



# **Variability in Physico-Chemical Fruit Quality in Dessert Type of Jackfruit (*Artocarpus heterophyllus* Lam.) Genotypes Located in Four Districts of Karnataka, India**

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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

The survey work for identifying elite jackfruit type was initiated in the year 2015 jackfruit season. During 2015 jackfruit season, 27 jackfruit types identified through an extensive survey were spread in 4 districts viz., North Canara (2 types), Chikmagalore (6 types), Tumkur (16 types) and Hassan (3 types). Analysis of variance for 30 characters in 27 type jackfruits revealed a greater variability in the survey zone. Flake thickness, bulb length and TSS exhibited a considerable amount of variation in number. Fruit weight had a range from 0.91 kg (Type-23) to 9.30 kg (Type-12). The type-12 recorded maximum fruit length (42.00 cm) and fruit breadth (30.40 cm). The bulb color varied from cream (Type-6) to Yellow (12 jackfruit types), light yellow (Eight types) and orange (four types) The maximum bulb number of 170 was noticed in the type-7. Bulb weight was maximum in Type-12 (5.42 kg) and minimum in Type-23 (0.22 kg). Bulb length showed a range from 8.53 cm (Type-17) to 3.92 cm (Type-23). Similarly bulb breadth was maximum in Type-13 (5.60 cm) and minimum in Type-5 (3.07 cm) and Type-6 (3.07 cm). Total Soluble Solids (TSS) content was noticed high in Type-18 (32.38°Brix). The maximum score for crispness was noted Type-4 (4.90) and Type -17 (4.90). Overall acceptability score was higher in Type-10 (4.50). Type-10 (4.50) was the best and having good score for overall acceptability and other physico chemical parameters studied.

**Keywords:** Jackfruit; type; selections; physico-chemical; variability.

## 1. INTRODUCTION

Jackfruit (*Artocarpus heterophyllus* Lam., Family: *Moraceae*) is one major tropical fruit crop it was originated from India and widely distributed in many parts of Asia, but extensively seen in India and Bangladesh. The cultivation of jackfruit in wild form was observed in Western Ghats of India. Its distribution is sporadic in regions with low rainfall and constant along the western coast, where there is high rainfall all the way to Konkan. In Western Ghats, it is found up to 1500 m and has tremendous diversity (Murulidharan *et al.*, 1997). Flakes of ripe fruits are rich in nutritive value containing 18.9 g carbohydrates, 0.8 g minerals, 30 IU vitamin A and 0.25 mg thiamine for every hundred gram [1]. Despite being rich in nutrients, the jackfruit is commonly referred to as "Poor man's food" in Eastern and Southern India. Productivity of the crop is relatively high (25.71 t/ha) (Anon., 1992).

"Numerous trees that produce jackfruit, each with a fruit that varies in size, shape, and quality. For the purpose of maintaining distinctness these types can be further differentiated based on the fruit's size, flavour and aroma of the flesh, and the nature, variety, and shape of the prickles on the rind" [2]. Singh and Srivastava [3] identified "18 clones of jackfruit as superior in various parts of eastern Uttar Pradesh based on physico-chemical qualities of fruits, bearing, yield and fruit maturity. The jackfruit has several types or forms with various fruit qualities since it is highly cross-

pollinated and is primarily grown by seed. The types differ among themselves in the shape and density of spikes on the rind, bearing, size, shape, latex, flake size, flake color, quality and period of maturity".

In jackfruit-growing regions, lot of variations was seen in sweetness, acidity, flavour, and taste. The Western Ghats, the region where jack originates, have such an immense number of clones, which provides a significant opportunity for clonal selection to improve this crop. There is a substantial amount of genetic diversity within the species as a result of cross-pollination and the dominance of seed propagation over a long period of time. The vast variation found in nature makes it easier to choose more appealing species. At the site of College of Horticulture there is a jackfruit nursery, wide range of clones are available in Western Ghats of India where the jack was originated hence there is a huge scope for studying the variability among the existing resources. Considering these parameters a study was undertaken to identify the superior jackfruit genotypes based on its physical and chemical properties.

## 2. MATERIALS AND METHODS

Jackfruit types used for the study were selected based on a survey conducted with the assistance of farmers, fruit merchants, officials of State Department of Horticulture and Forestry, Government of Karnataka. During 2015 jackfruit

**Table 1. Selected jackfruits types located in 4 districts of Karnataka (2015)**

Sl. No.	District surveyed	Types	Total types
1.	North Canara	1, 2	2
2.	Chikmagalore	3, 4, 5, 6, 7, 8	6
3.	Tumkur	12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27	16
4.	Hassan	9, 10, 11	3

**Table 2. Mean values for fruit characters in selected dessert type jackfruits located in 4 districts of Karnataka (2015)**

Tree No.	Fruit shape	Fruit color	Fruit length (cm)	Fruit breadth (cm)	Fruit weight (kg)	Rind thickness (cm)	Rind weight (kg)	Rind (%)	Cylinder diameter (cm)		Cylinder length (cm)	Cylinder weight (kg)	Cylinder (%)
									Max	Min			
1	3	Green yellow	40.55	20.15	8.76	0.97	3.60	41.10	5.20	3.10	30.00	0.38	4.34
2	3	Yellowish green	42.00	21.00	6.74	2.03	3.29	48.81	7.00	3.80	32.50	0.57	8.46
3	3	Green	28.30	15.90	3.59	0.67	1.54	42.90	4.30	1.30	21.80	0.18	5.01
4	3	Green	28.00	20.00	5.56	1.00	1.95	35.07	5.50	3.70	18.00	0.21	3.78
5	3	Brown	28.50	21.30	5.35	0.77	2.41	45.05	5.40	3.60	25.50	0.34	6.36
6	3	Brown	29.00	16.50	4.18	0.57	1.75	41.87	4.40	4.80	23.80	0.42	10.05
7	5	Light yellow	32.60	18.50	7.05	0.67	1.94	27.52	5.50	3.20	23.80	0.35	4.96
8	3	Brown	39.00	19.00	4.92	0.57	1.67	33.94	5.80	3.20	33.50	0.56	11.38
9	3	Yellow	36.20	23.80	9.07	1.00	3.51	38.70	5.70	3.70	27.30	0.47	5.18
10	5	Brown	26.00	14.00	3.23	0.67	1.48	45.82	4.70	4.60	23.20	0.34	10.53
11	3	Green	25.25	19.25	3.46	0.60	1.34	38.73	4.20	3.60	16.65	0.28	8.09
12	5	Green	42.00	30.40	9.30	0.70	3.51	37.74	4.80	3.40	35.80	0.47	5.05
13	3	Greenish yellow	37.50	17.50	5.49	1.00	2.87	52.28	4.00	3.00	21.00	0.19	3.46
14	3	Yellowish green	31.00	18.00	4.82	0.57	1.91	39.63	5.50	5.00	24.50	0.37	7.68
15	2	Green	25.00	20.00	4.68	0.70	2.26	48.29	4.20	3.00	13.50	0.13	2.78
16	3	Yellow	23.40	17.80	4.17	0.73	1.52	36.45	5.20	4.60	17.50	0.31	7.43
17	3	Light green	28.80	22.50	6.66	1.10	2.67	40.09	7.10	4.70	11.00	0.47	7.06

Tree No.	Fruit shape	Fruit color	Fruit length (cm)	Fruit breadth (cm)	Fruit weight (kg)	Rind thickness (cm)	Rind weight (kg)	Rind (%)	Cylinder diameter (cm)		Cylinder length (cm)	Cylinder weight (kg)	Cylinder (%)
									Max	Min			
18	2	Light yellow	25.00	19.80	4.73	1.23	2.52	53.28	6.75	5.05	19.00	0.28	5.92
19	3	Green	28.50	19.80	5.93	0.90	2.00	33.73	6.30	3.60	19.20	0.33	5.56
20	3	Green	31.00	15.50	5.30	1.00	1.85	34.91	4.90	3.20	21.50	0.12	2.26
21	3	Green	22.50	15.80	2.81	0.93	1.47	52.31	4.90	3.20	15.80	0.15	5.34
22	3	Brown	31.50	22.00	6.47	1.03	3.79	58.58	7.90	7.00	19.50	0.63	9.74
23	2	Brown	13.70	12.40	0.91	1.33	0.61	67.03	4.35	2.30	6.75	0.07	7.36
24	2	Brown	18.00	15.00	2.43	0.73	1.24	51.03	4.70	2.70	15.60	0.12	4.94
25	4	Light green	32.60	22.80	6.82	1.73	3.39	49.71	5.70	1.90	29.50	0.38	5.57
26	3	Light green	35.00	24.50	7.38	0.78	2.48	33.60	6.50	5.10	32.50	0.60	8.13
27	3	Greenish yellow	23.80	16.10	2.93	0.58	0.93	31.74	4.25	3.50	20.15	0.54	18.43
<b>Mean</b>			<b>29.80</b>	<b>19.23</b>	<b>5.29</b>	<b>0.91</b>	<b>2.20</b>	<b>42.96</b>	<b>5.36</b>	<b>3.70</b>	<b>22.18</b>	<b>0.34</b>	<b>6.85</b>

**Table 3. Mean values for bulb characters in selected dessert type jackfruits located in 4 districts of Karnataka (2015)**

Tree No.	Bulb color	Bulb number	Bulb length (cm)	Bulb breadth (cm)	Bulb weight (kg)	Bulb volume (ml)	Flake thickness (cm)	Flake wt. (kg)	Flake (%)	Seed weight (kg)	Seeds (%)	No. of seeds
1	Light yellow	148	6.67	3.98	4.79	36.67	0.53	3.75	42.81	1.04	11.87	147
2	Yellow	94	4.73	4.23	2.81	65.00	0.73	1.86	27.60	0.95	14.09	94
3	Light yellow	83	4.70	4.17	1.77	24.33	0.47	1.25	34.82	0.52	14.48	82
4	Yellow	123	6.63	3.70	3.63	40.00	3.00	2.49	44.78	1.14	20.50	119
5	Light yellow	167	6.47	3.07	3.39	30.00	0.50	2.34	43.74	1.05	19.63	167
6	Cream	158	5.10	3.07	2.28	21.67	0.60	1.45	34.69	0.83	19.86	158
7	Yellow	170	6.23	3.63	4.88	33.33	0.40	3.35	47.52	1.53	21.70	170
8	Yellow	150	4.90	3.53	2.33	16.67	0.37	1.32	26.83	1.01	20.53	150
9	Orange	129	7.57	4.00	4.51	30.00	0.70	3.48	38.37	1.03	11.36	129
10	Yellow	59	5.33	3.90	1.30	21.67	0.53	0.64	19.81	0.66	20.43	59
11	Yellow	85	5.62	4.02	1.74	28.33	0.38	0.90	26.01	0.84	24.28	85
12	Yellowish orange	109	7.30	5.40	5.42	46.67	0.67	3.71	39.89	1.71	18.39	102
13	Yellow	45	7.10	5.60	2.29	26.67	1.00	1.85	33.70	0.44	8.01	45
14	Light yellow	91	5.10	4.35	2.78	28.33	0.50	1.85	38.38	0.93	19.29	86
15	Orange	48	6.63	5.43	2.56	56.67	0.70	2.18	46.58	0.38	8.12	46
16	Orange	114	4.93	3.57	2.27	21.67	0.37	1.42	34.05	0.85	20.38	114
17	Light orange	60	8.53	4.50	3.36	40.00	0.80	2.66	39.94	0.70	10.51	60
18	Yellow	45	6.02	4.02	1.74	40.83	0.92	1.39	29.39	0.35	7.40	45
19	Yellow	94	5.90	4.33	1.36	31.67	0.50	0.39	6.58	0.97	16.36	88
20	Yellow	84	6.23	4.17	3.24	40.00	0.77	2.66	50.19	0.58	10.94	81
21	Yellow	58	4.50	3.40	1.49	26.00	0.77	1.08	38.43	0.41	14.59	58
22	Yellow	71	5.30	4.63	2.25	21.67	0.70	1.12	17.31	1.13	17.47	69
23	Light yellow	10	3.92	4.30	0.23	13.75	0.43	227 (g)	24.91	33 (g)	3.63	10

Tree No.	Bulb color	Bulb number	Bulb length (cm)	Bulb breadth (cm)	Bulb weight (kg)	Bulb volume (ml)	Flake thickness (cm)	Flake wt. (kg)	Flake (%)	Seed weight (kg)	Seeds (%)	No. of seeds
24	Orange	49	4.97	3.37	1.17	21.67	0.43	0.88	36.21	0.29	11.93	49
25	Light yellow	84	6.87	4.27	2.91	26.67	0.47	2.11	30.94	0.80	11.73	84
26	Light yellow	134	6.93	4.33	4.15	31.67	0.67	3.44	46.61	0.71	9.62	129
27	Light yellow	66	5.45	4.80	1.69	35.00	0.67	1.08	36.86	0.61	20.82	64
<b>Mean</b>		<b>93.63</b>	<b>5.91</b>	<b>4.14</b>	<b>2.68</b>	<b>31.73</b>	<b>0.69</b>	<b>1.88</b>	<b>34.70</b>	<b>0.79</b>	<b>15.11</b>	<b>92.22</b>

Table 4. Mean values for biochemical and sensory characters of bulbs in selected dessert type jackfruits located in 4 districts of Karnataka

Tree No.	Biochemical characters			Sensory score (Out of 5.00)				
	TSS °B	Titratable acidity (%)	TSS:Acid	Colour and appearance	Crispiness	Aroma	Taste &flavour	Overall acceptability
1	22.93	0.21	109.19	3.0	3.3	3.5	3.6	3.4
2	22.67	0.25	90.68	3.8	4.3	4.1	3.7	4
3	16.00	0.16	100.00	3.9	4.4	3.5	3.6	3.8
4	19.60	0.15	130.67	4.0	4.9	4.1	4.0	4.2
5	22.60	0.22	102.73	3.7	3.0	3.8	3.9	3.6
6	17.93	0.17	105.47	3.9	4.5	3.9	3.9	4.0
7	27.77	0.12	231.42	3.8	4.7	4.1	4.5	4.3
8	28.20	0.16	176.25	3.9	4.3	4.3	4.6	4.2
9	20.23	0.14	144.50	4.9	4.2	4.1	4.4	4.4
10	20.63	0.14	147.36	4.8	4.9	4.1	4.2	4.5
11	25.97	0.15	173.13	4.3	3.8	4.2	4.4	4.2
12	21.67	0.22	98.50	4.6	4.1	3.6	3.7	4.0
13	22.90	0.17	134.71	4.3	4.3	4.0	4.4	4.3
14	23.67	0.21	112.71	3.8	3.9	4.3	4.5	4.1
15	16.20	0.27	60.00	4.5	4.3	3.9	3.5	4.0
16	23.60	0.17	138.82	4.1	3.5	3.7	4.0	3.8
17	15.53	0.15	103.53	4.8	4.9	3.9	3.8	4.3
18	32.38	0.15	215.87	4.2	4.0	4.4	4.3	4.2

Tree No.	Biochemical characters				Sensory score (Out of 5.00)			
	TSS °B	Titratable acidity (%)	TSS:Acid	Colour and appearance	Crispiness	Aroma	Taste &flavour	Overall acceptability
<b>19</b>	22.20	0.17	130.59	4.2	4.1	4.2	4.2	4.2
<b>20</b>	22.20	0.28	79.29	4.1	4.3	3.7	4.4	4.1
<b>21</b>	23.33	0.17	137.24	3.6	4.4	4.1	3.8	4.0
<b>22</b>	31.97	0.14	228.36	4.3	4.0	4.3	4.3	4.2
<b>23</b>	30.48	0.16	190.50	3.7	3.3	3.6	3.6	3.5
<b>24</b>	24.00	0.27	88.89	4.0	3.9	3.7	4.0	3.9
<b>25</b>	25.73	0.18	142.94	4.0	3.8	3.9	3.6	3.8
<b>26</b>	25.27	0.27	93.59	4.0	4.0	3.7	3.9	3.9
<b>27</b>	22.65	0.15	151.00	4.0	4.3	4.6	4.6	4.4
<b>Mean</b>	<b>23.27</b>	<b>0.19</b>	<b>134.00</b>	<b>4.08</b>	<b>4.13</b>	<b>3.97</b>	<b>4.05</b>	<b>4.05</b>

season, 27 jackfruit types identified through an extensive survey were spread in 4 districts viz., Shivamogga (1 types), Mysuru (1 types), Mandya (2 types) and Tumkur (24 types) (Table 1). "The fruits were brought to the laboratory of Post Harvest Technology at College of Horticulture, UHS, Udyanagiri Bagalkot for further studies with regard to morphological and biochemical features" (Tables 2, 3, 4).

"Total mass of the fruit was recorded in kilograms. The fruit was cut and the mass of different components of fruit were recorded separately. Flake (weight of pulp without seeds) mass was recorded in kilograms after removing seeds from the bulbs. Five bulbs from each fruit were selected at random and cut across to facilitate measurement of flake thickness. Flake thickness for each bulb was measured in centimeter with the help of digital vernier calipers. Length and breadth (at the midpoint) of each bulb was recorded in centimeters. Color of the bulb was visually observed and recorded. Total mass of bulbs of each fruit was divided by total number of bulbs in that fruit to work out average mass of bulb in grams. Per cent edible (flake) portion was calculated by dividing total mass of edible constituents (flakes = bulbs without seed) by total mass of fruit and expressed in percentage".

Similarly, the following chemical parameters were analyzed following the methods indicated against each of the parameter.

Biochemical parameters	Method
TSS (°B)	Hand
Refractometer	
Titration acidity (%)	Anon., 1984
TSS:Acid ratio	Ratio worked out
Total sugars (%)	Miller, 1972
Reducing sugars (%)	Miller, 1972

### 3. RESULTS AND DISCUSSION

The main aim of this study was finding the best jackfruit choices with the optimal physico-chemical characteristics and their organoleptic acceptability. The outcome of the variability studies of bulb characters and biochemical properties and physico chemical properties of 27 selections are given under Tables 2, 3, 4. A. The 27 jackfruit types examined and analysed from the 4 districts of Karnataka showed a significant variation in physico-chemical characteristics of jackfruit bulbs. The knowledge of these criteria

makes it possible to choose the clones for the advancement of crops. However, not many studies have been done to describe and survey the different types of jackfruit that are best for desserts [4,5,6,7].

#### 3.1 Fruit Characters

The shape of the jackfruit was assigned the number from 1 to 6 according to IBPGR descriptor for jackfruit. Nineteen of 27 fruits studied were similar in shape and were accorded standard shape number *i.e.* 3. None of the trees studied showed the shape 1 and 6. Fruit rind colour exhibited diversity. It varied from, green, yellow, greenish-yellow, yellowish-green, light green, light yellow and brown. Fruit weight had a range from 0.91 kg (Type-23) to 9.30 kg (Type-12). The type-12 recorded maximum fruit length (42.00 cm) and fruit breadth (30.40 cm) while, the jackfruit type-23 showed minimum fruit length and breadth (12.4cm).

Rind thickness ranged from 0.57 cm (Type 8 and 14) to 2.03 cm (Type-2). Similarly, rind weight was maximum in type-22 (3.79 kg) and minimum in type-27 (0.93 kg). The type-2 with maximum rind weight also showed maximum cylinder weight (0.57 kg). A minimum cylinder weight of 0.12 kg was noted in the types 20 and 23.

#### 3.2 Bulb Characters

Remarkable variation was observed Inbulb color. It was *cream* in one type (Type-6). *Yellow* colour was noticed in a majority of the types studied (12 jackfruit types). Eight types recorded *light yellow* coloured bulbs, four types were *orange* in colour and two types were *light orange* in colour. The maximum bulb number of 170 was noticed in the type-7, followed by type -5 with 167 bulbs. A small sized spherical fruit of type-23 had just 10 bulbs. The seed number was same as the bulb number .

Bulb weight was maximum in Type-12 (5.42 kg) and minimum in Type-23 (0.22 kg). Bulb length showed a range from 8.53 cm (Type-17) to 3.92 cm (Type-23). Similarly bulb breadth was maximum in Type-13 (5.60 cm) and minimum in Type-5 and Type-6 (3.07 cm). Flakes were thicker in Type-13 (1.00 cm) and thinner in Type-4 (0.30 cm). Seed weight ranged from 1.71kg (Type-12) to 33 grams (Type-23).

#### 3.3 Biochemical Parameters

Total Soluble Solids (TSS) content varied from 15.53°Brix (Type-17) to 32.38°Brix (Type-18).



The type-22 with 31.97°Brix was the second highest. Titratable acidity content ranged from 0.12% (Type-7) to 0.28% (Type-20). The TSS to Acid ratio was maximum in Type-7 (231.42) followed by Type-22 (228.36). The minimum TSS to Acid ratio was noted in Type-15 (60.00) followed by Type-20 (79.29).

### 3.4 Sensory Evaluation

“Jackfruit bulbs of different jackfruit types under the study were evaluated for sensory quality by a panel that consisted of faculty and post graduate students of the University of Horticultural Sciences, Bagalkot”. The evaluation was carried out on a 5 point hedonic scale, where score of 4.1-5.0=Excellent, 3.1-4.0=Very good, 2.1-3.0=Good, 1.1-2.0=Fair and 0-1.0=Poor.

None of the jackfruit types collected in this study scored below 3.00 indicating their acceptability in the score range more than 3.00. The maximum score for crispness was noted Type-4 and Type -17 (4.90). Though the Type-8 scored maximum for taste and flavor among all the collections, its overall acceptability score was lower (4.20) than Type-10 (4.50) on account of lower score for color and appearance (3.90). The jackfruit Type-1 recorded minimum score for all the sensory parameters in comparison to other types covered in the study. The Types 9, 10 and 17 have scored maximum for color and appearance. The Types 15, 16 and 24 though had orange colored bulbs, their color and appearance score was not higher, probably because the appearance of bulbs was determined even by the integrity of the of tissue at ripe stage. The integrity of the tissue depends on the activity of pectolytic enzymes. Higher the activity of these enzymes, lower will be the integrity. All the soft flesh types are known to have a very high activity. Even in the firm flesh types, the crispness of the flakes is partly dependent upon the presence or degradation of pectin [8-15].

### 4. CONCLUSION

Type-10 (4.50) was the best and having good score for overall acceptability and other physico chemical parameters studied.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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