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Prevalent Variability among Jackfruit Genotypes: An Assessment on Fruit and Flake Characteristics

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Jackfruit (*Artocarpus heterophyllus* Lam) belongs to the family Moraceae is a tropical climacteric fruit and known to be the world's largest edible fruit. Tropical Asia is regarded as origin of jackfruit. India is considered as the mother land of jackfruit with the production of 1.4 million tonnes per year. All parts of jackfruit is consumable, the flesh of jackfruit in unripen stage can be used as vegetable

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and in fully ripen stage can be used as fruit. Seeds can be used for making curries. Jackfruit bulbs are rich in sugars and contain fair amounts of carotene, protein and minerals. Jackfruit is rich in dietary fiber, which makes it a good bulk laxative. Jacalin content present in seeds has anti-cancer abilities. Finding a jackfruit genotype with high nutritional composition is highly recommended. An experiment was conducted during the year 2022-2033 at Department of Fruit Science, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulam. Biometric parameters of 25 jackfruits genotypes, collected from diverse locations were evaluated for variations observed in their morphological features and sensory attributes. The results showed that AH 2, AH 7, AH 11 genotypes sampled from Theni, Cuddalore, Pondicherry district exhibited impressive results with high recovery percentage and proved to be economical in comparison to other genotypes. Based on flake quality AH 2 found to be suitable for table purpose and AH 7, AH 11 for culinary purpose. These findings will come handy in studying the variation among genotypes for future hybridization programme to develop superior varieties.

Keywords: Jackfruit; quality; variation; flakes; nutrition.

1. INTRODUCTION

Jackfruit (*Artocarpus heterophyllus* Lam) belongs to the family Moraceae is a tropical climacteric fruit and known to be the world's largest edible fruit [1]. Jack fruit is deemed as "poor man's food" [2,3]. Predominant jackfruit growing countries are India, Vietnam, Myanmar, Bangladesh, Sri Lanka, Indonesia Brazil, Malaysia, West Indies, Pakistan and other tropical countries. In India, jackfruit is the most sought after fruit in Southern and Eastern states like Kerala, Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal, Maharashtra, Assam, Andaman and Nicobar Islands (APAARI, 2012). India is considered as the mother land of jackfruit with the production of 1.4 million tonnes per year and cultivation area around 1.51 lakh hectares. The growing jackfruit districts in Tamil Nadu are Cuddalore, Ariyalur, Pudukkottai, Kanyakumari and Dindigul. Cuddalore district stands first with 60.42 tonnes of production/year with the area of over 700 hectares.

Jackfruit grows upto 8-25 m in height [4]. It has a straight rough stem and a green or black bark comprising a thickness of around 1.25cm, exuding milky latex (Rowe-Dutton 1985). The leaves are broad, elliptic, dark green in colour and alternate. The tree has rich timber value since it is highly tolerant to attacks of white ants and bacterial and fungal decay.When the wood of jackfruit is subjected to chemical analyzation impressive biochemical content of Cellulose 56.74%, Lignin 28.76%, Charcoal yield of 38.74% were obtained.

Jackfruit belongs to the genus *Artocarpus.* Important species in *Artocarpus* genus include breadfruit (*A. altilis*), dugdug (*A. mariannensis*) and breadnut (*A. camansi*). They are dicotyledonous compound fruits formed by the fusion of multiple flowers [5] possessing an oblong cylindrical shape, and an approximate length of about 22 to 90 centimeters with the average diameter of 13-50 centimeters. Single fruit weighs between 2 and 20 kilo grams. The rind is green or yellow when ripe, hard cone like points of the rind is attached to a thick rubbery whitish or pale yellowish wall. Fully developed perianth called as bulbs lodged among long narrow strips of undeveloped perianth (also called perigones) and a central pithy core are considered as edible part. About 30 % of fruit weight is occupied by flesh. Each bulb encompasses a smooth oval light brown seed with a whitish outer membrane. Due to the presence of laticiferous cells that produce latex, which helps in holding the fruits together, the core of the fruit (fruit axis) is regarded inedible. Jackfruit matures 4- 5 months after flowering. Maturity index of jackfruit is the discharge of dull hollow sound when tapped and the colour change of rind from green to yellow brown. Value added products like Jam, Jellies, Ice creams are made using pureed jackfruit.

Jackfruit varieties vary among each other in terms of their fruit size, fruit shape, colour, nutritional availability and chemical composition. Jackfruit bulbs are rich in sugars and contain fair amounts of carotene, protein and minerals. Jackfruit is rich in dietary fiber, which makes it a good bulk laxative.Jacalin content present in seeds has anti-cancer abilities. The widespread genetic variability existing among jackfruit genotypes should be thoroughly utilized. Quantitative assessment on fruit characters helps the breeders in hybridization programme while choosing better parentage in terms of

morphological features for variety release. Therefore, a study was conducted with a main objective of identifying quality jackfruit genotypes by observing and evaluating the variabilities present amidst twenty five physiologically mature fruits procured from different locations.

2. MATERIALS AND METHODS

The Studies on Evaluation of jackfruit genotypes for variability among the fruit and flake characteristics was carried out from January 2023 to July 2023 at Department of Fruit Science, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulam. The experimental site is situated at an elevation of 300m above mean sea level, at 10° North latitude and 77.8° East latitude. Physiologically mature Jackfruit samples viz., released varieties, popular cultivars, local eco types, were collected from university germplasm collection and farmer's field. They were analyzed for their morphological characters based on IPGRI,2000 (Bio diversity international) jackfruit descriptor.

(i) Sampling

Physiologically mature Jackfruit genotypes consisting of white and yellow flakes were collected from university germplasm collection and farmer's field. Maturity index of the fruits were identified by colour change from green to brownish yellow, spacing between the spines present in the rind and production of deep hollow sound when tapped. The details of the location of the genotypes collected were furnished in Table 1.

(ii) Subject of study

In this study, the fruit carpels were taken as samples. Samples collected from the fully matured (Physiologically mature) fruits from the identified trees at different places of Tamilnadu

(iii) Preparation of samples

Untarnished and fully mature fruits were cleaned out with water and the surface was wiped up using clean cloth. The cleaned air dried samples were weighed to calculate recovery percentage and cut in cross section using a sharp knife. Fruit carpel and rind of the fruit were separated for sample preparation. The fruit carpels of each fruit were collected and immediately stored in Ziploc bags and the rind of the fruit was weighed to calculate recovery percentage and later used as cattle feed.

2.1 Observations Recorded

(i) Fruit shape

Shape of the fruits collected from different trees was observed and categorized into 1.Obloid 2. Spheroid 3. Ellipsoid 4. Clavate 5. Oblong 6. Irregular

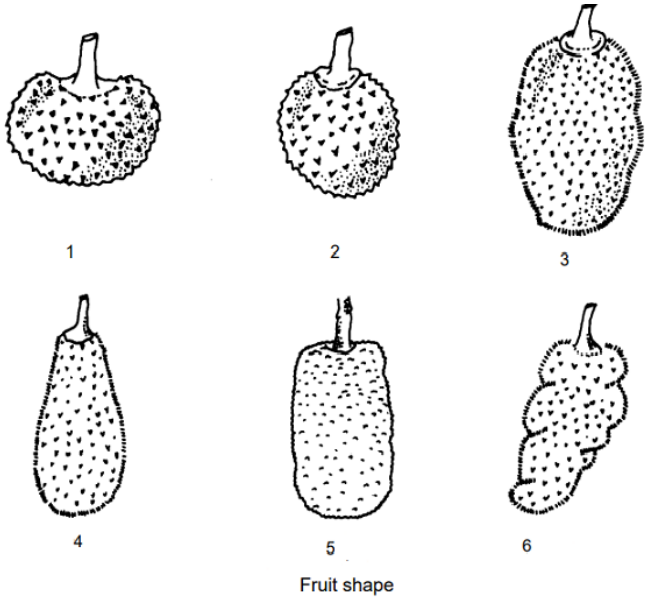

Fig. 1. Fruit Shape

Table 1. Genotypes and location of trees under study

S. No.	Accession number	Name of the genotype	Site of the Samples taken
1	AH 1	Palur 2	Jackfruit germplasm, HC &RI, Periyakulam,Theni dist
2	AH 2	Muthandikuppam	Jackfruit germplasm, HC &RI, Periyakulam,Theni Dist
3	AH 3	Tamil Nadu selection	Jackfruit germplasm, HC &RI, Periyakulam, Theni Dist
4	AH 4	PDC selection	Jackfruit germplasm, HC &RI, Periyakulam, Theni Dist
5	AH 5	Viruthachalam	Jackfruit germplasm, HC &RI, Periyakulam, Theni Dist
6	AH 6	Maligampattu Selection-1	Farmer's field in Maligampattu village, Panruti taluk, Cuddalore district
7	AH 7	Maligampattu Selection-2	Farmer's field in Maligampattu village, Panruti taluk, Cuddalore district
8	AH 8	Maligampattu Selection-3	Farmer's field in Maligampattu village, Panruti taluk, Cuddalore district
9	AH 9	Then Varikkai	Jackfruit field HC &RI, Periyakulam, Theni Dist
10	AH 10	Nattu Varikkai	Jackfruit field HC &RI, Periyakulam, Theni Dist
11	AH 11	Pakkam Selection- 1	Farmer's field in Pakkam village, Pondicherry
12	AH 12	Pakkam Selection- 2	Farmer's field in Pakkam village, Pondicherry
13	AH 13	Natham Selection-1	Farmer's field in Natham village, Dindugal district
14	AH 14	Natham Selection -2	Farmer's field in Natham village, Dindugal district
15	AH 15	PKM 1	Jackfruit field HC &RI, Periyakulam,Theni dist
16	AH 16	Natham Selection- 3	Farmer's field in Natham, Dindugal district
17	AH 17	Natham Selection-4	Farmer's field in Natham, Dindugal district
18	AH 18	Muttam Varikkai	Jackfruit field HC &RI, Periyakulam,Theni dist
19	AH 19	Natham Selection- 5	Farmer's field in Natham, Dindugal district
20	AH 20	Sirumalai	Farmer's field in Sirumalai, Dindugal dist
21	AH 21	Koolayanur	Farmer's field in Koolayanur, Theni dist
22	AH 22	Malayanur	Farmer's field in Malayanur village, Cuddalore dist.
23	AH 23	Palur 1	Jackfruit field HC &RI, Periyakulam,Theni dist
24	AH 24	Singapore jack	Jackfruit field HC &RI, Periyakulam,Theni dist
25	AH 25	Palpala	Farmer's field, Jawadhu Hills, Thiruvannamalai district

(ii) Fruit length (cm)

The fruit length and measured using a ruler and the result was expressed in centimeter.

(iii) Fruit girth (cm)

Girth is measured at the widest region of the fruit using a ruler and the result was expressed in centimeter

(iv) Fruit weight (kg)

The weight of the fruit from each genotype was recorded using a weighing balance and the result was expressed in kilogram

(v) Fruit rind weight (Kg)

The weight of the rind from each genotype was recorded and expressed in kilogram

(vi) No. of. flakes (bulbs) per fruit

Bulbs (seeded) was determined based on visual count when the fruits were cut

(vii) Weight of individual flake with seed (g)

Measured using a weighing balance and the results was expressed in grams

(viii) Weight of individual flake without seed (g)

Measured using a weighing balance and the results was expressed in grams

(ix) Flake length (cm)

Measured using a Vernier caliper and the results was expressed in centimeter

(x) Flake girth (cm)

Measured using a Vernier caliper and the results was expressed in centimeter

(xi) Flake thickness (mm)

Measured using a Vernier caliper and the results was expressed in millimetre

(xii) Flake seed ratio

Measured by the formula:

$$\frac{\text{Weight of 10 flakes (without seed)}}{\text{Weight of 10 seed}}$$

(xiii) Recovery percentage (%)

Expressed by the formula:

$$\frac{\text{Fruit weight} - \text{Rind weight}}{\text{Fruit weight}} \times 100$$

(xiv)Total Soluble Solids (°Brix)

TSS content of different jackfruit genotypes were determined by using Hand-Held refractometer and expressed in ° Brix. A drop of fresh juice from sample was squeezed on the prism of the refractometer and the total soluble solids were recorded in °Brix from the direct reading of the instrument.

(xiv) Sensory evaluation of flakes

Flakes were examined for organoleptic evaluation by panel consisting of 5 members.

Flakes overall acceptability were scored based on the 9- Point Hedonic scale [6]. The attributes evaluated were Colour, Taste, Aroma, Juiciness, Texture and Overall acceptability.

(a) **Colour**
- Deep yellow
- Yellow
- Light yellow
- White

(b) **Taste**
- Low
- Medium
- High

(c) **Aroma**
- Low
- Medium
- High

(d) **Juiciness**
- Low
- Medium
- High

(e) **Texture**
- Soft
- Firm

(f) **Overall acceptability based on Hedonic scale**

9- Like extremely; 8- Like very much; 7-like; 6-Like slightly; 5-Neither like nor dislike; 4-Dislike slightly; 3-Dislike moderately; 2- Dislike; 1-Dislike Extremely

3. RESULTS AND DISCUSSION

1. Fruit characters

Regarding fruit weight (Table 2), fruit weight is the crucial factor in deciding recovery percentage, yield, sales potential in market. Among the genotypes studied the fruit weight ranged from 2.67 kg to 22.09 kg. The accession with the minimum fruit weight was identified as AH 22 (2.67 kg) and maximum weight was observed in AH 15 (22.09 kg). Variations observed in fruit weight may be due to genetic makeup and fruit bearing position. Fruits developing from main trunk has higher weight compared to primary and other higher order branches. This may be the result of stronger sink reaction in main trunk. Similar findings were found by Gladis et al*.,* [7]. Their study revealed that fruit bore in clusters in main trunk and primary branches produced more solitary fruits compared to main braches. Consumption rate of small to medium sized fruit is large due to high consumer acceptance. Wangchu et al. [8] genotypes with smaller fruit weight is suitable for conjugal family and fruits which weighs high is suitable for chips processing. His study revealed that the smaller fruit was around 1.6 kg and the largest fruit weight was found to be 16.47 kg.

With reference to (Table 2), Wide variation was observed in fruit length among the genotypes. Fruit length ranged from 22.60 cm to 60.17 cm. The longest fruit length was observed in AH 25 (60.17 cm) and the shortest length was observed in AH 14 (22.60 cm). Oblong shaped fruits exhibited longest fruit length. Obloid shaped fruit possessed shortest fruit length. Similar findings were reported by Muthulakshmi [9]. Her examination over biometric characters revealed that highest fruit length was observed in oblong shaped fruit (47.59 cm) and the shortest fruit length was found in (32.63 cm).

The Fruit girth (Table 2), ranged from 35.33 cm to 79.20 cm. The genotype which had increased diameter was observed in AH 23 (79.20 cm) and the genotype with the shortest diameter was observed in AH 3 (35.33 cm). Ellipsoidal shaped

fruits possessed more diameter. This finding was in accordance with the study done by Muthulakshmi [9] where, the ellipsoidal shaped fruit had the highest diameter of (67.26 cm) and Oblong shaped fruit exhibited second shortest diameter (65.26cm). The range of fruit rind weight (Table 2),is from 1.44 kg to 10.65 kg. Higher rind weight affects the recovery percentage of total fruit. Rind weight is directly proportionate to edible portion of the fruit of jackfruit genotypes i.e. results in higher number of bulbs per fruit. Similar findings were reported by Akter and Rahman. Highest rind weight was observed in accession AH 15 (10.65 kg) and lowest in AH 22 (1.44 kg).Highest rind weight is not preferable as it reduces the recovery rate of fruit (availability of edible portion).

With reference to Recovery rate (Table 2). The amount of edible portion available for consumption from whole fruit is an important factor. Higher the number of inner perigones (non-edible perianth) results in higher non-edible portion. About 60% of jackfruit consists of inedible portion like outer rind (54%), inner perigones and central core (6%) the remaining 40% holds the edible portion. The inedible portions were used as cattle feed. These findings were reported in Subburamu et al [10]. Wide variations was observed in recovery rate and it ranged from 33.12% to 62.10 %. Highest recovery was found in AH 11 (62.10%) and lowest was found in AH 24 (33.12%).

Number of fruits/tree/year (Table 2), depends upon the health status of the tree. The genotypes bearing an average 25 or more fruits are considered to be good bearer [11]. The range is from 35.67 to 146. Highest number of fruits was found in genotype AH 2 (146) and lowest was found in AH 4 (35.67). Number of fruits has an inversely proportional to the average fruit weight. Genotypes like AH 4,AH 5, AH 15 produced average fruits of 35.67, 40.0 and 37.33 but a single fruit weighed around 12.25 kg, 14.79 kg, and 22.09 kg. whereas genotypes like AH 2, AH 11, AH 14, AH 16, AH 22 produced fruits of about 146, 140.33,127.33, 123.33, 111.33 and each fruit weighed around 6.69 kg, 6.3 kg, 2.96 kg, 3.18 kg, 2.67 kg. Yield (Table 2), is one of the most important evaluation criteria in terms of breeding programme for selection of superior variety. In jackfruit, trees with more number of fruits and high fruit weight produces more yield. Among the genotypes studied yield/tree/year ranged from 300.58 kg to 1000.56 kg. Highest yield was found in genotype AH 2 (1000.56 kg), and lowest was found in AH 22 (300.58 kg).

Fruits shape (Table 6), from the collected genotypes could be classified into 6 different shape ‘obloid’, ‘spheroid’, ‘ellipsoid’, ‘clavate’, ‘oblong’ and ‘irregular. Among the different fruit shape, ellipsoid (44%) was the most observed fruit shape, followed by Oblong (28%), Spheroid (12%), Obloid &Irregular (8%). There was no clavate shaped fruits observed in the 25 genotypes collected. Ellipsoid and Oblong are the most preferred in the market. Ellipsoid shape was observed in AH 1,AH 2, AH 7,AH 8,AH 15,AH 17,AH 18, AH 20, AH 21, AH 22, AH 23.Oblong shape was observed in AH 3,AH 9,AH 12,AH 13,AH 19,AH 25.

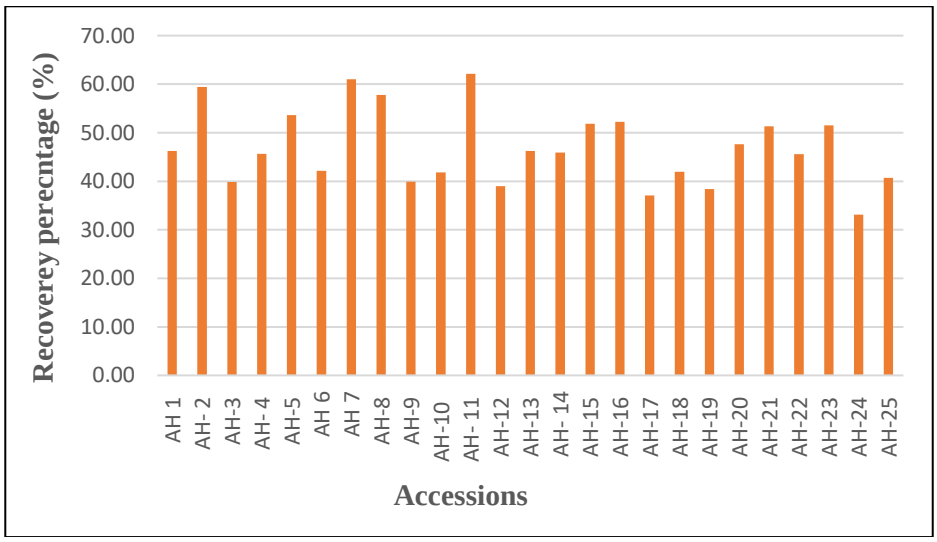

Fig. 2. Variability in recovery percentage (%)

Table 2. Studies on fruit characteristics of jackfruit genotypes

Sample	Fr.W (kg)	Fr.L (cm)	Fr.G (cm)	FRW (Kg)	RP (%)
AH 1	11.38	29.00	39.17	6.11	46.23
AH- 2	6.69	42.40	48.93	2.69	59.40
AH-3	11.56	43.67	35.33	6.95	39.82
AH- 4	12.25	43.87	54.20	6.65	45.64
AH-5	14.79	49.10	76.50	6.90	53.64
AH 6	7.78	42.53	50.60	4.32	42.13
AH 7	13.6	44.00	50.00	5.30	61.00
AH-8	11.65	32.23	54.40	4.94	57.80
AH-9	4.87	33.00	44.00	2.93	39.91
AH-10	12.38	52.67	46.67	7.22	41.81
AH- 11	6.31	39.00	51.67	2.37	62.10
AH-12	5.67	35.67	61.63	3.47	38.97
AH-13	8.91	22.87	51.07	4.76	46.24
AH- 14	2.96	22.60	53.97	1.60	45.90
AH-15	22.09	51.77	39.60	10.65	51.83
AH-16	3.18	25.60	54.83	1.60	52.27
AH-17	9.39	38.67	51.67	5.90	37.06
AH-18	6.69	35.33	51.00	3.89	41.95
AH-19	11.09	43.67	53.00	6.84	38.42
AH-20	9.69	38.67	67.17	5.06	47.63
AH-21	3.49	40.80	50.33	1.73	51.30
AH-22	2.67	32.27	37.00	1.44	45.61
AH-23	12.49	45.50	79.20	6.11	51.49
AH-24	5.21	50.13	58.30	3.47	33.12
AH-25	11.42	60.17	52.67	6.74	40.72
Mean	9.12	39.81	52.52	4.79	46.88
Minimum	2.67	22.60	35.33	1.44	33.12
Maximum	22.09	60.17	79.20	10.65	62.10
SE(d)	1.44	3.41	6.05	0.77	3.22
CD(0.05)	2.89	6.86	12.15	1.56	6.48
CV %	19.33	10.51	14.11	19.88	8.43

AH-Artocarpus heterophyllus, SE- Standard error, CD-crtical difference, CV- Coefficient of variation
Fr.W: Fruit Weight (kg), Fr.L: Fruit Length (cm), Fr.G: Fruit Girth (cm), FRW: Fruit rind weight (kg), RP: Recovery percentage (%)

2. Flake characters

Referring to number of flakes (Table 3), Flake quality is the prime objective in determining the genotypes for its uasge in table and culinary purpose. Genetic characters of the plant and size of the fruit determines the number of bulbs. The range is from 32.67 to 389.33. Highest number of flakes was found in the accession AH 25 (389.33) it had the size of about 60.17 cm in length and the girth of about 52.67 cm. The lowest number of flakes was found in AH 12 (32.67). Referring to flake weight with and without seed (Table 3), Jackfruit flakes with higher weight holds commercial importance and considered as a crucial criteria in selection of best quality genotypes. Number of flakes and average weight of flakes without seed directly indicate the edible portion of ripe jackfruit. The weight of individual flakes with seed ranged from 11.7 g to 68.1 g. Highest weight of individual flake with seed was found in AH 12 (68.1 g). Lowest weight of flake with seed was found in AH 25 (11.7 g). In terms of flake weight without seed the range is around 7.30 g to 59.27 g. Highest flake weight without seed was found in AH 12 (59.27 g) and lowest was found in AH 25 (11.7 g).

The range of flake length (Table 3), was found between 3.80 cm to 10.73 cm. Highest flake length observed in AH 5 (10.73 cm) and lowest was found in AH 21 (3.80 cm). This finding was in accordance with the range of flake length studied by Chandrasekhar et al*.* [12]. Their study revealed, the range of flake length to be between 3.71-10.08 cm.

In terms of Flake girth the range was found to be 4.97 cm to 11.03 cm. The highest flake girth was found in AH 12 (11.03 cm) and lowest was found in AH 1 (4.97 cm). Jagadeesh et al*.* [13] observed the flake girth in his study to be between 2.63 cm to 4.60 cm. In relation to Flake thickness (Table 3), Jackfruits with thick flakes are generally preferred for table purpose

(Mathura et al. (2003). The range was found to be between 2.23 mm to 8.67 mm. Highest flake thickness was found to be observed in AH 12 (8.67 mm) and lowest was found to be present in AH 9 (2.23 mm).

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Flake seed ratio (Table 3), represents the individual proportion of flake and seed in total bulb. Range is from 1.63 to 7.67. Highest flake seed ratio was found to be in AH 23 (7.67) and lowest was in AH 25 (1.63). Chandrasekhar [12] reported that, flake seed ratio represents the edible portion of the fruit and the range of flake seed ratio in his study to be between 1.56 to 5.70.

With respect to TSS (Table 3). The quality of jackfruit is normally judged by the TSS content of ripened flakes and one of the main criteria for consumer acceptance. The range was between 22.33 to 33° Brix. Highest TSS content was found in AH 11 (33° Brix) and lowest was found in AH 4 (22.33°Brix). Jagadeesh et al. [14] observed the TSS range in his study to be between 23.83 to 34.33 (º Brix) [15-20].

3. Organoleptic evaluation

The organoleptic test is the final protocol for quality acceptance of selected genotypes. Variation in results may be due to genetic nature of genotype and growing condition. Ripe flake of jackfruit was evaluated for organoleptic qualities using five parameters and 9 point hedonic scale.

(a) Colour: The colour of flakes (Table 4,5,6) is an important factor for consumer acceptance. The colours were classified Deep yellow, yellow, light yellow, white. Mean of flake colour that is scored using hedonic scale was found to be 7.87 and it ranged from 6.33 to 9.00. 'Deep yellow' is preferred more on the market and it was found in AH 2, AH 9, AH 11, AH 14, AH 16, AH 17,AH 9, AH 21,AH 22,AH 23,AH 24 and had a frequency distribution of 44%.

Table 3. Studies on flake characteristics of jackfruit genotypes

Sample	NFL/F (Nos.)	WFIS (g)	WFI (g)	FL.L(cm)	FL.G(cm)	FL.T(mm)	FL:S	TSS(°Brix)
AH 1	108.67	47.67	40.67	6.30	4.97	5.00	6.00	27.00
AH- 2	161.00	26.73	22.00	8.67	8.97	7.00	4.60	31.67
AH-3	172.67	26.00	19.33	4.97	5.40	3.50	2.97	23.67
AH- 4	204.67	27.00	20.33	7.50	8.23	5.83	3.07	22.33
AH-5	189.67	45.47	39.47	10.73	7.43	5.30	6.57	24.00
AH 6	135.67	25.47	21.00	5.93	6.30	8.00	4.07	27.67
AH 7	236.00	36.67	30.67	8.00	5.00	4.93	5.50	30.00
AH-8	165.67	45.67	38.33	6.37	5.93	5.67	5.33	26.00
AH-9	86.00	18.00	13.33	5.33	7.67	2.23	2.53	29.67
AH-10	201.33	24.50	18.00	6.17	7.33	6.30	2.77	24.67
AH- 11	171.67	24.67	18.00	6.33	7.00	6.33	2.73	33.00
AH-12	32.67	68.10	59.27	7.13	11.03	8.67	6.70	29.00
AH-13	142.33	28.93	22.27	6.77	7.13	4.00	3.33	29.33
AH- 14	65.00	24.60	15.33	6.30	6.67	6.00	2.40	29.33
AH-15	261.67	43.33	34.67	8.24	7.67	4.15	4.03	25.33
AH-16	75.00	22.50	15.73	6.33	5.53	5.33	2.37	29.67
AH-17	144.00	24.00	19.00	6.20	6.63	2.27	3.90	28.67
AH-18	51.33	53.67	46.67	7.83	6.67	4.50	6.67	27.00
AH-19	343.67	14.00	9.67	5.90	8.00	3.50	2.23	26.00
AH-20	129.00	37.60	31.07	7.57	8.27	6.67	4.87	28.67
AH-21	89.00	19.00	14.67	3.80	5.40	2.50	3.40	26.00
AH-22	66.33	18.00	13.00	4.37	6.50	4.00	2.63	28.67
AH-23	185.00	39.87	35.33	9.17	8.91	4.67	7.67	22.33
AH-24	44.33	38.00	29.67	5.00	6.53	2.83	3.57	27.00
AH-25	389.33	11.70	7.30	5.83	5.10	3.33	1.63	24.00
Mean	154.07	31.65	25.39	6.67	6.97	4.90	4.06	27.23
Minimum	32.67	11.70	59.27	3.80	4.97	2.23	1.63	22.33
Maximum	389.33	68.10	7.30	10.73	11.03	8.67	7.67	33
SE(d)	31.44	4.32	4.07	0.98	1.12	0.63	0.80	1.31
CD(0.05)	63.17	8.68	8.18	1.98	2.25	1.28	1.62	2.63
CV %	25.00	16.73	19.65	18.12	19.70	15.97	24.35	5.91

AH-Artocarpus heterophyllus, SE- Standard error, CD-Critical difference, CV- Coefficient of variation
NFL/F: Number of flakes per fruit (Nos.), WFIS: Weight of flake with seed (g),WFI : Weight of flake without seed (g), FL.L : Flake length (cm), FL.G : Flake girth (cm), FL.T : Flake thickness (mm), FL.S : Flake seed ratio, TSS: Total soluble solids (°Brix)

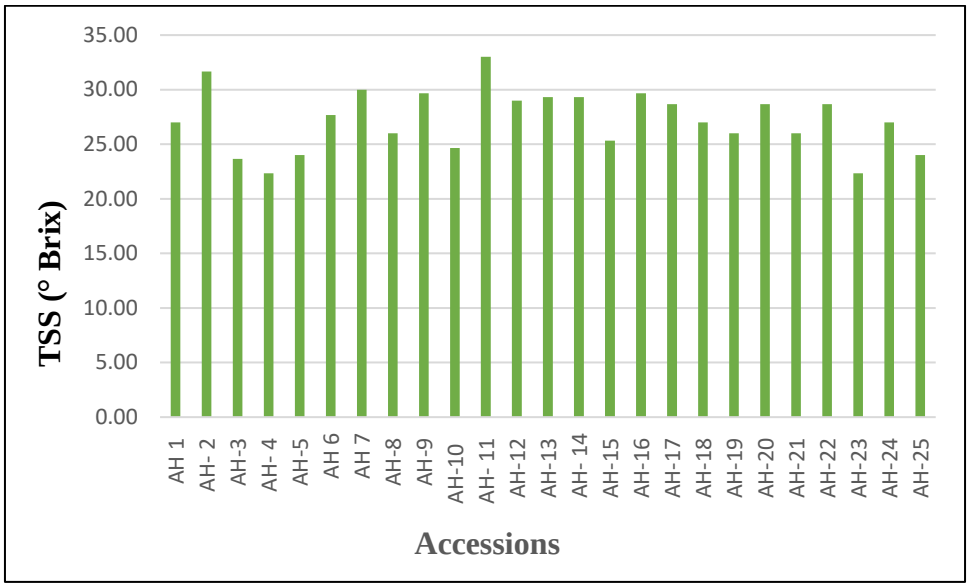

Fig. 3. Variations obserevd in TSS (ºBrix)

Table 4. Studies on sensory attributes of jackfruit genotypes

Sensory Evaluation of Flakes						
Sample	**Colour**	**Taste**	**Aroma**	**Juiciness**	**Texture**	**Overall acceptability**
AH 1	Yellow	High	High	High	Soft	Liked
AH- 2	Deep yellow	High	High	High	Firm	Liked extremely
AH-3	Light yellow	Low	Medium	Medium	Firm	Liked slightly
AH- 4	yellow	Low	Low	High	soft	Liked
AH-5	Light yellow	Medium	Medium	Medium	Firm	Liked slightly
AH 6-	yellow	High	High	High	Soft	Liked
AH 7	yellow	High	High	High	Soft	Liked extremely
AH-8	yellow	High	High	High	Soft	Liked extremely
AH-9	Deep yellow	High	High	High	Soft	Liked extremely
AH-10	Light yellow	medium	High	Medium	Firm	Liked slightly
AH- 11	Deep yellow	High	High	High	Soft	Liked extremely
AH-12	Light yellow	High	High	High	Firm	Liked slightly
AH-13	light yellow	High	low	medium	Firm	Liked slightly
AH- 14	Deep yellow	High	High	High	Soft	Liked
AH-15	Light yellow	Medium	High	Medium	Firm	Liked extremely
AH-16	Deep yellow	High	High	High	Soft	Liked
AH-17	Deep yellow	High	High	High	Soft	Liked extremely
AH-18	Light yellow	Medium	Medium	Medium	Firm	Liked
AH-19	Depp Yellow	Medium	Medium	Medium	Firm	Liked
AH-20	yellow	High	High	medium	soft	Liked extremely
AH-21	Deep yellow	Medium	Medium	Medium	Firm	Liked slightly
AH-22	Deep yellow	High	High	Medium	Soft	Liked extremely
AH-23	Deep yellow	medium	High	High	Soft	Liked extremely
AH-24	Deep Yellow	Medium	Medium	Medium	Soft	Liked
AH-25	White	Low	Low	Medium	Firm	Liked slightly

(b) Texture: Flakes texture (Tables 4,5,6) were classified into soft and firm. Firm and thicker flakes were preferred for table purpose and soft flakes were preferred for culinary purpose. The mean was 8.00 and ranged between 7.00 to 9.00. AH 1,AH 4, AH 6, AH 7, AH 8, AH 9, AH 11, AH 14, AH 16, AH 17, AH 20, AH 22, AH 23, AH 24 and had a frequency distribution of 56 % .Firm flakes were found in AH 2, AH 3, AH 5, AH 10, AH 12, AH 13, AH 15, AH 18, AH 19, AH 21, AH 25 and had a frequency distribution of 44%. Among the genotypes collected flakes with softer texture was found more.

Table 5. Studies on sensory evaluation based on 9 point hedonic scale

Sample	Colour	Juiciness	Taste	Aroma	Texture	Overall Acceptabiliy
AH 1	7.00	8.00	8.00	8.00	8.33	7.67
AH- 2	8.67	9.00	8.67	8.33	9.00	8.40
AH-3	7.00	7.00	6.33	7.33	7.67	7.07
AH- 4	6.33	8.00	6.67	6.00	8.00	7.00
AH-5	7.67	7.33	6.00	6.33	7.67	7.00
AH 6	8.00	8.00	8.00	8.00	8.00	8.00
AH 7	8.33	8.00	8.33	8.67	9.00	8.47
AH-8	8.33	7.67	8.00	8.67	8.33	8.20
AH-9	8.33	8.00	8.33	8.33	8.00	8.20
AH-10	7.33	7.00	7.67	8.00	7.67	7.53
AH- 11	9.00	9.00	9.00	9.00	9.00	9.00
AH-12	7.00	8.67	8.33	8.30	8.33	8.13
AH-13	6.67	7.00	8.33	6.33	7.33	7.13
AH- 14	8.00	8.00	8.00	8.67	8.00	8.13
AH-15	8.00	7.67	8.67	8.33	9.00	8.33
AH-16	8.33	8.33	8.33	8.00	7.67	8.13
AH-17	8.67	8.00	8.33	8.00	7.67	8.13
AH-18	7.33	7.00	7.00	8.33	7.00	7.33
AH-19	8.33	7.00	7.33	8.00	8.00	7.73
AH-20	8.00	7.67	8.67	8.33	7.67	8.07
AH-21	8.00	7.00	7.33	8.00	7.00	7.47
AH-22	8.00	7.00	8.00	8.67	8.00	7.93
AH-23	8.33	8.00	7.00	8.00	8.67	8.00
AH-24	8.33	7.00	7.33	7.33	8.00	7.80
AH-25	7.67	8.00	6.00	6.67	7.00	7.07
Mean	7.87	7.73	7.75	7.91	8.00	7.84
Minimum	6.33	7.00	6.00	6.00	7.00	7.00
Maximum	9.00	9.00	9.00	9.00	9.00	9.00
SE(d)	0.36	0.28	0.43	0.36	0.35	0.47
CD(0.05)	0.73	0.56	0.86	0.73	0.70	0.94
CV %	5.68	4.48	6.83	5.66	5.40	7.35

AH-Artocarpus heterophyllus, SE- Standard error, CD-Critical difference, CV- Coefficient of variation

A: AH 11

B: AH 7

C: AH 2

Plate 1. Diversity in fruit and flake shapes

(c) Juiciness: With respect to juiciness (Tables 4,5,6) Consistency of the flakes is an important criteria of jackfruit for their sale in retail market. Low juicy flakes turn to be crispy and high juicy flakes used to have softer consistency. The mean was found to be 7.73 and the range was found to be between 7.00 to 9.00.Highest score of 9.00 was found in AH 2 and AH 11(9.00) and lowest score of 6.00 was found in AH 3, AH 10, AH 13, AH 18, AH 19, AH 21, AH 22, AH 24.

(d) Aroma: In terms Aroma (Tables 4,5,6) it holds an important place in organoleptic evaluation. Aroma tends to have a captivating effect on consumers. The mean was found to be 7.91 and the range was between 6.00 to 9.00. Highest score was found in AH 11 (9.00) and lowest was found in AH 4(6.00)

(e) Taste: Referring to Taste (Tables 4,5,6) The quality of jackfruit is primarily decided by the taste of the ripened flakes. The mean was found to be 7.75. The range is from 6.00 to 9.00. Highest score was found in AH 11(9.00) and the lowest was found in AH 25 and AH 5.

(f) Overall acceptability: In terms of overall acceptability (Tables 4,5,6) The mean was found to be 7.84.The range is from 7.00 to 9.00. Highest score of 9.00 in overall acceptability was found in AH 11 and lowest score of 7.00 was found in AH 4 and AH 5.

Table 6. Studies on frequency distribution of jackfruit genotypes for fruit shape, colour, taste, aroma, juiciness, texture, overall acceptability

Characters	Observations	No.of.Genotypes	Frequency (%)
	Obloid	2	8
	Spheroid	3	12
	Ellipsoid	11	44
Fruit shape	Oblong	7	28
	Clavate	0	0
	Irregular	2	8
Sensory evaluation of jackfruit flakes			
	Deep yellow	11	44
Colour	Yellow	6	24
	Light yellow	7	28
	White	1	4
Taste	Low	3	12
	Medium	8	32
	High	14	56
	Low	3	12
Aroma	Medium	6	24
	High	16	64
	Low	0	0
Juiciness	Medium	12	48
	High	13	52
Texture	Soft	14	56
	Firm	11	44
	Liked extremely	10	40
Overall acceptability	Liked	8	32
	Liked slightly	7	28

4. CONCLUSION

Biometric parameters tend to play a vital role in the identification of superior germplasm for crop improvement. Therefore, a study was conducted at Department of Fruit Science, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulam on fruit and flake characteristics of jackfruit genotypes. The findings of the study revealed that each genotype exhibited distinct variability in terms of quantitative and qualitative fruit traits. Based on performance with reference to recovery rate and TSS the genotypes AH 2, AH 7, AH 11 was found to be promising and economical. AH 11 had the highest recovery percentage of (62.10 %), follwed by AH 7 (61.00 %) and AH 2 (59.40 %).In terms of organoleptic evaluation AH 2 found to be suitable for table purpose and AH 7, AH 11 for culinary purpose. AH 2 exhibited firm flakes whereas AH 7 and AH 11 exhibited soft flakes. All of the selected genotypes had higher overall acceptability in terms of consumer preference

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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