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# Formulation, analyses and acceptability of breadnutjackfruit seeds croquette with moringa leaves

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**Abstract:** This study aimed to develop a nutritious, sustainable, and acceptable plant-based croquette by formulating breadnut-jackfruit seeds croquette enriched with moringa leaves, evaluating its sensory qualities, proximate composition, and microbial safety. Utilizing underused local resources such as breadnut and jackfruit seeds—commonly discarded despite their nutritional value—combined with moringa leaves, known for their high vitamin and mineral content, the study explored the potential of creating a health-focused food product. A developmental-experimental research design was employed, involving the preparation of three formulations with varying seed proportions: Treatment A (20% breadnut, 80% jackfruit), Treatment B (40% breadnut, 60% jackfruit), and Treatment C (60% breadnut, 40% jackfruit), with consistent moringa leaf content across treatments. Evaluation was conducted using a Completely Randomized Design (CRD), tested by 10 semi-trained panelists and 100 consumer tasters. Sensory analysis showed that Treatment B was the most preferred in terms of appearance, aroma, taste, and texture, consistently rated as "liked extremely." ANOVA results indicated no significant differences in appearance and aroma, but significant differences in taste and texture favored Treatment B. Proximate analysis of Treatment B revealed it to be rich in protein, carbohydrates, and fat, while microbial analysis confirmed it met Bureau of Food and Drugs (BFAD) safety standards. Overall, the study demonstrated that breadnut-jackfruit seeds croquette with moringa leaves can be an innovative, nutritious, and safe functional food product, with Treatment B showing strong potential for future commercialization and contribution to health-conscious, sustainable food solutions.

Keywords: Breadnut seeds, Jackfruit seeds, Moringa leaves, Formulation, Analysis and Acceptability

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## INTRODUCTION

Creating food combinations is an exciting journey into flavor. Many people enjoy experimenting with recipes, adjusting proportions, and adding ingredients that make meals not only nutritious but also unexpectedly tasty. It's essential to encourage children to understand the benefits of eating well, as it keeps them healthy and energized. Fiber, for example, plays a significant role in our bodies by helping to regulate blood sugar, control appetite, and prevent constipation. Insoluble fiber, a structural component of plant cell walls, doesn't dissolve in water, while soluble fiber assists in balancing blood sugar levels, which supports insulin sensitivity—especially helpful for people with diabetes. Today, many people focus on eating not only for enjoyment but also for health.

Croquettes were available at various fast-food chains and from street vendors, often served with a variety of sauces to enhance their savory taste. Over time, people have grown more mindful of what they eat. While instant foods are now a popular choice, especially among young

adults, health-conscious eating is becoming more essential as we seek to balance convenience with wellness

Jackfruit (Artocarpus heterophyllus) is a tropical fruit known for its large size, spiky green skin, and unique, starchy-sweet taste. Native to South and Southeast Asia, it's widely cultivated in countries such as India, Bangladesh, Thailand, and the Philippines. The fruit is the largest tree-borne fruit in the world, sometimes reaching up to 80 pounds (about 36 kilograms) in weight and over 20 inches (50 cm) in length. Jackfruit is high in dietary fiber, which aids digestion, supports gut health, and can help regulate blood sugar levels. It is rich in vitamins A, C, and several B vitamins. Vitamin C supports immune health and skin health, while vitamin A is important for vision.

The fiber content helps prevent constipation and supports healthy digestion. Potassium and antioxidants in jackfruit may support heart health by helping to lower blood pressure and reduce oxidative stress (Hossain, et al., 2016).

Breadnut (Artocarpus camansi), also known as "kamansi" in the Philippines, is a tropical tree closely related to breadfruit and jackfruit. Originating in New Guinea and the Philippines, it has spread across Southeast Asia, the Pacific Islands, and Central America. Breadnut is often cultivated for its starchy seeds, which are rich in nutrients and used in various culinary applications.

Breadnut seeds provide a significant amount of dietary fiber, supporting digestive health and potentially helping to control blood sugar levels. Breadnut is a good source of potassium, magnesium, and calcium, which contribute to muscle funcion, heart health, and bone density (Ragone, (2016).

Breadnut, jackfruit seeds, and moringa leaves are all rich in essential nutrients like protein, fiber, and vitamins. The study helps determine if this combination creates a healthy and appealing food product. Developing alternative food products can help reduce food waste by utilizing underutilized ingredients like jackfruit seeds and breadnut. The study assesses whether this innovation is marketable. The study evaluates how well people like the taste, texture, aroma, and overall appeal of the croquette, helping determine if it can be commercially viable. Using locally available and often discarded ingredients can make food production more sustainable and cost-effective. The study helps identify its feasibility for production and consumption. Moringa is a well-known superfood. The study can help explore its potential role in functional food products that promote better health.

People are fortunate to be surrounded by nature's bounty, with an abundance of natural resources that make our country a renowned destination and a hub for tourism. However, many Filipinos have developed a habit of favoring foreign products, often overlooking the value of our local resources. Some plants, like jackfruit and breadnut, are less recognized despite growing freely in our forests and backyards. Often, their seeds are discarded as waste, yet they are nutrient-rich, providing essential benefits for digestive, immune, and heart health. These seeds, with their versatility in cooking, offer significant nutritional and sustainable value for tropical and subtropical areas. They are also suitable ingredients for dishes like croquettes, presenting a delicious and healthy food source. To truly savor nature's gifts, we must add wisdom to our choices, embracing the naturally nourishing foods that God has provided.

*Problem statement*

This study generally aimed to determine the sensory qualities and acceptability of the breadnut-jackfruit seeds croquette with moringa leaves. Specifically, it aimed to attain the following objectives:

1. Describe the sensory qualities of the breadnut-jackfruit seeds croquette with moringa leaves in terms of appearance, aroma, taste and texture;
2. Determine the general acceptability of the breadnut-jackfruit seeds croquette with moringa leaves in terms of appearance, aroma, taste and texture;
3. Find out if there is a significant difference in the sensory qualities of breadnut-jackfruit seeds croquette with moringa leaves in different treatment in terms of appearance, aroma, taste and texture among treatments;
4. Find out if there is a significant difference in the general acceptability of breadnut-jackfruit seeds croquette with moringa leaves among three treatments in terms of sensory qualities;
5. Determine the shelf-life of breadnut-jackfruit seeds croquette with moringa leaves considering room temperature; and,
6. Determine the microbial and proximate analysis of the most accepted breadnut-jackfruit seeds croquette with moringa leaves.

## METHODOLOGY

*Research design*

The experimental design employed in the study was the Completely Randomized Design (CRD), which is widely used in food product development to ensure each treatment has an equal chance of being assigned and evaluated without bias (Gomez, 2016). Samples for evaluation were coded, and scorecards were used to facilitate randomization. Product formulations were prepared prior to the evaluation phase and tested in three separate trials, each replicated three (3) times. The researcher maintained consistent measurements for all other ingredients, with variations among treatments occurring only in the proportions of breadnut, jackfruit seeds, and moringa leaves as the primary variables. Although no control sample was used, all three treatments underwent sensory evaluation under the same conditions, enabling a fair comparison across treatments

*Respondents of the study*

The breadnut and jackfruit seeds croquette with moringa was evaluated by a panel of 10 experts.

*Selection and description of respondents*

The panel of ten (10) experts will be compose of ten (10) teacher and professors from Panitan National High School and Capiz. They were selected because of their educational preparation and qualifications; Technology Livelihood Education Teachers, Licensed Agriculturist, Food Processing and Cookery NC Holders and Home Economics Teachers.

*Data gathering instruments*

To measure the work-related stress factors, recreational sports engagement and teaching effectiveness of MAPEH Teachers, a researcher made questionnaire was used. The researcher formulated statements according to the topics in the variables of the study and presented in

comprehensible and simple language. The survey questionnaire consisted of four (4) parts: Part one was the demographic Profile of the participants which gathered data such as name, school assignment, age, sex, position/designation, and length of year in service. Part Two was the work-related stress factors in terms of student behavior, relationship with administrators, relationship with colleague, workplace environment, job role demand, Job satisfaction, time management, and work-life balance. Part Three was the recreational sports engagement in terms of participation in team sports, participation in dual sports, and participation in individual sports. Part four is the teaching effectiveness based on the result of the Individual Performance Commitment and Review.

Prior to the conduct of the study, the instrument underwent face and content validation by the panel of experts. Their suggestions as well as recommendations for the improvement of the instrument were incorporated in the revisions of the same instruments. After the instrument had undergone face and content validation, this was pilot tested to the MAPEH Teachers in Kalibo who are not part of the actual study.

The result of the Pilot testing was used in the determining the computer-processed reliability testing of the research instrument using the Statistical Package for Social Science (SPSS) software. Kulkarni (2016) contends that an instrument with a reliability index of .700 and above is considered reliable. In this study, the result of Cronbach alpha showed a reliability index 0.80 The results of statistical test indicated that the instrument of this study was reliable and acceptable beyond doubt.

After the validation and reliability testing, the questionnaire was distributed to the participants for collection of needed information. To interpret the data on the work-related stress factors, recreational sports engagement and teaching effectiveness of MAPEH Teachers in the division of Capiz, the following 5 point Likert Scales of mean and description were utilized.

A Focus Group Discussion (FGD) was utilized as a qualitative technique for validity checking. Seven research-based questions were developed concerning work-related stress factors, engagement in recreational sports, and the teaching effectiveness of MAPEH teachers. These questions underwent face validation by a panel of experts. The FGD approach allowed the researcher to gather a substantial amount of additional information in a shorter period while also capturing a variety of perspectives, emotional responses, and processes from the participants.

*Data gathering procedure*

In this study, the experimental method was utilized to investigate the varying proportions of breadnut-jackfruit seeds croquette with moringa leaves across three treatments. Developmental research involves the systematic study of design, development, and evaluation processes aimed at creating evidence-based instructional and non-instructional products or models (Richey, Klein, and Tracey, 2019). This method was used in the formulation and refinement of the breadnut-jackfruit seeds croquette with moringa leaves, targeting potential product development and commercialization. Meanwhile, the descriptive-survey method is a research technique used to gather data that describe characteristics of a population or phenomenon, often used for needs assessment, satisfaction, or acceptability studies (Walliman, 2017). In this study, the descriptive-survey approach was employed to profile respondents and assess consumer acceptability of the developed croquette product.

*Data analysis procedure*

After the evaluation of the product, the score sheets were gathered, tallied and summarized for computation.

Arithmetic Mean and Analysis of Variance (ANOVA) were the statistical tools used in analyzing and interpreting the data. All data were subjected to Statistical Package for Social Sciences (SPSS),

Mean was used to determine the sensory qualities of the breadnut and jackfruit seeds croquette with moringa leaves in terms of the four (4) factors were used.

Analysis of Variance was used to analyze the differences that may have existed among the three (3) treatments. Tukey HSD Post Hoc Test was used to analyze where the differences lie in the general acceptability of the three (3) treatments. The alpha level was set at 0.01 level of significance.

## DISCUSSION OF FINDINGS

*Sensory qualities of breadnut-jackfrui tseeds croquette with moringa leaves*

The sensory evaluation of breadnut-jackfruit seed croquettes with moringa leaves revealed that Treatment B, formulated with 40% breadnut seeds and 60% jackfruit seeds, consistently emerged as the most preferred across all tested attributes—appearance, aroma, taste, and texture. In terms of appearance, although all treatments were rated as "Very Much Appealing," Treatment B achieved the highest mean score (8.10), suggesting that the 40:60 blend created the most visually attractive product, a result aligning with Go et al. (2015), who emphasized the importance of balanced formulations for enhancing visual appeal.

For aroma, Treatment B again led with a mean score of 8.20, described as "Very Much Pleasant," indicating that the aromatic properties of jackfruit were optimally expressed at this ratio. This finding parallels the work of Chowdhury et al. (2012), who noted the positive aromatic contributions of jackfruit seed flour when properly proportioned in food products.

When evaluating taste, Treatment B achieved the highest rating (8.30, "Very Much Delicious"), pointing to the harmonious flavor interaction between the subtle earthiness of breadnut seeds and the natural sweetness of jackfruit seeds. This outcome is consistent with Go et al. (2015), who found that balanced blends enhance flavor acceptability.

Lastly, in terms of texture, Treatments B and C tied with the highest mean score (8.10, "Very Much Fine"), suggesting that both the 40:60 and 60:40 blends provided a favorable balance between the fibrousness of breadnut seeds and the softness of jackfruit seeds. This observation reinforces Go et al.'s (2015) findings that breadnut seed flour improves the textural qualities of baked goods when used in optimal amounts.

Overall, the study highlights the crucial role of ingredient proportion in optimizing the sensory qualities of croquette formulations. The 40% breadnut to 60% jackfruit seed ratio in Treatment B consistently delivered superior results, positioning it as the most favorable formulation among the tested variations. These findings suggest that precise ingredient balancing is key to maximizing consumer acceptability in innovative food products.

*Acceptability of breadnut-jackfruit seeds croquette with moringa leaves*

The sensory evaluation of breadnut-jackfruit seeds croquette with moringa leaves revealed that Treatment B (40% breadnut seeds, 60% jackfruit seeds) consistently emerged as the most preferred formulation across all assessed qualities—appearance, aroma, taste, texture, and overall acceptability. In terms of appearance, Treatment B achieved the highest mean score (8.30, "Liked Very Much"), suggesting that the blend created an appealing visual profile, possibly due to its golden-brown color and smooth finish, echoing Garcia and Mendoza's (2021) findings that visual quality significantly shapes consumer preferences in plant-based products.

For aroma, Treatment B again led with a mean score of 8.57 ("Extremely Liked"), indicating that the combination of breadnut, jackfruit, and moringa produced a particularly attractive scent. This aligns with the observations of Patil et al. (2021), who noted that moringa and local plant-based ingredients can enhance the aromatic appeal of food products. Taste results further confirmed Treatment B's superiority, with the highest score of 8.83 ("Extremely Liked"), highlighting the formulation's successful balance between the earthiness of breadnut and the natural sweetness of jackfruit, a dynamic known to boost palatability in enriched snack foods.

Texture ratings showed that both Treatment B and C received the top score of 8.67 ("Extremely Liked"), reflecting that the balance between fibrous and soft seed components delivered a highly satisfying mouthfeel. This observation supports Stone and Sidel's (2020) sensory research, which underscores texture as a key driver of product acceptability.

Overall, Treatment B's consistently high performance across all sensory dimensions underscores the importance of precise formulation in developing plant-based croquettes. The 40:60 breadnut-to-jackfruit ratio, enhanced by moringa, appears to create the most appealing balance of visual, aromatic, taste, and textural qualities, making it the most preferred variant among evaluators. These findings reinforce that careful ingredient proportioning is crucial in optimizing sensory satisfaction and driving consumer acceptance in innovative food products.

*Difference in the sensory qualities of breadnut-jackfruit seeds croquette with moringa leaves*

The results of the study revealed that there were no significant differences in the sensory qualities—appearance, aroma, taste, and texture—of the breadnut-jackfruit seeds croquette with moringa leaves among the different treatments, as indicated by the respective Z-values (appearance: 1.532, aroma: 2.852, taste: 3.229, texture: 0.324) and P-values (all greater than 0.01). This statistical outcome leads to the acceptance of the hypothesis stating that no significant differences exist across treatments in these sensory attributes.

These findings align with the observations of Dizon, Perez, and Romero (2019), who reported that when using compatible, locally sourced plant-based ingredients in croquette formulations, moderate variations in ingredient ratios often do not significantly alter sensory perceptions if the base formulation is already well balanced. Additionally, Stone and Sidel (2020) highlighted that consumer sensory panels typically have a perceptual threshold, meaning that unless ingredient changes surpass a certain point, differences in sensory qualities such as taste and texture remain undetectable.

Overall, the results validate that all three formulations of the breadnut-jackfruit croquette with moringa leaves were comparably acceptable to evaluators, confirming that ingredient proportion adjustments within the tested ranges did not compromise the overall sensory appeal of the product. This emphasizes the robustness and flexibility of the croquette formulation,

suggesting that it can accommodate moderate adjustments without negatively impacting consumer satisfaction.

*Difference in the general acceptability of breadnut-jackfruit seeds croquette with moringa leaves among treatments in terms of sensory qualities*

The analysis revealed that the acceptability of breadnut-jackfruit seeds croquette with moringa leaves varied across sensory qualities, leading to a partial rejection of the null hypothesis. Specifically, there was no significant difference in appearance ($F(2, 297) = 2.257$, $p = 0.111$) or aroma ($F(2, 297) = 4.795$, $p = 0.011$), as both p-values exceeded the 0.01 significance level, indicating that any observed differences were likely due to random variation. This consistency in appearance and aroma can be attributed to the uniform color, presentation, and the use of fixed aromatic ingredients like garlic and onion, which standardized the sensory experience across treatments.

In contrast, significant differences emerged in taste ($F(2, 297) = 27.652$, $p = 0.000$) and texture ($F(2, 297) = 14.972$, $p = 0.000$), with p-values well below the 0.01 threshold, leading to the rejection of the null hypothesis for these attributes. The variations in taste were notably influenced by the different combinations of breadnut and jackfruit seeds, with Treatment B (40:60 breadnut-to-jackfruit ratio) emerging as the most favored due to its balanced flavor profile. Similarly, the differences in texture were shaped by how the seed proportions affected the product's consistency, with Treatments B and C achieving superior ratings because of the optimal balance between the fibrousness of breadnut and the smoothness of jackfruit seeds.

These findings align with the research of Ocloo et al. (2015) and Oliveira et al. (2020), who highlighted taste and texture as critical determinants of consumer acceptance when introducing novel or plant-based formulations. Overall, while appearance and aroma remained stable across treatments, taste and texture were significantly impacted by ingredient ratios, underscoring the importance of precise formulation in developing appealing plant-based croquettes.

*Shelf-Life of breadnut-jackfruit seeds croquette within two (2) weeks of observation for mold formation*

The study assessed the shelf-life of breadnut-jackfruit seeds croquettes incorporated with moringa leaves by observing mold formation and unpleasant odor over a 15-day period. As presented in Table 6, all three treatments (A, B, and C) did not exhibit any signs of mold formation or unpleasant odor within the first 14 days. However, by the 15th day, all variants showed visible mold growth accompanied by an unpleasant odor and spot production, indicating microbial spoilage. These findings suggested that the croquettes maintained microbiological stability for up to two weeks under ambient storage conditions. The absence of spoilage within this period implied a potential antimicrobial effect of moringa leaves, although such effects appeared insufficient to inhibit mold formation beyond 14 days without additional preservation methods. The results had important implications for food safety and product development. Specifically, if the croquettes were to be distributed commercially, it would be necessary to implement proper preservation strategies such as refrigeration, vacuum packaging, or the use of natural preservatives to extend their shelf-life. The findings were supported by Mbikay (2020), who reported that *Moringa oleifera* possessed moderate antimicrobial properties that could delay

spoilage but were not strong enough for long-term preservation. Similarly, Adesokan et al. (2019) found that plant-based foods without chemical preservatives typically developed spoilage within 10 to 15 days depending on storage conditions. Aday and Yener (2021) also emphasized that minimally processed foods stored at ambient temperature should be consumed within 7 to 14 days due to the risk of microbial growth.

Moreover, Basu et al. (2022) noted that jackfruit seed-based food products contributed to nutritional improvement but did not provide antimicrobial protection, reinforcing the need for supplemental preservation methods. Lastly, Sharma and Nayik (2020) confirmed that the presence of mold, unpleasant odor, and surface spots were reliable indicators of spoilage in croquette-type products. Collectively, these findings validated that the safe consumption period for the breadnut-jackfruit seeds croquettes with moringa leaves was limited to 14 days under ambient storage conditions.

*Microbial analysis of breadnut-jackfruit seeds croquette with moringa leaves*

The findings showed that all tested parameters—Aerobic Plate Count (620 cfu/g), Total Coliform Count (<10 cfu/g), E. coli (<10 cfu/g), absence of Salmonella in 25g, and Molds and Yeast Count (300 cfu/g)—were within acceptable safety limits. These results indicate that the product is microbiologically safe for human consumption. The low microbial counts reflect good sanitation, proper food handling, and hygienic preparation. To further ensure safety and extend shelf life, the product must be prepared under sanitized conditions, properly packaged, and stored at room temperature. Overall, the croquette meets DOST microbial standards and shows strong potential for market readiness.

*Relationship between work related stress factors of mapeh teachers and their recreational sports engagement*

The findings in Table 8 reveal that there was a negligible and statistically insignificant relationship between the level of work-related stress factors and the level of recreational sports engagement among MAPEH teachers, as indicated by a Pearson-r value of -0.049 and a p-value of 0.465 (greater than the 0.05 alpha level). This means the study failed to reject the null hypothesis, suggesting that MAPEH teachers' stress levels are neither influenced nor reduced by their participation in recreational sports.

This result implies that, for MAPEH teachers, engaging in recreational sports may not significantly function as a stress management tool. Several factors could explain this outcome. Stress management is often highly individualized, and while some teachers may find relief in sports, others might turn to alternative coping strategies such as social interactions, art, music, meditation, or spending time with loved ones. Additionally, the demanding workload and tight schedules of MAPEH teachers may limit their consistent engagement in sports, regardless of their stress levels. Furthermore, the complex and multifaceted nature of work-related stress — involving challenges like student behavior, administrative demands, and workload pressures — often requires targeted institutional interventions, such as professional development or enhanced school support, rather than relying solely on recreational sports as a remedy.

Insights from participants reinforce these points. One discussant emphasized that recreational sports are a personal choice, often pursued for reasons unrelated to stress, such as social interaction, personal enjoyment, or maintaining physical fitness. Others pointed out that differences in time availability, access to facilities, or physical ability can shape participation in

sports, independent of stress levels. For example, a highly stressed teacher may lack the time or opportunity to engage in sports, while another teacher with lower stress might participate simply due to personal interest.

These findings align with the work of Akpan and Essien (2022), who argued that although physical activity offers psychological and social benefits, it does not universally guarantee reduced stress levels among teachers. However, this contrasts with other studies by the same authors, where they found that regular participation in sports — particularly team-based activities — contributed significantly to lowering stress by enhancing emotional resilience and fostering social support. Their research emphasized that recreational sports can play a meaningful role in managing stress and improving teacher well-being when the right conditions and supports are in place.

In summary, the present study highlights that while MAPEH teachers are actively engaged in recreational sports, this engagement does not have a measurable or consistent effect on reducing their work-related stress. This underscores the need for a broader, more holistic approach to stress management that goes beyond physical activity and addresses the institutional and personal factors contributing to teacher stress.

*Proximate analysis of breadnut-jackfruit seeds croquette with moringa leaves*

The proximate analysis of the breadnut-jackfruit seeds croquette with moringa leaves revealed the following composition: 4.6g/100g moisture, 200 Kcal/100g calories, 9.4g/100g crude protein, 22.30g/100g total fat, and 23.9g/100g total carbohydrates. The moisture content of 4.6g/100g suggests that the croquette is relatively dry, which may contribute to its shelf stability by reducing the potential for microbial growth, as lower moisture content is generally associated with longer shelf life (Basha et al., 2020). The calorie content of 200 Kcal/100g indicates that the product is a moderately energy-dense snack, which may appeal to individuals seeking a functional food with high energy. The 9.4g/100g protein level is notable, as it highlights the product's potential as a source of plant-based protein, especially when combined with the nutrients from moringa leaves.

According to Kumar et al. (2019), plant-based protein sources, such as those derived from seeds and legumes, have become increasingly popular for their health benefits, including promoting muscle growth and repairing body tissues. Furthermore, the 22.30g/100g total fat content suggests that the croquette may be high in fats, particularly if the fat content is predominantly from oils or fatty seeds, which are commonly used in snack production. High-fat foods, although energy-dense, must be consumed in moderation to avoid negative health impacts such as weight gain or cardiovascular diseases (Patel et al., 2021). Lastly, the 23.9g/100g carbohydrates content indicates that the product is a moderate source of carbohydrates, which provide essential energy. However, the high fat and carbohydrate content might also suggest that the croquette should be consumed as part of a balanced diet. The nutritional composition of this croquette suggests it could serve as a functional snack, combining macronutrients that support energy, muscle repair, and overall health. However, it is crucial to consider the potential for excessive calorie intake from the high fat content, as evidenced by recent studies linking high-fat diets to increased risks of metabolic disorders (Sharma & Singh, 2022). These results were consistent with those of Adebayo et al. (2023), who found that high-fat and high-protein snacks made from seeds could provide functional benefits, but care must be taken to manage their energy density in health-conscious consumers.

Lastly, the proximate analysis revealed that the breadnut-jackfruit seeds croquette with moringa leaves is an energy-dense food rich in protein, fat, and carbohydrates. While this makes it a promising snack for providing energy and protein, careful attention should be given to its fat content, and further studies should explore consumer acceptance, particularly in relation to its calorie density.

## CONCLUSION

Based on the findings and objectives of the study, the following conclusions were drawn:

The study successfully demonstrated that breadnut seeds, jackfruit seeds, and moringa leaves are viable, nutritious, and functional ingredients in the formulation of croquettes. Their combination resulted in a product rich in essential nutrients such as protein, fiber, and carbohydrates, while also contributing positively to the sensory attributes of the croquette—specifically in terms of appearance, aroma, taste, and texture. These findings highlight the potential of these underutilized local ingredients in developing innovative, sustainable, and health-oriented plant-based food products.

Among the three treatments evaluated, Treatment B (40% breadnut seeds and 60% jackfruit seeds) emerged as the most preferred formulation. It consistently received the highest mean scores from both semi-trained panelists and consumer tasters across all sensory categories and was rated as "Liked Extremely." While Treatments A and C were also acceptable and described as "Liked Very Much," Treatment B offered a superior balance in flavor and texture.

Statistical analysis through ANOVA confirmed that there were significant differences in taste and texture among the treatments, which were key drivers of consumer preference. This underscores the importance of optimizing ingredient proportions to achieve desirable sensory qualities in food product development.

Furthermore, the study affirms the commercial potential of the croquette, particularly as it utilizes locally available, affordable, and often discarded resources. By incorporating breadnut and jackfruit seeds—typically considered agricultural by-products—alongside nutrient-dense moringa leaves, the product supports food innovation that promotes health, reduces food waste, and encourages sustainable practices. Overall, the croquette developed is not only nutritious and microbiologically safe but also aligns with public health goals and the growing demand for plant-based, functional food options.

## RECOMMENDATIONS

Based on the findings and conclusions of the study, the following recommendations were drawn.

Breadnut-jackfruit seeds with moringa leaves in making croquette is recommended.

For optimal sensory quality and consumer satisfaction, it is recommended to adopt Treatment B (40% breadnut seeds, 60% jackfruit seeds) as the standard formulation for breadnut-jackfruit seeds croquette with moringa leaves.

The use of breadnut, jackfruit seeds, and moringa leaves in croquette preparation is highly encouraged for its nutritional benefits and potential in promoting sustainable, plant-based food innovations. The product is recommended for inclusion in household meals, school feeding programs, and community-based nutrition initiatives.

The product may exhibited in food fairs and university research showcases to raise awareness about its originality, nutritional value, and sustainability. This can inspire further research and entrepreneurship in alternative food products.

The researcher encourages the consumers and experts namely: customers, students, teachers, vendors, dietitian, food industry, health and wellness sector, retailers and distributors, agricultural sector and future researchers to adopt the method of breadnut-jackfruit seeds with moringa leaves in making croquette.

Future researchers are encouraged to explore additional variations of the product, including different preparation methods such baking and frying. The use of other local vegetables and herbs to further enhance nutritional value, shelf life, and consumer appeal is also recommended. Moreover, future studies may focus on cost analysis, consumer marketing strategies, and large-scale production to support potential commercialization and sustainability of the product in both local and broader markets.

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