Physico-chemical Properties of Jackfruit (Artocarpus heterophyllus Lam.) Pulp at Various Maturity Stages

Janeth L. Lacostales[1*], Leonardo E. Lacostales[2]

[1]Cebu Technological University Barili Campus; janeth.lacostales@ctu.edu.ph

[2]Carcar City College; lacostalesnardz@gmail.com

***Correspondence:** janeth.lacostales@ctu.edu.ph

ABSTRACT

Background: The physico-chemical attributes of jackfruit pulp were examined across eight stages of maturity (80 to 150 Days after Female Flower Selection, DFFS) to determine their influence on fruit quality perception and consumer acceptability. This quantitative study assessed critical parameters, including total soluble solids (TSS), titratable acidity (TA), pH, firmness, and dry matter content, alongside consumer sensory evaluation using hedonic scales.

Results: Findings revealed significant variations across maturity stages. Total Soluble Solids (TSS) increased markedly from 4.00° Brix at 80 DFFS to a peak of 33.33° Brix at 150 DFFS. Pulp firmness also peaked at the latest stage (13.42 kg/cm² at 150 DFFS), while TA increased to 0.80%. These properties correlated directly with sensory data, confirming that fully mature fruits (120–150 DFFS) exhibit optimal TSS and flavor profiles, resulting in the highest consumer preference scores. Conversely, immature fruits displayed lower TSS, higher weight loss, and lower sensory ratings.

Conclusion: The study identifies that the complex relationship between increasing TSS and high firmness defines the optimal harvest window, underscoring the necessity of precise harvest timing to maximize the market potential and desirable sensory and nutritional attributes of high-quality jackfruit pulp.

Keywords: Total Soluble Solids (TSS); Titratable Acidity (TA); Firmness; Artocarpus heterophyllus; Quality Perception

How to cite this article: Lacostales JL, Lacostales LE. Physico-chemical Properties of Jackfruit (Artocarpus heterophyllus Lam.) Pulp at Various Maturity Stages. Int J Drug Deliv Technol. 2026;16(13s): 451-454. DOI: 10.25258/ijddt.16.13s.49

Source of support: Nil.

Conflict of interest: None

1. Introduction

Jackfruit (*Artocarpus heterophyllus* Lam.) is a significant tropical fruit crop, valued globally for its nutritional benefits (Ong & Teoh, 2010; Swami et al., 2012) and its increasing commercial demand as a meat substitute (Galvez & Dizon, E.I., 2017). The quality and market value of the edible pulp are intrinsically linked to its maturity stage. Ripening involves a complex sequence of physiological and biochemical transformations (Moneruzzaman et al., 2008), including the breakdown of starch into simpler sugars and the accumulation of aromatic volatiles. These changes directly determine consumer acceptability, influencing taste, aroma, texture, and color (Khan et al., 2014; Singh et al., 2016).

Among the objective physico-chemical indices used to evaluate fruit quality, Total Soluble Solids (TSS), Titratable Acidity (TA), pH, firmness, and dry matter content are critical. TSS, representing sugars, increases with ripening to enhance sweetness, while TA establishes the optimal sugar-acid balance (Chowdhury et al., 1997). Firmness, though generally expected to decrease, must be maintained to achieve a desirable texture and prevent mushiness

(Wills et al., 2007). Color changes are also a primary visual cue of ripeness (Bwala et al., 2015).

While studies confirm that maturity dictates volatile composition and sugar-acid balance in tropical fruits (Verma & Singh, 2015; Zhang et al., 2013), a significant research gap exists in precisely correlating these physico-chemical parameters with sensory preference for specific jackfruit varieties like 'Eviarc Sweet'. Determining the optimal harvest window requires a balanced assessment of chemical maturity (TSS) and structural integrity (firmness). Sensory evaluation techniques, specifically hedonic scaling, provide the necessary quantitative link between these chemical properties and consumer perception (Mishra & Kumar, 2018).

This study was thus undertaken to examine the physico-chemical properties of jackfruit pulp across different maturity stages and quantify their influence on sensory quality and consumer acceptability. The goal is to identify the optimal maturity stage for harvesting, thereby providing a scientific basis for enhancing the postharvest quality and market potential of the ‘Eviarc Sweet’ variety.

2. Materials and Methods

The study employed a Completely Randomized Design (CRD) to investigate the physico-chemical properties of jackfruit pulp across different maturity stages. The experimental material consisted of jackfruit pulp from the 'Eviarc Sweet' variety, a locally sourced and popular cultivar. The treatments were defined by eight distinct maturity stages (T1 to T8), ranging from 80 to 150 Days after Female Flower Selection (DFFS), with samples collected at 10-day intervals.

1.1. Data Collection Instruments

Data for the study were collected using a combination of objective physico-chemical instruments and subjective sensory evaluation tools. Objective measurements relied on a Digital Refractometer for determining Total Soluble Solids (TSS in ° Brix), an Automatic Titration System for measuring Titratable Acidity (TA), a Digital pH Meter, and a Handheld Penetrometer for quantifying pulp firmness (kg/cm^2).

1.2. Data Analysis

All data collected for both physico-chemical parameters and consumer acceptability were subjected to Analysis of Variance (ANOVA) to determine significant differences among the eight maturity stages. Where significant differences were identified, means were compared using the Least Significance Difference (LSD) test at the 5% level of significance ($p \leq 0.05$). Statistical computations were performed using the STAR statistical software package.

3. Results

3.1. Pulp Physico-Chemical Parameters

Data on the physico-chemical properties of jackfruit pulp were significantly affected by fruit maturity stage, except for pH. A sharp increase in Total Soluble Solids (TSS) was observed as the fruit matured, ranging from 4.00° Brix at 80 DFFS to a peak of 33.33° Brix at 150 DFFS. The dramatic increase in TSS, primarily composed of sugars, is a strong indicator of advancing ripeness. This is consistent with literature reporting that sugar content generally increases as complex carbohydrates are broken down during ripening (Moneruzzaman et al., 2008).

The Titratable Acidity (TA) also showed an increase, reaching a high of 0.80%at 150 DFFS. While TA often decreases or remains stable during ripening, the increase in both TSS and TA in the later stages of this variety suggests a unique metabolic profile where the high accumulation of sugar effectively balances the acidity, leading to a highly palatable taste.

The firmness of the pulp was highest at the latest stage, 150 DFFS, measuring 13.42 kg/cm^2. This result deviates from the typical expectation that firmness decreases in ripening fruits due to enzymatic softening (Hulme, 1970). This maintenance or increase in structural integrity, alongside high dry weight accumulation (9.47% at 150 DFFS), is a notable characteristic of this variety.

The simultaneous presence of maximal TSS (sweetness) and maximal firmness (structural integrity) at the latest maturity stage (150 DFFS) is highly significant for the market. High TSS confirms optimal nutritional and taste development (Swami et al., 2012), while the high firmness indicates superior postharvest quality and potential for extended shelf-life, as textural

breakdown—a primary cause of post-harvest loss—is minimized (Wills et al., 2007). This suggests the 'Eviarc Sweet' variety offers a beneficial combination of chemical maturity and physical robustness.

Table 1. TSS, TA, pH, firmness, weight loss and dry weight of jackfruit pulp as influenced by different stages of fruit maturity

Treatments (DFFS)	TSS (°Brix)	TA (%)	pH	Firmness (kg/cm^2)	Pulp Weight Loss (%)	Pulp Dry Weight (%)
T1 – 80	4.00 d	0.43 e	5.20	6.62 cd	98.00 a	2.00 c
T2 – 90	4.67 d	0.50 de	5.21	7.08 cd	99.00 a	1.00 c
T3 – 100	5.33 d	0.57 cd	4.93	6.24 d	97.53 a	2.47 c
T4 – 110	23.67 b	0.57 cd	4.72	8.57 bcd	96.80 ab	3.20 bc
T5 – 120	28.67 ab	0.73 ab	4.42	9.26 bc	94.87 b	5.13 b
T6 – 130	29.77 ab	0.63 bc	4.52	10.92 ab	90.87 c	9.13 a
T7 – 140	27.53 ab	0.67 bc	4.58	11.01 ab	91.53 c	8.47 a
T8 – 150	33.33 a	0.80 a	4.47	13.42 a	90.53 c	9.47 a
CV (%)	22.97	11.54	7.61	18.82	1.39	25.81

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

Correlation with Sensory Quality

The sharp increases in TSS and Firmness found between 120 and 150 DFFS strongly and directly correlate with the highest consumer acceptability ratings obtained in the associated sensory evaluation. The pulp categorized as "Extremely sweet" and "Moderate jackfruit aroma" corresponds precisely to the maturity stages exhibiting maximal sugar accumulation. As flavor acceptance is intrinsically linked to the sugar-acid balance (Khan et al., 2014; Bwala et al., 2015), the high TSS at 120–150 DFFS is the key driver for the highest taste scores ("like moderately to like very much").

Furthermore, the persistence of high firmness at full maturity is critical. It ensures the pulp maintains a satisfactory, non-mushy texture, which significantly enhances overall consumer satisfaction, as both flavor and texture are decisive factors in fruit acceptance (Singh et al., 2016).

This integrated analysis provides an objective and reliable basis for determining the optimal commercial harvest window. Growers can move beyond simple visual inspection or DFFS count by utilizing quick field measurements of TSS (e.g., aiming for 30° Brix) and firmness as definitive metrics for harvest. This science-based approach ensures that the fruit delivered to market maximizes both its sensory appeal and its nutritional value, resolving the inconsistency in quality often caused by subjective harvest timing and supporting commercial standardization (Mishra & Kumar, 2018).

5. Conclusions

Fruit maturity significantly altered the physico-chemical composition and sensory attributes of *Eviarc Sweet* jackfruit pulp. Progressive maturation resulted in significant increases in total soluble solids, titratable acidity, firmness, and dry matter content, with minimal variation in pH. Peak sensory acceptability was observed at 120–150 days from fruit set, coinciding with maximum sugar accumulation and sustained textural integrity.

Based on these quantitative relationships, harvesting *Eviarc Sweet* jackfruit at 120–150 DFFS, using total soluble solids (≥30 °Brix) and firmness as maturity indices, is scientifically justified to optimize flavor development, textural quality, and postharvest performance.

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.

References

1. Bwala, R. L., Abano, E. E., & Amoah, R. S. (2015). Effect of ripening stages on quality and sensory attributes of jackfruit. *Journal of Food Processing & Technology, 6*(6), 457.

2. Chowdhury, M. G. F., Rashid, M. A., & Alam, M. K. (1997). Effect of different stages of maturity on chemical composition of jackfruit. *Bangladesh Journal of Agricultural Research, 22*(1), 79–85.

3. Galvez, L. A., & Dizon, E. I. (2017). Physico-chemical and functional properties of jackfruit (*Artocarpus heterophyllus*) pulp flour. *Annals of Tropical Research, 39*(2), 100–106.

4. Hulme, A. C. (1970). *The Biochemistry of Fruits and Their Products*. Academic Press..

5. Karim, M. R., Chowdhury, M. S., & Haque, M. O. (2008). Effect of harvesting time on jackfruit seed vivipary. *International Journal of Sustainable Crop Production, 3*(6), 48–57.

6. Moneruzzaman, K. M., Hossain, A. B. M. S., Sani, W., & Alenazi, M. M. (2008). Changes in fruit quality and composition during ripening of jackfruit. *Journal of Biological Sciences, 8*(1), 138–142.

7. Muñoz-Blanco, A. (2008). Strawberry Fruit Softening: The Role of Pectate Lyase. *Journal of Experimental Botany, 59*(9), 2315-2323.

8. Singh et al. (2016). Flavor and aroma are key determinants of fruit acceptance and marketability, especially for tropical fruits like jackfruit (*Artocarpus heterophyllus Lam.*)..

9. Swami, S. B., Thakor, N. J., Patil, M. M., & Haldankar, P. M. (2012). Jackfruit and its many functional components. *Comprehensive Reviews in Food Science and Food Safety, 11*(6), 565–576.

10. Wills, R., McGlasson, B., Graham, D., & Joyce, D. (2007). *Postharvest: An Introduction to the Physiology and Handling of Fruit, Vegetables and Ornamentals* (5th ed.). UNSW Press.