely Crisp," while a rating of 1 indicated "Extremely Unappealing," "Extremely Unpleasant," "Extremely Not Delicious," or "Extremely Not Crisp." The same scale was used in determining the general acceptability of the product, ranging from "Liked Extremely" to "Disliked Extremely."

***Statistical Tools and Analysis***

The data gathered from the evaluation sheets were analyzed using descriptive and inferential statistical tools. Mean was used to determine the sensory qualities of the crackers in terms of appearance, aroma, taste, texture, and general acceptability.
Analysis of Variance (ANOVA) was used to determine the significant differences among the treatments of crackers with medicinal leaves. The evaluation sheets completed by the respondents were tabulated, computed, and analyzed using SPSS software. The level of significance used in the study was set at 0.01 alpha.

***Cost Analysis of the Study***

Cost analysis was conducted to determine the economic feasibility of producing crackers with medicinal leaves. The total production cost included both the cost of materials and labor expenses. Labor cost was computed as 40% of the total material cost.
The cost of materials amounted to ₱80.86, while labor cost was ₱32.34, resulting in a total project cost of ₱113.20 for 10 packs of crackers. Each pack contained 50 grams of crackers with an estimated production cost ranging from ₱11.32 to ₱11.90 per pack.
The findings of the cost analysis revealed that the production of crackers with medicinal leaves was economically feasible and suitable for small-scale production.

## III.RESULT AND DISCUSSION

This part presents the results, analyses, and interpretation of data gathered from the sensory evaluation, general acceptability, shelf-life assessment, microbial analysis, and proximate analysis of crackers fortified with medicinal leaves such as Alagaw, Insulin, and Tagpo-tagpo. The discussion highlights the acceptability of the products in terms of appearance, aroma, taste, texture, and overall consumer preference.

***Sensory Qualities of Crackers with Medicinal Leaves***

The sensory evaluation revealed that all cracker formulations were highly acceptable to the evaluators. The products were assessed in terms of appearance, aroma, taste, and texture across three treatments with varying concentrations of medicinal leaves.

For Alagaw crackers, Treatment A consistently obtained the highest ratings in appearance, aroma, and taste, indicating that the lower concentration of powdered leaves provided a more balanced and visually appealing product. The lighter color and milder herbal flavor likely contributed to greater consumer preference. In terms of texture, however, Treatments B and C received slightly higher ratings, suggesting that increased leaf concentration improved crispness.

Similarly, Insulin crackers showed highly positive sensory ratings. Treatment A again emerged as the most preferred formulation due to its superior appearance, aroma, and taste. Evaluators favored the milder herbal characteristics of the lower concentration treatment. Texture ratings remained consistently high across all treatments, indicating that the addition of Insulin leaves did not negatively affect crispness.

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For Tagpo-tagpo crackers, sensory preference varied depending on the attribute evaluated. Treatment A received the highest score in appearance and texture, Treatment C excelled in aroma due to the stronger herbal scent, while Treatment B achieved the highest rating in taste. These findings imply that Tagpo leaves can enhance different sensory properties depending on the concentration used in the formulation.

Overall, the results demonstrated that crackers fortified with medicinal leaves possessed desirable sensory characteristics and were generally rated from "Very Much Appealing" to "Extremely Appealing," "Very Much Delicious" to "Extremely Delicious," and "Extremely Crisp." Moderate incorporation of medicinal leaves was found to produce the most balanced sensory quality. Excessive concentrations tended to intensify herbal flavor and aroma, which slightly reduced consumer preference.

The findings support previous studies emphasizing that successful functional food products must maintain a balance between nutritional enrichment and sensory acceptability. The study confirms that medicinal leaves can be incorporated into crackers without compromising product quality and consumer appeal.

***General Acceptability of Crackers with Medicinal Leaves***

The general acceptability test evaluated the overall consumer preference for the cracker formulations. Results showed that all treatments were highly acceptable to consumers.

Among the three formulations, Insulin crackers obtained the highest ratings in appearance, aroma, taste, texture, and overall acceptability. The product was generally described as "Liked Extremely," indicating strong consumer preference. This suggests that Insulin leaves contributed positively to the flavor profile and overall quality of the crackers.

Tagpo-tagpo crackers also achieved high ratings, particularly in taste and texture, while Alagaw crackers were consistently rated as "Liked Very Much." Although all formulations were acceptable, Insulin crackers stood out as the best product in terms of total consumer preference.

The results indicate that medicinal leaves can successfully function as fortifying ingredients in snack products while maintaining sensory satisfaction. The high hedonic ratings further support the feasibility of producing functional snack foods using locally available medicinal plants.

The findings also correspond with previous studies showing that herbal and medicinal ingredients can improve the nutritional and functional value of food products without negatively affecting consumer acceptability. The incorporation of medicinal leaves provided unique flavor characteristics while preserving the desirable qualities of crackers.

***Difference in the Sensory Qualities of Crackers with Medicinal Leaves***

Statistical analysis revealed that there were no significant differences in the sensory qualities of the crackers across treatments in terms of appearance, aroma, taste, and texture.

For Alagaw, Insulin, and Tagpo-tagpo crackers, all computed p-values were greater than the 0.01 level of significance. This means that the sensory variations among treatments were not statistically significant, and all formulations were considered similarly acceptable by the evaluators.

The acceptance of the null hypothesis indicates that the amount and type of medicinal leaves used did not significantly alter the sensory characteristics of the crackers. Although some treatments obtained slightly higher mean scores, these differences were minimal and did not greatly influence consumer perception.

The findings suggest that Alagaw, Insulin, and Tagpo-tagpo leaves are all suitable ingredients for cracker production. Product developers therefore have flexibility in selecting medicinal leaves based on availability, nutritional content, or intended functional properties without risking sensory rejection from consumers.

This result also demonstrates the potential of medicinal plants as viable fortifying agents in functional food development. The products maintained desirable appearance, aroma, taste, and texture despite the addition of herbal ingredients.

***Difference in the General Acceptability of Crackers with Medicinal Leaves***

The analysis of variance for general acceptability revealed mixed results. No significant differences were observed in appearance, aroma, taste, and texture among treatments since all p-values were greater than the 0.01 level of significance. However, a significant difference was identified in overall acceptability.

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The overall acceptability obtained a p-value lower than 0.01, indicating that consumers had a preferred formulation when evaluating the product as a whole. Among all treatments, Insulin crackers received the highest overall acceptability score, making it the most preferred product.

The findings imply that while the individual sensory attributes were comparable among treatments, the total eating experience influenced consumer preference. The combination of flavor, aroma, texture, and overall satisfaction contributed to the superiority of Insulin crackers.

Despite the statistical difference in overall acceptability, all formulations remained acceptable to the evaluators. This confirms that medicinal leaves can be incorporated into crackers successfully while maintaining favorable consumer perception.

### *Shelf Life of Crackers with Medicinal Leaves at Room Temperature*

The shelf-life evaluation showed that all cracker treatments remained stable and acceptable during the 21-day observation period at room temperature.

No mold formation, rancidity, or staleness was observed from Day 0 to Day 21 across all treatments. The crackers maintained their crisp texture and pleasant aroma throughout the storage period.

These findings indicate that crackers fortified with medicinal leaves possess good storage stability. The low moisture content of the products likely contributed to the prevention of microbial growth and spoilage. Proper storage conditions and sealed packaging further support product quality preservation.

The results suggest that medicinal leaf crackers can serve as convenient snack products with relatively long shelf life compared to other snack foods. This makes them suitable for extended consumption and potential commercial production.

### *Microbial Analysis of Crackers with Insulin Leaves*

Microbial analysis of Insulin crackers revealed that the product met acceptable food safety standards. The Aerobic Plate Count, Yeast and Mold Count, and Total Coliform Count were all below the standard limits established by regulatory authorities.

The low microbial counts indicate that the crackers were processed under sanitary conditions and were safe for human consumption at the time of testing. Minimal fungal contamination and the absence of harmful coliform bacteria further confirm the microbiological stability of the product.

The findings emphasize the importance of proper food handling, sanitation, and preparation practices in maintaining product safety. The results also support the viability of medicinal leaf crackers as safe functional snack products.

### *Proximate Analysis of Crackers with Insulin Leaves*

The proximate analysis revealed that Insulin crackers were characterized by low moisture content, moderate fat content, measurable protein and mineral content, and high nitrogen-free extract.

The low moisture level suggests good shelf stability and reduced susceptibility to microbial spoilage. The ash content reflected the mineral contribution of the ingredients, while the moderate fat content enhanced flavor, texture, and energy value.

The crackers also contained measurable crude protein, indicating nutritional value, while the high nitrogen-free extract showed that carbohydrates were the primary component of the product. These results classify Insulin crackers as energy-dense snack foods.

Overall, the proximate analysis confirms that crackers fortified with medicinal leaves are not only acceptable in sensory quality but also possess nutritional value suitable for functional food development.

## IV. CONCLUSIONS

Based on the findings and objectives of the study, the following conclusions were formulated.

Crackers with medicinal leaves demonstrate satisfactory sensory qualities across all treatments, and high consumer acceptability confirms that these medicinal plants can be used as ingredients in cracker production. This finding concludes that crackers with *Alagaw, Insulin,* and *Tagpo tagpo* leaves are a successful formulation of savory, nutritious, and functional snack foods, with no significant differences in sensory qualities. However, *Insulin* crackers stand out as the best treatment overall in terms of general acceptability, as they are considered to deliver superior overall balance in preferences. Moreover, the first 21 days confirm that crackers have a longer shelf life than other snack foods, making them more convenient for extended consumption and labor-intensive activities.

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The microbial test results confirmed that the product met the minimum safety standards confirming that the crackers with *Insulin* leaves are safe for human consumption and is an energy dense food based on the given proximate analysis result. This outcome concludes that the product is nutritionally innovative and microbiologically sound food.

## Recommendations

Based on the conclusions drawn from the sensory evaluation, general acceptability valuation, and shelf-life of crackers with medicinal leaves, the recommendations were constructed as follows:

It is recommended that further development and experimentation be undertaken on cracker formulations, particularly focusing on integrating medicinal leaves to enhance flavor while maintaining product quality. In addition, exploring the use of locally available medicinal plants that align with consumer preferences may broaden the potential for culturally relevant and health-oriented innovations. Moreover, future studies on storage and packaging materials are advised to ensure product stability and sustained quality over time.

Farmers are encouraged to cultivate more medicinal plants, both to support productive agriculture and to generate additional income. Consumers should be educated on the health benefits and culinary uses of these herbs, and encouraged to incorporate medicinal leaves into their daily diets. Bakers and entrepreneurs are likewise advised to incorporate medicinal leaves into their food production ventures, creating healthier, more innovative products.

For students, faculty, and researchers, continuous innovation in food formulations is recommended, with emphasis on developing savory and nutritious snacks that minimize reliance on additives and preservatives. Finally, efforts should be sustained to bridge locally sourced raw materials with global food trends, while upholding quality standards in education and fostering productive innovation.

Based on this study, the researcher recommends using *Alagaw*, *Insulin*, and *Tagpo-tagpo* leaves in cracker production, as these ingredients can provide a healthy, nutritious snack suitable for people of all ages.

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