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# Biochemical evaluation of local genotypes of jackfruit (*Artocarpus heterophyllus* Lam.) in Pudukkotai District

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**Abstract**
The research was conducted during 2015-2016 in eight villages of Pudukkotai district of Tamil Nadu, India with an objective to evaluate the local seedling genotypes of jackfruit using biochemical traits. Totally 40 genotypes were evaluated. The coefficient of variation for fruit biochemical characters such as TSS (18.15 %), total sugars (24.70 %), reducing sugars (22.64), non-reducing sugars (27.50 %), titrable acidity (34.83 %), ascorbic acid content (32.81 %) and carotene content (41.86 %) showed considerable variations. Among the biochemical parameters, carotene content (41.86 %) exhibited high variation among the evaluated genotypes. Based on the yield per tree and biochemical parameters, the genotypes namely AH-11, AH-13, and AH-35 were found promising. These identified genotypes can be good donor in hybridization programme to evolve the superior varieties for crop improvement.

**Keywords:** Jackfruit, biochemical, evaluation, selection

## Introduction
Jackfruit (*Artocarpus heterophyllus* Lam., Moraceae), is an evergreen tree which comes up well under humid and warm climate of hill slopes. It also grows well under arid and warmer plains of south India. Flowering twigs emerge from the trunk and the main branches. Male and female flowers are borne separately on the same tree. The female flower, which has a fleshy ring at the base, is larger than the male flower. Jackfruit is a multiple fruit which contains large number of flakes and each flake is a fruit. The probable origin of Jackfruit is India and it is widely cultivated in south and south-east Asia including Bangladesh, Malaysia, Myanmar, Indonesia, the Philippines, Sri Lanka, South China, Thailand and Vietnam. In India, it is commercially grown in states like Kerala, Tamil Nadu, Karnataka and Andhra Pradesh and to a smaller scale in Assam, Bihar, Orissa, Maharashtra and West Bengal. The area under jackfruit cultivation in India is 1.52 lakh hectares and the production is 18.46 lakh MT. In Tamil Nadu, the estimated total area under cultivation is 2,760 hectares with an annual production of 49,730 MT and productivity of 18.02 MT per hectare (NHB, 2016) [7].

Recently, it has been reported that jackfruit could be very useful in the treatment of the dreaded diseases of human being such as AIDS. An extract of jackfruit called 'Jacaline' was seen to have inhibited the growth of HIV infection under *'in vitro'* conditions (Prakash *et al.,* 2009) [10]. Jacaline is inactive on lymphocytes which are already infected but has proved its might by protecting the healthy ones. Hot water extracts of leaves improve the glucose tolerance level of diabetic patients. The fruit rind and leaves are excellent cattle feed. Besides these beneficial properties, jackfruit may be considered as source of natural antioxidant and consumption of these fruits may supply substantial antioxidants which may provide health promoting and disease preventing effects. The resveratrol content of jackfruit skin was 3.56 µg/g which was comparatively similar to that of skin extracts of grapes (Akshatha *et al.,* 2015) [2]. So, it is essential to study the biochemical properties of jackfruit.

In Tamil Nadu, the districts like Cuddalore and Villupuram have been known as traditional districts for jackfruit cultivation. However, it has come to light that in and around Pudukkottai district is also another potential area of jackfruit cultivation. The unique feature of jackfruit cultivation in this area is that most of the trees are grown as border trees except in few areas where it is grown on commercial scale (Single crop) under laterite soil conditions which is responsible for more colour and taste in the flakes. The objective of the study was to evaluate biochemical characteristics of the jackfruit germplasm available at Pudukottai, and isolate to identify the superior genotype based on fruit quality for future breeding programs.

## Materials and Methods

A survey was conducted in eight villages in and around Pudukkotai district, Tamil Nadu, India from May, 2015 to May, 2016. In which 40 genotypes were identified. The village includes Keeramangalam, Senthangudi, Kothamangalam, Alankadu, Karambakadu, Pullanviduthi, Mangadu and Vadakadu. Yield per tree and the biochemical characters were estimated among all the identified genotypes. Yield per tree was calculated by multiplying the number of fruits harvested per tree per year with the average fruit weight and expressed in kilogram (kg). The biochemical characters include total soluble solids (hand refractometer), total sugars (Somogyi, 1952) [14], reducing sugars (Somogyi, 1952) [14], non-reducing sugars (Somogyi, 1952) [14], titrable acidity of flakes (Ranganna, 1997) [12], ascorbic acid content of flakes (A.O.A.C., 1975) and carotene content of flakes (A.O.A.C., 1975). Different biochemical parameters were recorded and the mean data derived from the flakes of top, middle and bottom portion of five ripe fruits from each genotype with three replications. The statistical analysis includes Mean, Range, Standard deviation, Standard error and Coefficient of variation (Burton and Devane, 1953) [3].

## Results and Discussion

**Yield per tree** (Table 1)

The yield per tree ranged from 144.29 to 560.79 kg with a mean of 329.31 kg. Among the genotypes, the highest yield was recorded in genotype AH-13 (560.79 kg) followed by genotype AH-35 (514.60 kg) and it was the lowest in genotype AH-20 (144.29 kg). The coefficient of variation was 32.23 per cent.

**Total soluble solids (Table 1)**

The total soluble solids ranged from 13.72 to 32.40 º brix with a mean of 22.56 º brix. Among the genotypes, the lowest TSS was recorded in genotype AH-5 (13.72 º brix) and the highest in genotype AH-13 (32.40 º brix). The coefficient of variation for total soluble solids was 18.15 per cent.

**Total Sugars (Table 1)**

The total sugars of all the genotypes studied varied from 9.24 to 25.71 per cent with mean value of 18.40 per cent. The genotype AH-13 recorded the highest total sugars (25.71 %), while the genotype AH-5 recorded the lowest total sugars (9.24 %). The coefficient of variation for total sugar was 24.70 per cent.

**Reducing sugars (Table 1)**

The mean for reducing sugars in the forty genotypes was 4.94 per cent and it ranged from 2.94 to 7.26 per cent. Among the genotypes, the lowest reducing sugars were recorded in genotype AH-31 (2.94 %) and the highest was recorded in genotype AH-13 (7.26 %). The coefficient of variation for reducing sugars was 22.64 per cent.

**Non-reducing sugars (Table 1)**

The range and mean of non- reducing sugars was 5.40 to 18.45 per cent and 13.45 per cent. Among the genotypes, AH-5 recorded the lowest non- reducing sugars (5.40 %), while AH-13 recorded the highest non- reducing sugars (18.45 %). The coefficient of variation for non- reducing sugars was 27.50 per cent.

**Titrable acidity of flakes (Table 1)**

The titrable acidity of flakes ranged from 0.07 to 0.37 per cent with mean value of 0.19 per cent. From the forty genotypes studied, the lowest acidity was noticed in genotype AH-35 (0.07 %) and the highest in genotype AH-40 (0.37 %). The coefficient of variation for titrable acidity was 34.83 per cent.

**Ascorbic acid content of flakes (Table 1)**

The ascorbic acid content of flakes in all the genotypes varied from the lowest of 2.90 in AH-32 and the highest of 12.30 per cent in AH-20. The mean value of ascorbic acid content was 7.22 %. The coefficient of variation was 32.81 per cent.

**Carotene content of flakes (Table 1)**

The carotene content of the forty genotypes ranged from 0.128 to 0.897 mg per 100 g with a mean of 0.365 mg per 100 g. Among the genotypes, the lowest carotene content was recorded in genotype AH-38 (0.128 mg / 100 g) while the highest in genotype AH-35 (0.897 mg / 100 g). The coefficient of variation was 41.83 per cent.

In a breeding programme, even though many characters are studied on morphology, physiology, biochemistry, fruit and fruit quality, yield is the most important trait by which an accession or variety can be evaluated. In the case of jack, trees with more number of fruits and high fruit weight generally produce high yield. In the present study, wide variation was recorded in yield per tree per year (Table 1). Accessions namely AH-1, AH-6, AH-13, AH-15, AH-24, AH-34, AH-35 and AH-36 recorded higher yield per tree. Similar variations in yield per tree per year were reported by Ramakrishna *et al.* (2006) [11], Nipa (2013) [8] and Wangchu *et al*. (2013) [15] in jackfruit and Polat and Caliskan (2008) [9] in fig. Total soluble solids, total sugars and reducing sugars, non-reducing sugars, titrable acidity, ascorbic acid content and carotene content of the genotypes expressed remarkable variations (Table 1). Accessions namely AH-10, AH-11, AH-13, AH-17, AH-24, AH-34, AH-35 and AH-38 have registered higher total soluble solids, total sugars and reducing sugars, non-reducing sugars whereas AH-1, AH-10, AH-13, AH-23, AH-24, AH-32 and AH-35 registered lower titrable acidity and ascorbic acid content. The accessions like AH-10, AH-13, AH-23, AH-24, AH-34, AH-35, AH-36 and AH-38 had higher carotene content. According to Mitra and Mani (2000) [5], TSS (>25 ° brix) and total sugars (>20 %) are important for dessert purpose jackfruits. Reddy *et al.* (2004) [13] declared ACC No.18 with highest TSS, lowest acidity and highest reducing sugars as the superior type for table purpose. Higher carotene content of the genotypes indicate the possibility of selecting elite genotypes with rich Vitamin A (Murugan, 2007) [6]. Goswami *et al.* (2011) [4] reported that biochemical composition of jackfruit flakes is influenced by both genotype and place of growth. Therefore based on the yield per tree and biochemical parameters, the genotypes namely AH-11, AH-13, and AH-35 were found promising and can be promoted for cultivation for farmers.

**Table 1:** Mean, Range and CV % for yield per tree and biochemical characters for forty genotypes of jackfruit in Pudukkotai district

| Name of the genotypes | Yield / tree (kg) | TSS (º Brix) | Total sugars (%) | Reducing sugars (%) | Non-reducing sugar (%) | Titrable acidity (%) | Ascorbic acid content (%) | Carotene content (mg/100 g) |
|---|---|---|---|---|---|---|---|---|
| AH-1 | 481.74 | 21.40 | 16.47 | 4.87 | 11.60 | 0.19 | 4.43 | 0.213 |
| AH-2 | 311.85 | 22.13 | 17.13 | 6.14 | 10.99 | 0.26 | 6.25 | 0.355 |
| AH-3 | 274.05 | 18.40 | 12.85 | 4.27 | 8.58 | 0.20 | 5.81 | 0.257 |
| AH-4 | 172.09 | 21.42 | 16.83 | 5.09 | 11.74 | 0.24 | 6.67 | 0.402 |
| AH-5 | 316.51 | 13.72 | 9.24 | 3.84 | 5.40 | 0.08 | 4.09 | 0.849 |
| AH-6 | 435.24 | 20.90 | 16.14 | 4.93 | 11.21 | 0.19 | 5.29 | 0.386 |
| AH-7 | 187.74 | 24.90 | 12.94 | 5.25 | 7.69 | 0.23 | 9.90 | 0.425 |
| AH-8 | 372.96 | 24.18 | 22.17 | 6.18 | 15.99 | 0.09 | 5.16 | 0.392 |
| AH-9 | 247.00 | 25.00 | 21.35 | 5.62 | 15.73 | 0.25 | 7.13 | 0.461 |
| AH-10 | 412.45 | 24.25 | 20.74 | 5.29 | 15.45 | 0.14 | 6.35 | 0.383 |
| AH-11 | 242.12 | 29.72 | 24.58 | 7.13 | 17.45 | 0.16 | 4.97 | 0.321 |
| AH-12 | 264.13 | 18.60 | 12.82 | 4.81 | 8.01 | 0.26 | 7.83 | 0.349 |
| AH-13 | 560.79 | 32.40 | 25.71 | 7.26 | 18.45 | 0.21 | 8.80 | 0.465 |
| AH-14 | 237.16 | 24.26 | 20.19 | 4.91 | 15.28 | 0.15 | 7.14 | 0.249 |
| AH-15 | 442.15 | 14.90 | 10.28 | 3.27 | 7.01 | 0.32 | 11.24 | 0.386 |
| AH-16 | 211.75 | 23.81 | 18.75 | 4.37 | 14.38 | 0.17 | 10.26 | 0.418 |
| AH-17 | 357.12 | 28.20 | 24.14 | 6.31 | 17.83 | 0.23 | 8.43 | 0.209 |
| AH-18 | 332.30 | 17.83 | 12.73 | 3.72 | 9.01 | 0.31 | 11.38 | 0.204 |
| AH-19 | 216.60 | 22.14 | 19.37 | 3.97 | 15.40 | 0.24 | 9.58 | 0.347 |
| AH-20 | 144.12 | 22.30 | 22.81 | 4.61 | 18.20 | 0.12 | 12.30 | 0.419 |
| AH-21 | 174.99 | 23.40 | 23.26 | 5.86 | 17.40 | 0.18 | 9.10 | 0.255 |
| AH-22 | 202.86 | 23.62 | 23.81 | 6.17 | 17.64 | 0.09 | 7.33 | 0.155 |
| AH-23 | 357.87 | 27.60 | 23.31 | 6.09 | 17.22 | 0.19 | 8.19 | 0.521 |
| AH-24 | 440.44 | 26.35 | 22.71 | 5.75 | 16.96 | 0.15 | 6.23 | 0.420 |
| AH-25 | 366.24 | 20.40 | 20.57 | 4.57 | 16.00 | 0.14 | 9.51 | 0.365 |
| AH-26 | 314.64 | 21.94 | 15.83 | 3.14 | 12.69 | 0.17 | 7.33 | 0.410 |
| AH-27 | 300.90 | 22.68 | 20.02 | 5.47 | 14.55 | 0.24 | 7.70 | 0.384 |
| AH-28 | 183.38 | 19.14 | 14.86 | 3.59 | 11.27 | 0.32 | 5.61 | 0.176 |
| AH-29 | 382.95 | 18.53 | 15.13 | 3.91 | 11.22 | 0.20 | 11.27 | 0.208 |
| AH-30 | 492.48 | 28.50 | 24.36 | 6.74 | 17.62 | 0.19 | 10.83 | 0.295 |
| AH-31 | 261.69 | 17.95 | 12.41 | 2.94 | 9.47 | 0.24 | 6.94 | 0.301 |
| AH-32 | 432.65 | 18.30 | 14.84 | 3.82 | 11.02 | 0.13 | 2.90 | 0.347 |
| AH-33 | 356.59 | 20.30 | 14.97 | 4.05 | 10.92 | 0.12 | 4.40 | 0.413 |
| AH-34 | 418.18 | 23.18 | 18.29 | 4.61 | 13.68 | 0.16 | 6.60 | 0.409 |
| AH-35 | 514.60 | 25.20 | 21.78 | 4.73 | 17.05 | 0.07 | 4.21 | 0.897 |
| AH-36 | 446.04 | 21.41 | 17.52 | 4.93 | 12.59 | 0.26 | 4.76 | 0.516 |
| AH-37 | 294.70 | 23.30 | 18.41 | 4.81 | 13.60 | 0.21 | 6.37 | 0.285 |
| AH-38 | 409.06 | 28.50 | 24.17 | 6.47 | 17.70 | 0.18 | 7.52 | 0.128 |
| AH-39 | 311.41 | 26.10 | 21.83 | 5.27 | 16.56 | 0.23 | 5.21 | 0.422 |
| AH-40 | 230.67 | 15.90 | 10.86 | 3.17 | 7.69 | 0.37 | 4.17 | 0.237 |
| Mean | 329.31 | 22.56 | 18.40 | 4.94 | 13.45 | 0.19 | 7.22 | 0.365 |
| Maximum | 560.79 | 32.40 | 25.71 | 7.26 | 18.45 | 0.37 | 12.30 | 0.897 |
| Minimum | 144.29 | 13.72 | 9.24 | 2.94 | 5.40 | 0.07 | 2.90 | 0.128 |
| SE of mean | 16.78 | 0.65 | 0.72 | 0.18 | 0.58 | 0.01 | 0.38 | 0.02 |
| SD | 106.14 | 4.09 | 4.54 | 1.12 | 3.70 | 0.06 | 2.37 | 0.15 |
| CV (%) | 32.23 | 18.15 | 24.70 | 22.64 | 27.50 | 34.83 | 32.81 | 41.86 |

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