

Evaluation of Pulp Flavor Profile and Consumer Acceptability of Jackfruit (*Artocarpus heterophyllus* Lam.) at Different Maturity Stages

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ABSTRACT

Background: The flavor and aroma profile are a key determinant of consumer acceptance and marketability for tropical fruits, such as jackfruit (*Artocarpus heterophyllus* Lam.). While flavor compound development is known to evolve significantly during fruit maturation, a gap remains in comprehensive scientific research focused on how each specific stage of maturity affects the sensory profile and consumer acceptability of jackfruit pulp. This study aimed to analyze the flavor attributes and acceptability of jackfruit pulp harvested at different maturity stages, providing a scientific basis for optimizing harvest timing to produce pulp with superior sensory qualities.

Methods: The research employed a quantitative descriptive sensory analysis and 9-point hedonic rating scales to evaluate sensory attributes, including aroma, taste, color, and overall acceptability, across jackfruit pulp harvested at various stages (80 to 150 Days after Female Flower Selection, or DFFS).

Results: Results showed that mature jackfruit pulp harvested between 120 and 140 DFFS (T5 to T7) exhibited significantly enhanced flavor and aroma characteristics, correlating with the highest consumer preference scores, which fell under the "like moderately to like very much" category. Specifically, pulp from this optimal range scored highest for color (up to 8.19), aroma (up to 8.62), and taste (up to 8.43). Conversely, early-stage fruits (80-90 DFFS) displayed less developed sensory attributes (e.g., "None jackfruit aroma" and "Bland" taste), resulting in the lowest acceptability, categorized as "dislike moderately to dislike very much".

Conclusion: The findings demonstrate that optimal harvest timing is crucial for achieving desirable sensory qualities in jackfruit pulp, providing valuable insights for growers and processors aiming to improve product quality and marketability.

Keywords: Flavor profile, sensory evaluation, descriptive analysis, hedonic scale, consumer acceptability, harvest timing

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1. Introduction

Flavor and aroma are key determinants of fruit acceptance and marketability, especially for tropical fruits like jackfruit (*Artocarpus heterophyllus* Lam.) (Khan et al., 2014; Singh et al., 2016). The development of flavor compounds during ripening influences consumer preference and perceived quality (Zhang et al., 2013). Previous research indicates that flavor profiles evolve

significantly as the fruit matures, affecting aroma intensity, taste, and overall acceptability (Verma & Singh, 2015; Sultana et al., 2017). Sensory evaluation techniques are therefore essential tools for quantifying these preferences and guiding harvest decisions (Mishra & Kumar, 2018).

Jackfruit is a large, tropical fruit widely grown across Asia, valued for its nutritional content and its increasing global demand as a meat substitute when unripe. The acceptability of mature jackfruit pulp hinges on the complex interplay of volatile and non-volatile compounds (sugars, acids, etc.) that develop during maturation. These biochemical transformations increase sugar concentration while reducing starch and astringent compounds like tannins, thereby enhancing sweetness and reducing undesirable sourness (Chowdhury et al., 1997; Moneruzzaman et al., 2008). Understanding the precise stage at which jackfruit develops its optimal flavor characteristics is critical for growers and processors.

Although the fruit is consumed at various ripening stages, a gap remains in comprehensive scientific research focused on how each specific stage of maturity affects the sensory profile of the pulp and, consequently, consumer preference. Determining the optimal maturity stage is critical for improving consumer satisfaction and commercial processing consistency. Studies confirm that fruit maturity plays a crucial role in determining volatile composition and sugar-acid balance (Zhang et al., 2013; Verma & Singh, 2015). The variability in maturity stages at harvest often leads to inconsistency in product quality, posing a challenge to commercialization and standardization.

This study was therefore undertaken to evaluate the flavor profile and consumer acceptability of jackfruit pulp harvested at different maturity stages. By employing a combination of descriptive sensory analysis and hedonic testing, the research aims to identify key flavor and aroma attributes associated with different stages of maturity and how these influence consumer liking. The findings aim to provide a scientifically grounded basis for optimizing harvest timing, supporting high standards of sensory satisfaction, and maximizing the commercial potential of jackfruit.

2. Materials and Methods

2.1 Data Collection Instruments

The study was designed as a quantitative investigation to assess the flavor profile and consumer acceptability of jackfruit pulp as influenced by different stages of fruit maturity. Jackfruits were

harvested and categorized into eight distinct maturity stages (T1 to T8) based on the number of Days after Female Flower Selection (DFFS), ranging from 80 DFFS to 150 DFFS. The primary data collection instruments involved descriptive sensory analysis to characterize attributes like aroma (e.g., jackfruit aroma, none) and taste (e.g., bland, sweet), and a 9-point hedonic rating scale to measure consumer acceptability for attributes including color, aroma, and taste. Consumers evaluated the pulp across all treatments. Objective color measurements, including lightness (L^*), greenness (a^*), yellowness (b^*), and browning index, were also recorded. Data analysis focused on determining the mean acceptability ratings for the sensory attributes and analyzing objective color parameters, with statistical significance determined using an LSD Test at the 5% level.

2.2. Data Gathering Procedure

Jackfruit was harvested at various stages of fruit maturity, ranging from 80 to 150 Days after Female Flower Selection (DFFS), which were designated as different treatments (T1 to T8). Pulp from each maturity stage was evaluated by consumers using the established sensory evaluation techniques.

2.3. Data Analysis

The study analyzed the sensory data, including mean acceptability ratings for color, aroma, and taste, across the different maturity stages (T1 to T8). Data on objective color parameters, specifically lightness (L^*), greenness (a^*), yellowness (b^*), and browning index, were also collected. Statistical analysis, likely involving an LSD Test, was used to determine significant differences in means at the 5% level for both acceptability and objective color parameters.

3. Results

3.1. Color

The color of jackfruit pulp at 80-150 DFFS ranges from intense brownish yellow to yellow. Consumer acceptability was highest for pulp harvested at 120-140 DFFS, falling under the “like moderately to like very much” category. This preference suggests that consumers associate a lighter, more vibrant

yellow/yellow color (Light yellow to Yellow) with optimal maturity and quality. Objectively, the pulp from 140 DFFS had the highest degree of greenness (a*) at 9.67 units, while the highest yellowness (b*) was observed at 110-120 DFFS and 140-150 DFFS. Lightness (L*) and browning index were not significantly affected by maturity stage.

The strong consumer preference for the specific yellow hues found at 120-140 DFFS underscores that visual quality is a significant factor in perceived ripeness and market value (Bwala et al., 2015). This finding is consistent with general postharvest principles where changes in visual pigments, such as the degradation of chlorophyll and synthesis of carotenoids, signal ripeness and directly impact consumer appeal (Wills et al., 2007). Growers should utilize these objective color characteristics alongside DFFS as key indicators for commercial harvest.

Treatments (DFFS)	Description	Acceptability*
T1 – 80	Intense brownish yellow	2.76 d
T2 – 90	Intense brownish yellow	2.71 d
T3 – 100	Slight to moderate brownish yellow	5.71 c
T4 – 110	Slight brownish yellow	6.67 b
T5 – 120	Light yellow	7.86 a
T6 – 130	Yellow	8.19 a
T7 – 140	Light yellow	8.14 a
T8 – 150	Light yellow	6.43 bc
CV (%)		7.24

*Means within column followed by a common/without letter are not significantly different from each other at 5% level using LSD Test. ¹N=7

²Acceptability Score: 9-like extremely, 8-like very much, 7-like moderately, 6-like slightly, 5-neither like nor dislike, 4-dislike slightly, 3-dislike moderately, 2-dislike very much, 1-dislike extremely

Table 1. Color description¹ and mean acceptability rating² of jackfruit pulp as influenced by different stages of fruit maturity

Treatments (days)	L (Lightness)	a* (Greenness)	b*(Yellowness)	Browning Index
T1 – 80	60.23	-4.10 b	7.77 b	0.02
T2 – 90	65.50	-3.77 b	12.37 b	0.03
T3 – 100	62.87	-5.87 b	20.07 ab	0.06
T4 – 110	59.00	-0.90 b	38.53 a	0.19
T5 – 120	66.43	-0.50 b	38.87 a	0.20
T6 – 130	58.60	-3.07 b	26.07 ab	0.13
T7 – 140	55.20	9.67 a	37.30 a	0.20
T8 – 150	62.93	-5.43 b	34.17 a	0.12
CV%	14.62	-277.79	46.52	76.77

Means within column followed by a common/without letter are not significantly different from each other at 5% level using LSD Test.

Table 2. Degree of lightness, greenness, yellowness and browning index of jackfruit pulp as influenced by different stages of fruit maturity

3.2. Aroma

The aroma of the jackfruit pulp at 80-150 DFFS ranged from none to moderate jackfruit aroma. The highest acceptable aroma was found in the pulp harvested at 120-140 DFFS, described as having a "Moderate jackfruit aroma" and scoring "like moderately to like very much". Conversely, pulp harvested at 80-90 DFFS had the lowest aroma acceptability, described as "None jackfruit aroma" or "None or absent," and scored in the "dislike moderately to dislike very much" category.

This significant change in aroma acceptability is directly attributed to the maturity-dependent development of volatile compounds (esters, ketones, and aldehydes) responsible for the characteristic sweet jackfruit aroma (Moneruzzaman et al., 2008). The results confirm that the concentration and favorable balance of these volatile flavor compounds peak around 120-140 DFFS. Since aroma is a critical driver of fruit acceptance (Khan et al., 2014; Singh et al., 2016), these findings provide a precise physiological window for achieving superior flavor quality.

3.3. Taste

The taste of the jackfruit pulp harvested at 80-150 DFFS ranged from bland to extremely sweet. The highest acceptable taste was consistently noted for the pulp harvested at 120-140 DFFS, categorized as "like moderately to like very much". These stages were described as "Slightly sweet" to "Extremely sweet". The lowest taste acceptability was found at 80-90 DFFS, where the taste was described as "Bland" and scored in the "dislike moderately to dislike very much" category.

The observed transition from bland to sweet is explained by biochemical transformations where starch is converted into simple sugars and astringent compounds (tannins) are reduced (Chowdhury et al., 1997). This enzymatic activity significantly increases the concentration of total soluble solids (TSS) and achieves the optimal sugar-acid balance necessary for maximum palatability (Moneruzzaman et al., 2008). These changes enhance sweetness and eliminate the undesirable bitterness or sourness typical of underdeveloped pulp, confirming that the 120-140 DFFS window is essential for maximizing consumer

preference and the fruit's economic potential (Swami et al., 2012).

Treatments (DFFS)	Aroma Description	^a Acceptability*	Taste Description	^b Acceptability*
T1 – 80	None jackfruit aroma	3.10 e	Bland	2.57 d
T2 – 90	None or absent	2.86 e	Bland	2.95 d
T3 – 100	None or absent	5.86 d	Slightly sweet	5.38 c
T4 – 110	Slight jackfruit aroma	6.76 cd	Very sweet	6.29 bc
T5 – 120	Moderate jackfruit aroma	8.62 a	Slightly sweet	7.81 a
T6 – 130	Moderate jackfruit aroma	8.19 ab	Extremely sweet	8.43 a
T7 – 140	Moderate jackfruit aroma	7.53 abc	Extremely sweet	7.29 ab
T8 – 150	Moderate jackfruit aroma	6.95 bcd	Sweet	6.24 bc
CV (%)		12.28		14.01

*Means within column followed by a common/without letter are not significantly different from each other at 5% level using LSD Test. ¹N=7

²Acceptability Score: 9-like extremely, 8-like very much, 7-like moderately, 6-like slightly, 5-neither like nor dislike, 4-dislike slightly, 3-dislike moderately, 2-dislike very much, 1-dislike extremely

Table 4. ^aAroma and ^btaste description¹ and mean acceptability rating² of jackfruit pulp as influenced by different stages of fruit maturity

5. Conclusions

The study concludes that the maturity stage of jackfruit significantly influences the sensory profile and consumer acceptability of the pulp. The most desirable sensory qualities, including color, aroma, and taste, culminated in the pulp harvested at 120 to 140 Days after Female Flower Selection (DFFS). Pulp from this optimal harvest window achieved the highest consumer acceptance scores, consistently falling within the "like moderately to like very much" category. Early-stage fruits (80-90 DFFS) were consistently rated lowest due to underdeveloped aroma and bland taste. These findings underscore the critical importance of optimal harvest timing for maximizing the sensory quality, market value, and consumer satisfaction of jackfruit.

6. Institutional Review Board Statement:

The study adhered to the Declaration of Helsinki and received ethical approval from the Institutional Review Board of Cebu Technological University – Barili Campus. Informed consent was obtained from all participants. Microbiological evaluation verified that all food samples were safe for consumption.

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