

Comparative Analysis of Jackfruit (*Artocarpus heterophyllus*) Seeds as a Caffeine-Free Coffee Alternative from Vietnam and Bicol

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Abstract

The increasing demand for sustainable and caffeine-free beverage alternatives has encouraged researchers to explore underutilized agricultural by-products as substitutes for conventional coffee. This study investigated the potential of roasted jackfruit (*Artocarpus heterophyllus*) seeds from Bicol, Philippines and Vietnam as caffeine-free coffee alternatives and compared their sensory characteristics with Arabica coffee.

An experimental comparative research design was utilized. Jackfruit seeds underwent boiling, drying, roasting, grinding, and brewing procedures under controlled conditions. The resulting beverages were evaluated based on color, aroma, flavor intensity, and overall acceptability. Findings revealed that both jackfruit seed coffees possessed sensory properties comparable to conventional coffee, particularly after roasting due to the Maillard reaction. However, coffee produced from Bicol jackfruit seeds demonstrated stronger flavor intensity and was more frequently associated with the characteristics of Arabica coffee.

The study concludes that roasted jackfruit seeds show promise as a sustainable, caffeine-free coffee substitute while simultaneously contributing to food waste reduction. The findings support the potential utilization of agricultural waste products in developing functional and environmentally sustainable beverages.

Keywords: Jackfruit seed coffee, *Artocarpus heterophyllus*, caffeine-free coffee, food waste reduction, sustainable food innovation, coffee alternative, sensory evaluation

Introduction

Background of the Study

Food waste remains a major global environmental challenge. According to the United Nations, food waste contributes significantly to greenhouse gas emissions through methane production during decomposition in landfills (United Nations, n.d.). In the Philippines, agricultural losses remain a persistent issue, particularly involving underutilized by-products such as fruit seeds (Mopera, 2016).

Jackfruit (*Artocarpus heterophyllus*), locally known as “langka,” is widely cultivated throughout the Philippines and other tropical countries. While the edible flesh of the fruit is commonly consumed, the seeds are often discarded despite their nutritional value. Previous studies have shown that jackfruit seeds contain resistant starch, protein, dietary fiber, magnesium, riboflavin, thiamine, and antioxidants (Hettiaratchi et al., 2011). Additionally, López-Martínez et al. (2024) identified jackfruit seeds as a promising functional by-product for the food industry because of their nutritional composition and potential applications in sustainable food systems.

Coffee remains one of the most consumed beverages worldwide. In the Philippines, coffee consumption continues to increase due to cultural and social practices associated with drinking coffee (MacDonnell, 2024). However, excessive caffeine consumption may contribute to adverse health effects such as insomnia, anxiety, elevated blood pressure, and increased heart rate (Food and Nutrition Board, 2014). Cleveland Clinic (2025) further noted that caffeine may temporarily increase blood pressure by constricting blood vessels, while Houston Methodist explained that caffeine interferes with adenosine receptors responsible for sleep regulation (McCallum, 2023).

Recent studies have suggested that roasted jackfruit seeds may produce flavor and aroma compounds similar to coffee due to the Maillard reaction, a non-enzymatic browning process occurring during roasting (Science of Cooking, n.d.). Casuga (2025) reported that jackfruit seed coffee was generally accepted as a caffeine-free alternative beverage using sensory evaluation methods.

Given these findings, this study explored the feasibility of using roasted jackfruit seeds as a caffeine-free coffee substitute while comparing seeds sourced from Bicol and Vietnam to determine which more closely resembled Arabica coffee in sensory characteristics and acceptability.

Statement of the Problem

This study aimed to determine which jackfruit (*Artocarpus heterophyllus*) seeds produced a more acceptable caffeine-free coffee alternative: seeds from Vietnam or seeds from Bicol.

Specifically, the study sought to answer the following questions:

1. What sensory characteristics (taste, aroma, and color) are present in coffee made from Vietnam and Bicol jackfruit seeds?

- 2. Is there a noticeable difference in the acceptability of jackfruit seed coffee made from Vietnam and Bicol seeds?
 - 3. Which jackfruit seed coffee is more preferred in terms of color, aroma, intensity, and overall acceptability?
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Hypothesis

The researchers hypothesized that both jackfruit seed coffees would possess characteristics similar to regular coffee. It was further hypothesized that only minor sensory differences would exist between the Vietnam and Bicol jackfruit seeds due to their shared botanical origin. Lastly, it was hypothesized that the Bicol jackfruit seed coffee would receive higher acceptability ratings.

Review of Related Literature

Previous studies have emphasized the health implications of excessive caffeine consumption. According to the Food and Nutrition Board (2014), caffeine stimulates the cardiovascular system and may increase blood pressure among sensitive individuals. Similarly, Cleveland Clinic (2025) reported that caffeine can constrict blood vessels and elevate blood pressure levels. McCallum (2023) further explained that caffeine blocks adenosine receptors in the brain, thereby interfering with normal sleep regulation.

In contrast, jackfruit seeds are recognized for their nutritional benefits. Vinmec International Hospital (2025) reported that jackfruit seeds contain starch, protein, vitamins, minerals, and antioxidants. Hettiaratchi et al. (2011) similarly identified jackfruit seeds as nutritionally valuable because of their fiber and resistant starch content.

Research on jackfruit seed coffee alternatives remains limited but promising. Casuga (2025) investigated the consumer acceptability of jackfruit seed coffee and concluded that it could serve as a sustainable and health-conscious alternative to traditional coffee beverages. The roasting process is particularly important because it promotes the Maillard reaction, which generates flavor and aroma compounds associated with roasted coffee products (Science of Cooking, n.d.).

Methodology

Research Design

The study utilized an experimental comparative design to evaluate the sensory characteristics and acceptability of jackfruit seed coffee made from seeds sourced from Vietnam and Bicol.

Materials

The study utilized the following materials: Bicol jackfruit seeds, Vietnam jackfruit seeds, Arabica coffee beans, water, mortar and pestle, coffee filters, pan, baking tray, pot, cups, measuring spoons, thermometer, kitchen scale, spatula, tongs, kettle, and baking paper.

Variables

Independent Variable

- Source of jackfruit seeds (Vietnam and Bicol)

Dependent Variables

- Aroma
- Color
- Flavor intensity
- Overall acceptability

Controlled Variables

- Amount of seeds used
 - Roasting duration
 - Brewing temperature
 - Brewing time
 - Water volume
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Procedure

Preparation of Materials

The jackfruit seeds were weighed to approximately 15 grams and washed thoroughly. All laboratory materials and utensils were cleaned prior to experimentation. Baking paper was placed on the baking tray before drying procedures commenced.

Preparation of Jackfruit Seed Coffee

The seeds were boiled in water until the temperature reached 90°C and maintained for 10 minutes. The boiled seeds were peeled, crushed, and dried in an oven at 80°C for one hour. After drying, the seeds were roasted for approximately six minutes and thirty seconds until brown and aromatic. The roasted seeds were ground into powder and brewed using 75 mL of water heated to 90°C. The mixture was brewed for five minutes before filtration and serving.

Preparation of Arabica Coffee

Arabica coffee beans were ground and brewed under similar brewing conditions to serve as the control beverage for comparison.

Results and Discussion

The study found that both jackfruit seed coffees exhibited characteristics similar to Arabica coffee in terms of color and bitterness. However, sensory differences between the Vietnam and Bicol samples were observed.

The Vietnam jackfruit seeds were larger in size but produced a milder coffee flavor. In contrast, the Bicol jackfruit seeds produced a stronger and more bitter flavor profile that respondents associated more closely with regular coffee. Both jackfruit seed coffees possessed lighter brown coloration compared to Arabica coffee.

Additionally, both jackfruit seed coffees exhibited a more herbal aroma, whereas Arabica coffee demonstrated a stronger earthy scent. During sensory observations, the Bicol jackfruit seed coffee was more frequently mistaken for regular coffee than the Vietnam sample. These findings align with previous literature suggesting that roasting enhances flavor complexity in jackfruit seeds through Maillard browning reactions.

The comparative images presented on page 5 of the manuscript further demonstrate the visible differences in seed size, roasted powder appearance, and brewed coffee color between the two jackfruit seed samples and Arabica coffee.

Conclusion

The findings of this study indicate that roasted jackfruit seeds possess characteristics similar to conventional coffee, particularly in color and flavor intensity. Among the two seed sources evaluated, Bicol jackfruit seeds demonstrated greater similarity to Arabica coffee in terms of sensory acceptability and flavor strength.

The study further highlights the potential of utilizing jackfruit seeds as a sustainable food innovation that contributes to food waste reduction while providing consumers with a caffeine-free coffee alternative. These findings support the continued exploration of agricultural by-products for functional beverage development.

Recommendations

Future researchers are encouraged to:

- Conduct laboratory-based chemical and pH analyses of jackfruit seed coffee
- Utilize standardized sensory evaluation rubrics
- Increase the number of respondents for sensory testing
- Investigate the nutritional composition of roasted jackfruit seed coffee
- Explore commercial feasibility and product development opportunities

Researchers should also carefully control roasting conditions to prevent over-roasting and burnt flavor development.

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