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# Comprehensive assessment of biochemical traits in seedling jackfruit (*Artocarpus heterophyllus* Lam.) under Bastar Plateau conditions of Chhattisgarh

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**Abstract**
An experiment entitled "Comprehensive assessment of biochemical traits in seedling jackfruit (*Artocarpus heterophyllus* Lam.) under Bastar Plateau conditions of Chhattisgarh was performed during the session 2024-25 at Krantikari Debridhur College of Horticulture and Research Station, Jagdalpur, MGUVV, Durg, Chhattisgarh, to characterize the biochemical traits of 50 seedling jackfruit genotypes. The experiment was laid out in a Randomized Block Design (RBD) with four replications for each genotype. The present investigation revealed significant variability among the jackfruit genotypes for biochemical traits. Genotype $T_{27}$ recorded the highest TSS (27.93°Brix) followed by $T_{21}$ (27.86 °Brix). The maximum acidity was observed in $T_{10}$ (0.270%) and was closely followed by $T_{42}$0 (0.3262%). The highest TSS/Acid ratio was exhibited by $T_{21}$ (143.56) and $T_{27}$ (143.32). With respect to sugar fractions, $T_{27}$ recorded the highest total sugars (17.91), which was very close to $T_{21}$ (17.87). Genotype $T_{45}$ (7.99%) showed superiority in reducing sugars followed by $T_{36}$ (7.95%). For non-reducing sugars, $T_{27}$ (11.21%) was found superior, while $T_{39}$ (11.13%) also exhibited higher values. The highest ascorbic acid content was recorded in $T_{20}$ (8.94 mg/100 g) followed by $T_{44}$ (8.82 mg/100 g). These promising genotypes ($T_{27}$, $T_{21}$, $T_{10}$, $T_{45}$, and $T_{20}$,) exhibited superior biochemical attributes, making them valuable for varietal improvement in jackfruit. Their distinctive combination of high TSS, sugars, balanced acidity, and enriched ascorbic acid content highlights their potential for future breeding programmes, commercial cultivation, and development of value-added products.

**Keywords:** *Artocarpus heterophyllus* Lam., genotypes, total soluble solids (ºBrix), titratable acidity, total sugar, reducing sugar, non reducing sugars, acidity, ascorbic acid

## 1. Introduction

Jackfruit (*Artocarpus heterophyllus* Lam.) belonging to the family Moraceae, is indigenous to India and is extensively distributed across the Western Ghats, a region recognized for its rich biodiversity (Jagadeesh *et al*., 2007) [15]. Apart from India, it is also widely cultivated in tropical and subtropical regions of Bangladesh, Myanmar, Philippines, Indonesia, Thailand, Malaysia, and Brazil (Baliga *et al*., 2011; Dutta *et al*., 2011; Hameed *et al*., 2009) [7, 12, 13]. In India, its occurrence is widespread in the states of Assam, West Bengal, Uttar Pradesh, Maharashtra, Kerala, Tamil Nadu, and Karnataka, where it is popularly referred to as the "poor man's food" (Prakash *et al*., 2009) [20]. The tree is of medium stature, generally attaining a height of 8-25 m, and bears fruits on both primary and secondary branches. The fruits usually weigh between 3.5-10 kg, although some may reach up to 25 kg. On average, the composition of a ripe fruit consists of 54% rind, 29% edible pulp, and 12% seeds (Aziz, 2006) [5]. A single fruit may contain 100-500 seeds, each measuring 2-3 cm in length and 1-2 cm in diameter. Jackfruit is a nutrient-dense fruit, providing essential minerals such as calcium, potassium, iron, sodium, and zinc, as well as vitamins including thiamine, riboflavin, vitamin A, vitamin C, and niacin. It is low in calories, supplying only 94 kcal per 100 g of edible portion. The fruit contains 303 mg of potassium per 100 g, making it an excellent source of this mineral, which is known to help regulate blood pressure. Additionally, jackfruit is rich in vitamin C, a potent antioxidant that enhances immune function, supports oral health, and protects the body against damage from free radicals

(Umesh *et al*., 2010) [24]. The pulp of jackfruit can be processed into a variety of products, including cordials, juices, jams, jellies, and infant foods (Roy and Joshi, 1995) [23].

Jackfruit is considered suitable for cultivation in arid and semi-arid regions due to its hardy nature, broad adaptability, low input requirement, and high productivity (Alam *et al*., 2011) [1]. According to 2023 estimates, India had 193.42 thousand hectares under jackfruit cultivation, with a total production of 3392.14 thousand tonnes (Anon., 2023) [2, 3]. Among the states, Kerala ranked first in area and production, with 92.18 thousand hectares and 1521.62 thousand tonnes, respectively. In Chhattisgarh, the crop is cultivated over 10.457 thousand hectares with an annual production of 202.936 thousand tonnes, while Mahasamund district leads within the state, covering 1.131 thousand hectares and contributing 25.449 thousand tonnes (Anon., 2023) [2, 3].

Jackfruit is regarded as one of the most versatile crops, as almost every part of the tree contributes to human needs. It provides edible fruits, nutritious fodder, quality timber, and even fuel. The foliage serves as a valuable feed resource for livestock, while the wood is durable and of considerable utility. Because of its abundant availability and relatively low price, jackfruit has traditionally functioned as an important supplementary staple food, particularly among low-income communities. The crop has wide culinary importance, as the ripe and unripe fruits as well as the seeds are consumed in various forms. Furthermore, the presence of pectin in the fruit makes it a suitable raw material for the preparation of jelly and other value-added processed products.

Understanding the biochemical traits of jackfruit genotypes is important for selecting superior varieties that meet consumer preference and ensure economic value. In this context, the present study was undertaken to evaluate the biochemical properties of different jackfruit genotypes cultivated in the Bastar region.

## 2. Materials and Methods

### 2.1 Experimental Site

The present experiment was carried out during the year 2024-25 on already existing seedling jackfruit genotypes located in different villages under Jagdalpur block of Bastar district, comprising 50 treatments with 4 replications in a Randomized Block Design (RBD). The biochemical analysis of the collected fruit samples was conducted in the Biochemical Analysis Laboratory of Krantikari Debridhur College of Horticulture and Research Station, Jagdalpur, Bastar, Chhattisgarh, India.

### 2.2 Methods of experiment

#### 2.2.1 Total Soluble Solids (ºBrix)

The Total Soluble Solids (TSS) content of fruit juice was measured using a handheld refractometer, calibrated with distilled water before each use. Juice was extracted by crushing pulp through muslin cloth, and a drop of clear juice was placed on the prism. Readings were taken against natural light and expressed in °Brix.

#### 2.2.2 Titratable acidity (%)

Titratable acidity was estimated by acid-base titration following the method of Ranganna (1986). Ten grams of pulp were homogenized with distilled water, made up to 100 ml, and filtered. A 10 ml aliquot of the filtrate was titrated against 0.1 N NaOH using phenolphthalein as an indicator until a faint pink endpoint persisted. The results were expressed as percent citric acid using the formula:

Titratable Acidity (% as citric acid) = (Titre value × Normality of NaOH × Volume made up × Eq. Wt. of acid × 100)/(Aliquot volume × Sample weight × 1000)

#### 2.2.3 Total soluble solid/Acid ratio

The TSS to Acid ratio (Brix-Acid Ratio), an index of taste and flavour balance in fruits, was calculated using the formula:

TSS/Acid Ratio = Total Soluble Solids (°Brix)/Titratable Acidity (%).

#### 2.2.4 Total sugar (%)

Total sugar content was estimated by the Lane and Eynon method as described by Ranganna (1986). A 50 ml aliquot of the extract was hydrolyzed with concentrated HCl and kept for 24 hours for inversion of sucrose, then neutralized with NaOH using phenolphthalein as an indicator and diluted to 250 ml. The hydrolyzed solution was titrated against Fehling’s solution (A and B) using methylene blue as an indicator until the endpoint (brick-red precipitate) was reached. The total sugar content was calculated using the formula:

Total Sugars (%) = (Fehling's factor × Dilution factor × 100)/(Titre value × Volume of sample taken for hydrolysis)

#### 2.2.5 Reducing sugar (%)

Reducing sugar content was determined directly from the aqueous pulp extract using the Lane and Eynon method (Ranganna, 1986). A 5 g pulp sample was macerated with distilled water, heated, filtered, re-extracted, and the combined filtrates were made up to 250 ml. The extract was titrated against boiling Fehling’s solution (A and B) using methylene blue as an indicator until the reddish-brown endpoint appeared. The reducing sugar content was calculated using the formula:

Reducing Sugars (%) = (Fehling's factor × Dilution factor × 100)/(Titre value × Weight of sample)

#### 2.2.6 Non-reducing sugar (%)

Non-reducing sugar content (primarily sucrose) was obtained by subtracting reducing sugars from total sugars, using the formula:

Non-Reducing Sugars (%) = Total Sugars (%)-Reducing Sugars (%)

#### 2.2.7 Ascorbic acid (mg/100 g)

Ascorbic acid (Vitamin C) content was estimated by visual titration using 2,6-dichlorophenolindophenol dye (Ranganna, 1986). A 10 g pulp sample was homogenized in 3% metaphosphoric acid, diluted to 100 ml, and filtered. A 5 ml aliquot was titrated against the standardized dye solution until a light rose-pink endpoint persisted. The ascorbic acid content was calculated as:

Ascorbic Acid (mg/100 g pulp) = (Titre value × Dye factor × Volume made up × 100)/(Aliquot volume × Sample weight)

## 3. Results and Discussion

### 3.1 Total soluble solids (°Brix)

The observations on total soluble solids (TSS) of jackfruit genotypes are presented in Table 1. A wide range of variation was recorded, with TSS values extending from 19.04 to 27.93 °Brix. Genotype $T_{27}$ exhibited the highest TSS (27.93 °Brix), closely followed by $T_{21}$ (27.86 °Brix), whereas the lowest value (19.04 °Brix) was observed in genotype $T_{10}$. Such marked differences in TSS content indicate considerable genetic variability among the genotypes, which is in line with the findings of earlier studies (Mondal, 2015) [18].

### 3.2 Titratable acidity (%)

As shown in Table 1, titratable acidity of jackfruit genotypes exhibited noticeable variation, ranging from 0.194% to 0.270%. The maximum acidity was recorded in $T_{10}$ (0.270%), followed by $T_{20}$ (0.262%), whereas the minimum value (0.194%) was observed in $T_{21}$. Such variability in acidity content reflects the inherent genetic differences among jackfruit genotypes, which is in agreement with earlier reports of considerable variation in acidity levels among jackfruit accessions.

### 3.3 3. Total soluble solid/acid ratio

As presented in Table 1, the TSS: Acid ratio of jackfruit genotypes exhibited considerable variation, ranging from 68.49 to 143.56. The highest ratio was recorded in $T_{21}$ (143.56), followed closely by $T_{27}$ (143.32), whereas the minimum value was observed in $T_{10}$ (68.49). Such variability in the TSS: Acid ratio reflects the differences in fruit quality among jackfruit genotypes and is consistent with earlier reports highlighting variation in the TSS: Acid ratio among jackfruit accessions (Dey & Baruah, 2021) [9].

## 4. Total sugar (%)

As presented in Table 2, the total sugar content of jackfruit genotypes varied considerably, ranging from 10.02% to 17.91%. The highest sugar content was observed in $T_{27}$ (17.91%), followed closely by $T_{21}$ (17.87%), whereas the minimum value was recorded in $T_{10}$ (10.02%). Such variation in total sugar levels among jackfruit genotypes reflects the inherent genetic differences and is consistent with earlier reports documenting diversity in sugar content among jackfruit accessions (Mondal, 2015) [18].

## 5. Reducing sugar (%)

As presented in Table 2, the reducing sugar content of jackfruit genotypes exhibited considerable variation, ranging from 3.707% to 7.997%. The highest content was observed in $T_{45}$ (7.997%), closely followed by $T_{36}$ (7.995%), whereas the minimum value was recorded in $T_{20}$ (3.707%). Such differences among genotypes indicate significant genetic variability in reducing sugar content, which is in line with previous studies on jackfruit sugar composition.

## 6. Non Reducing sugar (%)

As presented in Table 2, the non-reducing sugar content of jackfruit genotypes varied considerably, ranging from 4.83% to 11.21%. The highest content was observed in $T_{27}$ (11.21%), followed closely by $T_{32}$ (11.13%), whereas the minimum value was recorded in $T_{35}$ (4.83%).

## 7. Ascorbic acid mg/100 g)

As presented in Table 2, the ascorbic acid content of jackfruit genotypes varied from 4.17 to 8.94 mg/100 g. The highest content was recorded in $T_{20}$ (8.94 mg/100 g), followed closely by $T_{44}$ (8.82 mg/100 g), whereas the minimum value was observed in $T_{21}$ (4.17 mg/100 g).

**Table 1:** Qualitative parameters of jackfruit genotypes for total Soluble Solid (°Brix), titratable acidity (%), TSS to acid ratio

| Treatment No. | TSS (°Brix) | Titratable Acidity (%) | TSS to acid ratio |
|---|---|---|---|
| $T_1$ | 21.54 | 0.25 | 87.56 |
| $T_2$ | 26.37 | 0.20 | 129.98 |
| $T_3$ | 23.54 | 0.23 | 102.50 |
| $T_4$ | 23.97 | 0.22 | 107.66 |
| $T_5$ | 22.91 | 0.23 | 97.22 |
| $T_6$ | 27.07 | 0.20 | 135.97 |
| $T_7$ | 23.01 | 0.23 | 95.02 |
| $T_8$ | 24.03 | 0.22 | 105.46 |
| $T_9$ | 25.42 | 0.21 | 117.7 |
| $T_{10}$ | 19.04 | 0.27 | 68.49 |
| $T_{11}$ | 23.27 | 0.23 | 98.24 |
| $T_{12}$ | 23.16 | 0.23 | 100.97 |
| $T_{13}$ | 26.57 | 0.20 | 129.38 |
| $T_{14}$ | 24.32 | 0.22 | 108.21 |
| $T_{15}$ | 26.42 | 0.20 | 126.66 |
| $T_{16}$ | 25.53 | 0.21 | 118.12 |
| $T_{17}$ | 24.26 | 0.22 | 108.89 |
| $T_{18}$ | 23.10 | 0.23 | 99.41 |
| $T_{19}$ | 23.62 | 0.23 | 99.29 |
| $T_{20}$ | 20.04 | 0.26 | 75.64 |
| $T_{21}$ | 27.86 | 0.19 | 143.56 |
| $T_{22}$ | 23.11 | 0.23 | 99.76 |
| $T_{23}$ | 26.58 | 0.20 | 127.03 |
| $T_{24}$ | 23.33 | 0.23 | 97.65 |
| $T_{25}$ | 23.58 | 0.23 | 103.37 |
| $T_{26}$ | 24.03 | 0.22 | 108.08 |
| $T_{27}$ | 27.93 | 0.19 | 143.32 |
| $T_{28}$ | 22.98 | 0.23 | 96.58 |
| $T_{29}$ | 23.85 | 0.22 | 105.12 |
| $T_{30}$ | 25.77 | 0.21 | 121.00 |
| $T_{31}$ | 25.53 | 0.21 | 118.16 |
| $T_{32}$ | 27.78 | 0.19 | 141.77 |
| $T_{33}$ | 27.37 | 0.20 | 138.79 |
| $T_{34}$ | 24.24 | 0.22 | 106.58 |
| $T_{35}$ | 21.88 | 0.24 | 89.82 |
| $T_{36}$ | 26.27 | 0.20 | 128.03 |
| $T_{37}$ | 25.93 | 0.21 | 121.89 |
| $T_{38}$ | 27.57 | 0.19 | 139.43 |
| $T_{39}$ | 25.78 | 0.21 | 121.71 |
| $T_{40}$ | 25.42 | 0.21 | 119.10 |
| $T_{41}$ | 25.93 | 0.21 | 123.16 |
| $T_{42}$ | 26.12 | 0.21 | 121.11 |
| $T_{43}$ | 24.39 | 0.22 | 107.3 |
| $T_{44}$ | 20.59 | 0.25 | 80.42 |
| $T_{45}$ | 26.98 | 0.20 | 134.23 |
| $T_{46}$ | 26.25 | 0.20 | 123.1 |
| $T_{47}$ | 26.68 | 0.20 | 130.21 |
| $T_{48}$ | 24.64 | 0.22 | 111.31 |
| $T_{49}$ | 26.76 | 0.20 | 133.9 |
| $T_{50}$ | 22.89 | 0.23 | 97.18 |
| S.Em± | 0.10 | 0.008 | 4.67 |
| C.D. at 5% | 0.28 | 0.02 | 13.07 |
| C.V. | 0.83 | 7.93 | 8.28 |

**Table 2:** Qualitative parameters of jackfruit genotypes for total sugar (%), reducing sugar (%) and non-reducing sugar (%), Ascorbic acid (mg/100 g pulp)

| Treatment No. | Total Sugar (%) | Reducing Sugar (% | Non-Reducing Sugar (%) | Ascorbic acid (mg/100 g pulp) |
|---|---|---|---|---|
| $T_1$ | 12.04 | 4.78 | 7.26 | 6.68 |
| $T_2$ | 16.50 | 6.03 | 10.47 | 6.59 |
| $T_3$ | 14.05 | 5.65 | 8.39 | 6.21 |
| $T_4$ | 14.40 | 6.58 | 7.81 | 8.24 |
| $T_5$ | 13.51 | 7.48 | 6.03 | 8.58 |
| $T_6$ | 16.95 | 7.51 | 9.44 | 6.06 |
| $T_7$ | 13.53 | 5.27 | 8.26 | 5.84 |
| $T_8$ | 14.23 | 7.76 | 6.46 | 7.82 |
| $T_9$ | 15.67 | 6.39 | 9.28 | 7.13 |
| $T_{10}$ | 10.02 | 4.39 | 5.63 | 8.79 |
| $T_{11}$ | 13.68 | 6.40 | 7.28 | 8.26 |
| $T_{12}$ | 13.56 | 6.42 | 7.14 | 8.18 |
| $T_{13}$ | 16.64 | 6.27 | 10.37 | 6.49 |
| $T_{14}$ | 14.64 | 5.83 | 8.80 | 7.61 |
| $T_{15}$ | 16.50 | 7.25 | 9.24 | 6.52 |
| $T_{16}$ | 15.53 | 5.82 | 9.71 | 7.22 |
| $T_{17}$ | 14.63 | 5.76 | 8.86 | 7.71 |
| $T_{18}$ | 13.46 | 7.87 | 5.59 | 8.44 |
| $T_{19}$ | 14.03 | 6.06 | 7.97 | 8.17 |
| $T_{20}$ | 10.86 | 3.70 | 7.15 | 8.94 |
| $T_{21}$ | 17.87 | 7.95 | 9.91 | 4.17 |
| $T_{22}$ | 13.57 | 5.18 | 8.39 | 8.21 |
| $T_{23}$ | 16.69 | 7.26 | 9.43 | 6.35 |
| $T_{24}$ | 13.81 | 5.20 | 8.61 | 8.12 |
| $T_{25}$ | 14.11 | 5.92 | 8.19 | 8.01 |
| $T_{26}$ | 14.35 | 6.76 | 7.59 | 7.67 |
| $T_{27}$ | 17.91 | 6.7 | 11.21 | 4.77 |
| $T_{28}$ | 13.35 | 6.01 | 7.34 | 8.32 |
| $T_{29}$ | 14.33 | 6.54 | 7.78 | 7.96 |
| $T_{30}$ | 15.80 | 6.56 | 9.24 | 7.57 |
| $T_{31}$ | 15.6 | 6.27 | 9.32 | 6.88 |
| $T_{32}$ | 17.80 | 6.67 | 11.13 | 4.82 |
| $T_{33}$ | 17.20 | 8 | 9.20 | 5.80 |
| $T_{34}$ | 14.58 | 7.41 | 7.16 | 7.65 |
| $T_{35}$ | 12.67 | 7.83 | 4.83 | 8.775 |
| $T_{36}$ | 16.38 | 7.99 | 8.38 | 6.15 |
| $T_{37}$ | 16.10 | 5.64 | 10.46 | 6.97 |
| $T_{38}$ | 17.39 | 7.09 | 10.29 | 5.48 |
| $T_{39}$ | 15.95 | 7.86 | 8.08 | 6.97 |
| $T_{40}$ | 15.83 | 7.72 | 8.10 | 7.31 |
| $T_{41}$ | 16.20 | 7.98 | 8.22 | 6.61 |
| $T_{42}$ | 15.87 | 7.97 | 7.89 | 6.30 |
| $T_{43}$ | 14.83 | 7.83 | 7.00 | 7.60 |
| $T_{44}$ | 11.46 | 5.21 | 6.25 | 8.82 |
| $T_{45}$ | 16.88 | 7.99 | 8.88 | 6.22 |
| $T_{46}$ | 16.47 | 6.61 | 9.85 | 6.36 |
| $T_{47}$ | 16.79 | 7.48 | 9.30 | 6.46 |
| $T_{48}$ | 14.97 | 7.53 | 7.43 | 7.59 |
| $T_{49}$ | 17.60 | 7.98 | 9.62 | 6.20 |
| $T_{50}$ | 13.38 | 6.21 | 7.17 | 8.62 |
| S.Em± | 0.07 | 0.10 | 011 | 0.17 |
| C.D. at 5% | 0.19 | 0.30 | 0.32 | 0.48 |
| C.V | 0.93 | 3.25 | 2.74 | 4.85 |

## 8. Conclusion

The present study demonstrated significant variation among jackfruit genotypes for key biochemical traits, including total soluble solids (TSS), titratable acidity, TSS: Acid ratio, total sugars, reducing and non-reducing sugars, and ascorbic acid content. Certain genotypes, such as $T_{27}$ and $T_{21}$ (notably high in TSS and total sugars), $T_{10}$ (lowest acidity), $T_{21}$ and $T_{27}$ (highest TSS: Acid ratio), $T_{45}$ and $T_{32}$ (reducing sugars), $T_{27}$ and $T_{32}$ (non-reducing sugars), and $T_{20}$ and $T_{44}$ (ascorbic acid), performed consistently well across these quality parameters. These superior genotypes constitute valuable genetic resources that can be harnessed for jackfruit breeding, varietal enhancement, and the production of nutritionally enriched, value-added products.

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