Research Article

Sensory Acceptability of Jackfruit (*Artocarpus heterophyllus Lam.*) Seed Food Spread

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Abstract

This study examined the sensory acceptability of jackfruit (*Artocarpus heterophyllus Lam.*) seed spread. It aimed to determine the sensory acceptability of each treatment in terms of color, texture, aroma, and taste. It analyzed the significant differences in sensory qualities among the experimental treatments as well as the significant differences between the experimental treatments and the control. This study used a completely randomized design composed of sixty (60) evaluators comprised of students, faculty, and staff of a culinary school and food production workers. The mean, Z-test, and analysis of variance were used to analyze the data. The results indicated that the experimental treatments received moderately acceptable ratings in terms of aroma, texture, color, and taste. The control treatment received acceptable ratings for texture, color, and taste, with a moderately acceptable rating for aroma. Overall, the experimental treatments were generally considered moderately acceptable, while the control treatment was rated as acceptable. The study also showed that there was a significant difference among the experimental treatments in terms of aroma, texture, color, and taste. Treatments 3 and 4 showed a consistent result that was considerably comparable to the control treatment.

Keywords:

Experimental research, jackfruit seed, peanut butter, sensory acceptability, food spread

1 Introduction

The jackfruit tree has a vast number of uses besides fruit production. The jackfruit seed is also edible and a rich source of carbohydrates, which makes it possible to produce starchy flour (Dass, 2017). Jackfruit seeds have been reported to contain a rich nutritional contents minerals, vitamins, flavonoids, antioxidants, amino acids and fiber (Suzihaque, et al., 2022; Swami, et al., 2012). Flours made from jackfruit seeds can be stored for a long time and can further be utilized individually or blended with other grain flours to manufacture new food items such as cake, bread, and biscuits without affecting the functional and sensory profiles of the final product (Akter & Haque, 2018). However, in a broader sense, there is a need to explore the commercial production of jackfruit seeds and their incorporation into food products. Products with jackfruit seed flour possess better nutraceutical appeal, leading to improved consumer acceptability (Waghmare et al., 2019).

Seeds are typically discarded as waste because of their perishable nature; however, when preserved in a cold, moist environment, they have a shelf life of approximately one month. To increase shelf life, roasted seeds can be ground into a powder and utilized to produce a variety of value-added goods (Chhotaray & Priyadarshini, 2022). As a cost-effective alternative, jackfruit seeds have seen a rise in demand as consumers become more aware of the correlation between diet and health. This food is not only nutritionally beneficial but is also believed to have additional physiological properties that make it a potent functional food (Waghmare et al., 2019).

Despite its nutritional content and numerous health advantages, jackfruit is rarely cultivated on a large scale as a business crop because of its short shelf life and lack of processing infrastructure in the areas where it is grown (Ranasinghe, 2019). Although it is a well-known fruit in Asia, its seeds are commonly underutilized and receive little regard from people (Waghmare et al., 2019). The common reason for not consuming seeds is that it is not a traditional practice; most people are not aware of the use of seed flour, and they lack awareness of nutrient content and decent technologies for the utilization of jackfruit seeds in food formulations (Akter & Haque, 2018).

A limited amount of research has been devoted to the investigation of the possibilities for the conversion of jackfruit waste into value-added products (Ranasinghe, 2019). From the different studies, it is seen that the medicinal and nutritional importance of jackfruit is very high, and because of ignorance, the seeds are generally discarded as waste (Chhotaray & Priyadarshini, 2022). This study addresses this empirical gap. This study explored the possible use of jackfruit seed as an alternative to flour used in food production. Additional experimental studies have suggested the utilization of jackfruit seeds in various food products (Waghmare et al., 2019). The possibility of jackfruit being consumed as food was supported; therefore, researchers have recommended further study on the processing of the seeds and use of other varieties of jackfruit local to them (Satheeshan, et al., 2019). In this study, jackfruit seed flour was processed and used as a substitute for peanut butter. Although peanuts are considered one of the major field legumes in the Philippines, there has been a decline in their production volume over the years (Department of Agriculture, 2019). Therefore, this study aimed to introduce a new source of peanut butter-like products using jackfruit seeds.

This research aimed to determine the sensory acceptability of jackfruit (*Artocarpus heterophyllus Lam.*) seeds as food spread. Specifically, it aims to (1) determine the acceptability of its sensory qualities in terms of aroma, texture, color, and taste; (2) determine if there is a significant difference among the experimental treatments in terms of aroma, texture, color, and taste; and (3) determine if there is a significant difference between the control and the experimental treatments in terms of aroma, texture, color, and taste.

2 Literature Review

2.1 Jackfruit *(Artocarpus heterophyllus Lam.)* Seed

Jackfruit seeds are edible and can be eaten raw or cooked in various dishes. Although they are consumed, they are often discarded or damaged because of their high moisture content. However, Royees and Pandey (2022) shared that the seeds may be roasted, boiled, or preserved in syrup and can be blended with wheat flour to create flour for baking.

Jackfruits are highly regarded in tropical countries for their flavor and aroma (Chai et al., 2021) and are commonly consumed alone, in a fruit salad, or as part of regional dishes. They are common food sources in the Philippines, are eaten as part of dishes like ginataang langka (jackfruit in coconut milk), and are used to make sweets. They are useful elements in bakeries, such as cookies (Maskey, et al., 2020).

Jackfruit (*Artocarpus heterophyllus Lam.*), native to India, is the largest tree-borne fruit. Pulps are eaten, and seeds, rind, and core are usually discarded. Jackfruit seeds are 2-4 cm long and 1.5–2.5 cm thick and are oval, ellipsoid, or round in shape. Each fruit typically has 100–400 seeds, 10% of which are used, whereas the remainder is wasted. These nutrient-rich seeds are available from March to July, and their consumption is encouraged to prevent waste and improve nutritional security (Borgis & Bharati, 2020).

Jackfruit seeds are a rich source of nutrients with antimicrobial and antibacterial properties. They provide protein, fiber, vitamin B, potassium, and carbohydrates, as well as insoluble fibers that help with digestion. Jackfruit seeds offer detoxifying benefits for the colon and promote healthy digestion. Additionally, fiber helps regulate digestive processes, promotes heart health, and reduces the risk of cardiovascular diseases. The protein found in jackfruit seeds is cholesterol-free and a rich source of iron (Kumari, Prasad, & Gupta, 2018).

Some studies have revealed that jackfruit seeds possess many valuable properties. Jackfruit seeds have been found to have a high starch content, making them suitable for starch isolation (Choy et al., 2016). Waghmare et al., 2019 added that incorporating jackfruit seed flour at the optimal concentration has demonstrated that it enhances the nutritional content, physicochemical, textural, color, and sensory qualities of various products.

2.2 Utilization of Jackfruit Seeds in Other Studies

Interest in utilizing jackfruit (*Artocarpus heterophyllus Lam.*) starch is growing, as it is grown in Asia, the Americas, and the Caribbean with low input costs. Jackfruit starch accounts for 8–15% of fruit weight and is known for its unique structural and functional features, making it a cheap, sustainable carbohydrate source with potential for various applications (Zhang et al., 2021). Recent studies have suggested that jackfruit seeds, which are also abundant in certain areas of Brazil, can potentially be used as a natural source of chocolate aroma. This could have a major impact on the flavor industry, as jackfruits contain compounds that are known for their sweet, cocoa-like scent and taste (Spada et al., 2021). Fermentation of jackfruit seed flours has been shown to have a significant effect on chocolate aroma in experimental beverages. Formulations containing fermented jackfruit seeds had more volatile and odor-active constituents than those made with non-alkaline cocoa powder. These results suggest that fermented jackfruit seed flours may be used as an additive to enhance the chocolate aroma in food products (Spada et al., 2022).

In an experiment by Khang et al. (2020), jackfruit seed starch exhibited properties similar to those of commercial starch. Adding more than 10% jackfruit seed starch to the pancake mix could impact the color, texture, and sensory value of the cupcake; therefore, its use should be limited to 10% or less. Several studies have shown that jackfruit seeds can be used in various applications. An innovative energy drink was created by combining jackfruit seed powder, date powder, and coffee powder and was determined to be nutritionally superior to other energy drinks available for purchase (Farhan et al., 2022). A study by Spada et al. (2018) stated that dry jackfruit seed flour adds a chocolate aroma to beverages. It can be used to replace up to 75% of the cocoa powder in cappuccino formulations without negatively affecting their sensory acceptability or characteristics.

3 Methodology

3.1 Materials

Knife, chopping board, food processor, blender, saucepan, grinder, oven, frying pan, measuring cups, measuring spoons, and mixing bowls were used to produce the treatments. All materials and equipment used were clean, thoroughly washed, sterilized.

3.2 Production Jackfruit Seed Spread

All jackfruit seeds were sourced and purchased from the local jackfruit harvesters in the Municipality of Polomolok, South Cotabato Province, Philippines. The seeds were thoroughly washed and peeled off. After which, the seeds were cut into bits and roasted in an oven at a temperature of 170 degrees Celsius for 10 minutes. Roasted seeds were fried in a small amount of oil until they turned golden brown in color. Using the food processor, all the seeds, including other ingredients, were put in and blended until smooth and creamy in consistency.

3.3 Composition Experimental Treatments and Control

Five (5) treatments, as shown in Table 1, were used in this experiment with a completely randomized design (CRD). Ratings by the evaluators were analyzed using mean, analysis of variance (ANOVA), and Z-test.

3.4 Sensory Evaluators

Sixty (60) respondents served as the panel of sensory evaluators for the study. The panel of evaluators was composed of students, faculty, and staff of the Joji Ilagan International School of Hotel and Tourism Management, as well as food production workers.

Table 1: Experimental Treatments and the Control

Treatment	Ratio	Composition
T1	100% JackfruitSeed	300 grams roasted jackfruit seed +1tsp Salt + 1tbsp sugar+ 1tsp vegetable oil
T2	75% Jackfruit Seed; 25% Peanut	225 grams roasted jackfruit seed+ 75grams roasted peanut + 1tsp Salt + 1tbsp sugar+ 1tsp vegetable oil
T3	50% Jackfruit Seed; 50% Peanut	150 grams Roasted jackfruit seed +150 grams roasted peanut + 1tsp Salt + 1tbsp sugar+ 1tsp vegetable oil
T4	25% Jackfruit Seed; 75% Peanut	75 grams Roasted jackfruit seed + 225grams roasted peanut + 1tsp Salt + 1tbsp sugar+ 1tsp vegetable oil
T5 (Control)	100% Peanut	Commercial peanut butter

3.5 Sensory Evaluation Procedures

The researchers secured permission from the school dean of the Joji Ilagan International School of Hotel and Tourism Management School Program before the actual conduct of the research. The researchers were able to obtain permission from the person in charge of the school kitchen laboratory to conduct the sensory evaluation on school premises.

During the sensory evaluation, the treatments were placed in a small plastic container labeled as Treatment 1, Treatment 2, Treatment 3, Treatment 4, and Treatment 5. The evaluators were instructed to taste each treatment sequentially. They were provided with water to drink to wash out the taste of every treatment.

The researchers provided evaluation forms to the evaluators and instructed them on how to fill them out and rate the treatments. The purpose of the study was clearly explained to them. Since the treatments contained peas that may cause allergies, all evaluators were asked to voluntarily participate and be made aware of the ingredients contained in the treatments. The collected survey results were then checked for completeness and compiled for data analysis. The sensory acceptability of the treatments was assessed using a 5-point hedonic scale as this was used by many food acceptance and experimental studies (e.g., in Berdos et al., 2021, and Zhi, et al., 2016). Further, Mihafu et al. (2019) mentioned that the 5-point hedonic scale is one of the most widely used sensory evaluation methods that measures the level of liking of food products by consumers. This scale allows participants to provide their responses based on their preferences, ranging from disliked very much (1.0–1.49) to liked very much (4.5–5.0).

3.6 Data Analysis

Weighted means were used to describe the acceptability of each treatment. Analysis of Variance (ANOVA) was used to analyze significant differences among the experimental treatments in terms of aroma, texture, color, and taste. Z- Test was used to analyze the significant difference between the control and experimental treatments in terms of aroma, texture, color, and taste.

3.7 Ethical Considerations

Product tastings were conducted with the utmost respect by participants or evaluators. These considerations include ensuring the safety and health of all evaluators and providing clear information to participants about the food being tasted, the purpose of the study, and their rights and responsibilities. Respect for the autonomy of the participants was observed; the evaluators were given full information about the study and were given the right to decide whether to participate. Informed consent was obtained from each evaluator before conducting the study. In addition, the research ensured that there was no harm to the evaluators. This ensured that all food provided was safe, healthy, and of high quality.

4 Findings

4.1 Acceptability of the Experimental Treatments and the Control

Table 2 presents the acceptability of the sensory qualities of jackfruit *(Artocarpus heterophyllus)* seed spreads. In terms of aroma, all experimental treatments were rated moderately acceptable with a mean of 2.68 (SD=.75), 2.95 (SD=.59), 3.40 (SD=.64), 3.25 (SD=.68), and 3.48 (SD=.60), respectively. The textures of all experimental treatments were rated moderately acceptable with mean values of 2.55 (SD=.89), 2.80 (SD=.78), 3.27 (SD=.80), and 3.22 (SD=.69), respectively, while treatment 5 was rated acceptable with a mean of 3.53 (SD=.64). In terms of color, all experimental treatments were rated moderately acceptable with means of 2.67 (SD=.75), 2.93 (SD=.78), 3.40 (SD=.72), and 3.18 (SD=.72), respectively, while the control was rated acceptable with a mean of 3.57 (SD=.65). In terms of taste, all experimental treatments were rated moderately acceptable with a mean of 2.73 (SD=.88), 2.88 (SD=.69), 3.40 (SD=.69), and 3.30 (SD=.67), respectively, whereas treatment 5 or the control received a rating of acceptable with a mean of 3.57 (SD=.58). It shows that all experimental treatments garnered a general rating of moderately acceptable, while treatment 5 obtained a general rating of acceptable. Observing the data, treatment 3 posted the highest rates of sensory qualities among the experimental treatments and was the closest to the acceptability ratings of the control treatment.

Table 2: Acceptability of the Experimental Treatments and the Control in Terms of the Sensory Qualities

Treatment	Aroma	SD	Texture	SD	Color	SD	Taste	SD	Mean	Interpretation
T1	2.68	.75	2.55	.89	2.67	.75	2.73	.88	**2.66**	Moderately acceptable
T2	2.95	.59	2.8	.78	2.93	.78	2.88	.69	**2.89**	Moderately acceptable
T3	3.4	.64	3.27	.80	3.4	.72	3.4	.69	**3.37**	Moderately acceptable
T4	3.25	.68	3.22	.69	3.18	.72	3.3	.67	**3.24**	Moderately acceptable
T5 (control)	3.48	.60	3.53	.64	3.57	.65	3.57	.58	**3.54**	Acceptable

Legend: 4.5 – 5.0 = Highly Acceptable; 3.5 – 4.49 = Acceptable; 2.5 – 3.49 = Moderately Acceptable; 1.5 – 2.49 Fairly Acceptable; 1.0 – 1.49 = Not Acceptable

4.2 The Significant Difference among the Experimental Treatments in Terms of Aroma, Texture, Color, and Taste

Table 3 presents the analysis of the differences among the experimental treatments in terms of aroma, texture, color, and taste. All p-values (0.00) were less than the significance level (0.05), and all F-values of aroma, texture, color, and taste (13.657, 11.249, 10.882, and 11.337, respectively) were greater than F-critical (2.643). This indicated that there was a significant difference in the sensory qualities among the experimental treatments. This indicates that the aroma, texture, color, and taste of the experimental treatments differed significantly from each other.

Table 3: Analysis of Variance (ANOVA) on the Difference in the Acceptability of Sensory Qualities among Experimental Treatments

ANOVA- Aroma

Source of Variation	*SS*	*df*	*MS*	*F*	*P- value*	*F crit*
Between Groups	18.31	3	6.104	13.657	0.000	2.643
Within Groups	105.48	236	0.447			
Total	123.80	239				

ANOVA- Texture

Source of Variation	*SS*	*df*	*MS*	*F*	*P- value*	*F crit*

Between Groups	21.217	3	7.072	11.249	0.000	2.643
Within Groups	148.367	236	0.629			
Total	169.5833333	239				

ANOVA- Color

Source of Variation	***SS***	***df***	***MS***	***F***	***P- value***	***F crit***
Between Groups	18.046	3	6.015	10.882	0.000	2.643
Within Groups	130.450	236	0.553			
Total	148.496	239				

ANOVA- Taste

Source of Variation	SS	***df***	***MS***	***F***	***P- value***	***F crit***
Between Groups	18.579	3	6.193	11.337	0.000	2.643
Within Groups	128.917	236	0.546			
Total	147.496	239				

4.3 The Significant Difference Between the Control and the Experimental Treatments in Terms of Taste, Appearance, Texture, and Aroma

Table 4 shows a summary of the z-test statistics conducted to determine the significance between experimental and control treatments. In terms of aroma, Treatment 1 and Treatment 5 were observed to have a significant difference at a P-value of 0.014; however, the average mean in terms of aroma at 0.129 was not significantly different from that of the control group. This can be interpreted as respondents liking the aroma of the experimental product as much as they liked the control product.

Table 4: Z-test on the between the Control and Experimental Treatments in Terms of Aroma, Texture, Appearance, and Taste.

Sensory Qualities	***Treatments***	***P-value***	***Remarks***	***Sensory Qualities***	***Treatments***	***P-value***	***Remarks***
Aroma	T1 vs T5	0.014	Significant	Color	T1 vs T5	0.007	Significant
	T2 vs T5	0.072	Not Significant		T2 vs T5	0.041	Not Significant
	T3 vs T5	0.410	Not Significant		T3 vs T5	0.324	Not Significant
	T4 vs T5	0.261	Not Significant		T4 vs T5	0.147	Not Significant
	Ave vs T5	**0.129**	**Not Significant**		**Ave vs T5**	**0.077**	**Not Significant**
Texture	T1 vs T5	0.002	Significant	Taste	T1 vs T5	0.006	Significant
	T2 vs T5	0.013	Significant		T2 vs T5	0.018	Significant
	T3 vs T5	0.169	Not Significant		T3 vs T5	0.247	Not Significant
	T4 vs T5	0.137	Not Significant		T4 vs T5	0.169	Not Significant
	Ave vs T5	**0.036**	**Significant**		**Ave vs T5**	**0.059**	**Not Significant**

In terms of texture, Treatment 1 and Treatment 2 were observed to have a significant difference from T5 at P values of 0.002 and 0.013; however, the average mean in terms of texture at 0.036 was significantly different from that of the control group. This means that the evaluators liked or disliked the control in terms of texture.

For color, Treatment 1 was observed to have a significant difference (P = 0.007); however, the average mean in terms of color at 0.077 was not significantly different from that of the control group. This means that the respondents liked the color of the experimental product as much as they liked the control product.

The tastes of Treatment 1 and Treatment 2 were significantly different from T5 at P values of 0.006 and 0.018; however, the average mean texture at 0.059 was not significantly different from that of the control group. This can be interpreted as meaning that the respondents liked the taste of the experimental product as much as they liked the control product on average.

5 Conclusion

Based on the results presented, it can be observed that all experimental treatments of jackfruit seed spread were moderately accepted in terms of their sensory qualities by the evaluators. This means that the evaluators liked or disliked the experimental treatments considerably. Treatment 3 had the highest mean rating, consistently gained higher sensory acceptance among the experimental treatments, and showed the least difference compared to the control (Treatment 5). Thus, Treatment 3 had the closest sensory quality acceptance to the standard or commercial product. The present study supports previous studies (for example, Khan et al., 2017; Wagmare et al., 2019; Habibah et al., 2021) showing that adding jackfruit seed flour can improve the sensory characteristics of food products. This has been shown in some experiments (for example, Akter & Haque, 2018; Papa Spada, et al., 2018; Ravindran, et al., 2020; Shinde, et al., 2021) that foods fortified with jackfruit seed may not sufficiently alter the flavor of a food. The results of the present study and previous studies reinforce the claim that jackfruit seeds can be a significant food source or food component.

6 Implications

6.1 Implications to Culinary Practice

Based on the results, texture gained the least acceptance among all experimental treatments. Due to the limited availability of the grinding machine in the area, a food processor was used to produce the paste, hence, it is recommended that the treatments be replicated using other equipment that may improve the texture of the jackfruit seed paste. If culinary professionals and households will use this product, it is recommended that they use a 1:1 ratio of jackfruit seed-peanut paste, as this treatment posted the highest acceptance of sensory qualities by the evaluators.

6.2 Implications to Research

This research recommends further analysis of the shelf life of jackfruit seed paste and its nutritional content. Other statistical analyses to test the acceptability of the product may be used to elicit deeper differences between the treatments. Future researchers may conduct a cost-return analysis of the experimental treatments and the control treatment to identify the potential economic return of the product.

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