

Comparative Study of Carotenoids and Mineral Composition in Five Different Pulp Colours of Jackfruit (*Artocarpus heterophyllus* Lam.)

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ABSTRACT

The study was undertaken to assess the carotenoids content and mineral composition in five different pulp colours of Jackfruit. Results revealed that, the red and orange colour pulp contained significantly higher concentrations of β -Cryptoxanthine (45.44mg/100 g and 42.57mg/100g) followed by β -Carotene (44.20mg/100g and 43.14 mg / 100g) α -Carotene (39.40 mg / 100 g 37.30 mg / 100 g) and Lycopene (30.20 mg / 100 g and 27.70 mg / 100 g), respectively. The mineral composition analysis revealed that the potassium content was higher (326.47 mg / 100 g) in dark yellow colour pulp followed by red colour pulp (322.70 mg / 100 g) and orange colour pulp (216.07 g / 100g). However, there were no significant differences in the concentrations of sodium, manganese, zinc, iron and copper among different pulp colours.

Keywords : Jackfruit, carotenoids, minerals, analysis

JACKFRUIT is believed to be native of India, originated in Western Ghats of Southern India. The Jackfruit produces more yield than any other fruit tree species. (Alagiapillai *et al.*, 1996). It is widely cultivated in Malaysia, Myanmar, The Philippines, Bangladesh, Sri Lanka, Brazil, West Indies, Pakistan and other tropical countries in the world. Jackfruit is the largest edible fruit in the world and is a tropical evergreen tree. Ripe Jackfruit is very nutritious, rich in pectin and minerals like phosphorus, iron, potassium, and calcium. Ripe bulbs are full of carbohydrates, protein, ascorbic acid and carotene; the ripe fruits are used in the preparation of canned products such as nectar, jam, jelly, fruit bar, candy, etc.

Jackfruit exhibits huge variation in fruit size, shape, pulp colour, taste, aroma and Total Soluble Solids (TSS). Among them the variations in pulp colour are the main criteria for commercial exploitation of the genotypes. The genotypes with orange and red colour pulp draws the attention of many consumers compared to yellow and cream colour pulp in spite of the taste and aroma present in yellow and cream colour types. Therefore, an attempt was made to quantify the variations in pulp carotenoids and mineral content among the various pulp color of Jackfruit and their relation to nutritional value of the fruit.

Carotenoids (Pro-vitamin A) in vegetables and fruits represent the main source of vitamin A for

70-90 per cent of people in developing countries. Carotenoids are fat-soluble compounds that occur naturally in fruit and vegetables. Carotenoids are reported to be of additional importance either as antioxidants or enhancing the immune response. Among carotenoids, the antioxidative properties were highest for Lycopene, β -carotene and lutein. Lycopene has the highest free radical scavenging ability, followed closely by β -cryptoxanthine and β -carotene. Carotenoids are known to be involved in scavenging and quenching singlet oxygen molecules, especially the β -carotene is well known as an antioxidant with considerable evidence for interaction of the β -carotene with free radicals (Umesh *et al.*, 2010). β -carotene has also been reported to be the most active provitamin A pigment and known to protect against photosensitive diseases in humans.

Fruits contribute significant amounts of minerals to the human diet. Minerals are required for normal cellular function, haemoglobin composition, gene expression and amino acid, lipid and carbohydrate metabolism (Marisa, 2006). The Jackfruit pulp eaten as fresh and used in fruit salads has high nutritive value. Every 100 g of ripe jackfruit pulp contains carbohydrate (18.9 g), protein (1.9 g), fat (0.1 g), moisture (77%), fibre (1.1 g), total mineral matter (0.8 g), potassium (191 to 407 mg), phosphorus (38 to 41 mg), calcium (20 to 37 mg), iron (0.50 to 1.70 mg),

and vitamin-A (175 to 540 I.U), with a caloric value of 84 calories. (Jagdeesh *et al.*, 2007). Further, nutritional the tender fruit is rich in potassium (246 mg / 100 g), phosphorus (97 mg / 100 g) and calcium (50 mg / 100g). The mineral composition of fruits can reflect the trace mineral content of soils in geographic region and varies with climate, maturity, cultivar, and agricultural practises. (Marisa, 2006).

Thus the above work was initiated to examine the differences in pulp carotenoids, mineral composition, TSS and crude fibre contents indifferent pulp colours of jackfruit (cream, light yellow, dark yellow, orange and red).

MATERIAL AND METHODS

Selection of Jackfruit genotypes

Surveys were conducted to identify Jackfruit genotypes with distinct pulp colours in different locations of Bangalore rural and Tumkur districts. Three genotypes from each pulp color *viz.*, cream, light yellow, dark yellow, orange and red were identified. Two fruits from each genotype were harvested at full maturity and brought to the laboratory for further analysis. The fruits were cut opened and the various flake characteristics were recorded. For estimation of pulp carotenoid content, 10 to 15 flakes from each genotype were packed in black polythene covers and stored at -20° C.

Total Soluble Solids (TSS° Brix)

The juice was extracted from fresh fruit pulp by squeezing the homogenized fruit pulp on to a Hand Refractometer to measure the TSS and was expressed in °Brix.

Estimation of pulp carotenoids content

The Protocol outlined by Chandrika *et al.* (2005) was followed. Fifty grams of Jackfruit pulp was cut into small pieces and homogenized in a mechanical blender into a fine paste by adding cold acetone and celite. The extract was filtered using Whatman filter paper No. 1. The grinding and filtration was repeated until the pulp was colourless. The final extract was mixed with petroleum ether in 1:1 ratio in a separatory funnel and the mixture was allowed to separate into two layers. The upper supernatant was collected and

a pinch of anhydrous sodium sulphate was added. Then the sample was read in U.V. Spectrophotometer (Varian Cary 50 Bio Australia) at different wave lengths for estimation of different carotenoids.

Pulp mineral analysis

The analysis for mineral composition in fruit pulp was carried out at the Department of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, Bangalore.

Fruit samples (25 g) were dried in an oven at 60°C and ground into a fine powder in a mixer. The dried sample (3 g) was taken and ashed in a muffle furnace at 600°C for 3 hours (until a whitish ash was obtained, indicating the complete elimination of organic material) and acid extracted, the acid digested sample was filtered through filter paper (Whatman filter paper 125 mm) and the volume was made upto 100 ml with distilled water in a volumetric flask. Minerals were estimated with the use of Atomic Absorption Spectrophotometer (AAS) (Perklin Elmer, U.S.A). The instrument was calibrated with the standard solutions containing known amount of the mineral being determined, using analytical reagents; the results were computed and expressed as mg / 100g pulp.

RESULTS AND DISCUSSION

Morphological traits of Jackfruit genotypes

The Jackfruit genotypes collected from different locations were analysed for morphological traits. The Total Soluble Solids (TSS) content recorded among the fifteen genotypes varied from 20°Brix to 32°Brix (Table I). It was lower in BHT 5 and higher in TDT 1, the variations in TSS content could be mainly due the characteristic of a genotype to assimilate the sugars and also the climate of the place where the plant is located, maturity, soil type and fertility etc. Similar reports on variations in Vit-C and mineral content in banana and papaya types has been reported (Marisa, 2006).

Carotenoid composition

The composition of four different carotenoids varied significantly (Table II). The β-cryptoxanthine content was significantly higher (45.44 mg and 42.57 mg / 100g) in red and orange colour pulp, followed by

TABLE I
Morphological characteristics of flakes from different Jackfruit genotypes

Genotypes	T S S (°Brix)	Flake color	Flake thickness
1VRT-11	25.50	Cream	Thick
2BHT-2	30.50	Cream	Medium
3KT-3	29.50	Cream	Thick
BHT-3	28.50	Light Yellow	Thick
BHT-5	20.00	Light Yellow	Thick
KT-7	26.50	Light Yellow	Medium
KT-10	22.50	Dark Yellow	Thin
APT-14	25.00	Dark Yellow	Thick
SWARNA	21.50	Dark Yellow	Thick
TDT-11	32.00	Orange	Medium
BHT-7	26.00	Orange	Thick
BHT-8	26.00	Orange	Thick
NKT-2	23.00	Red	Medium
NKT-3	30.00	Red	Medium
ALG-16	23.00	Red	Medium

Sample collection places:

BHT-Bommarasanahalli	Tumkur district
VRT-Virupakshipura	Tumkur district
KT-Kachahalli	Bangalore Rural District
NKT-Nelukunte	Bangalore Rural District
APT-Ankapura	Tumkur district
TDT-Thirumaladevarathi	Tumkur district
ALG-Allalgatta	Tumkur district

β -carotene (44.20 mg and 43.14 mg/100g), α -carotene (39.40 mg and 37.30 mg/100g) and Lycopene (30.20 mg and 27.70 mg/100g) respectively. Whereas, the above carotenoids composition of significantly lower in dark yellow, light yellow and cream colour pulp. The overall composition of carotenoids was higher (43%) in orange colour pulp followed by red (42%) and dark yellow (11%). Thus, the genotypes with range, red and dark yellow colour pulp can be used for developing nutraceutical drinks and water soluble powders from the dehydrated pulp of Jackfruit. Most of the carotenoids possess antioxidant capacity and known to possess the property of free radical scavenging.

These variations in carotenoids content could be influenced by the growing conditions, variety/cultivar, geographical location, ripeness, picking to market conditions. Further, it also been reported that the red pepper used as paprika has been reported to have higher carotenoids content than the other varieties (Almela *et al.*, 1991). The carotenoids composition has been reported to vary within populations as reported by Speek *et al.*, 1988 in different Thai vegetables.

The nutritional importance of carotenoids has been related to their role as precursor of vitamin A and only few carotenoids possess Pro-vitamin A activity, these include α -carotene, β -carotene, β -cryptoxanthine but not lycopene (Erdman *et al.*, 1998).

TABLE II
Carotenoids in different Jackfruit pulp colours

Pulp Color	α -carotene (μ g/100g)	β carotene (μ g/ 100g)	β crypto xanthine (μ g/100g)	Lycopene (μ g/100g)	Total carotenoids (μ g/100g)
Cream	0.02524	0.02201	0.02045	0.01268	0.08068
Light yellow	0.06137	0.09125	0.0525	0.06017	0.26529
Dark yellow	0.2511	0.2755	0.2367	0.1942	0.9575
Orange	0.9665	1.2228	1.0622	0.5877	3.8392
Red	0.934	1.294	1.0914	0.7368	4.0562
Mean	0.0667	0.2229	0.9074	0.9601	2.5171
SEM	0.0153	0.0371	0.1459	0.0408	0.2391
CD	0.0727	0.1760	0.6925	0.1937	1.1349

TABLE III
Mineral composition in different pulp colours of jackfruit (mg / 100 g pulp)

Pulp color	Potassium	Sodium	Manganese	Zinc	Iron	Copper
Cream	196.86	1.82	0.0354	0.1174	0.374	0.1214
Light yellow	212.87	1.51	0.0428	0.0907	0.2884	0.1027
Dark yellow	326.47	2.74	0.124	0.197	0.322	0.24
Orange	216.07	2.16	0.0608	0.120	0.864	0.163
Red	322.70	2.84	0.0610	0.164	1.044	0.2524
Mean	254.9867	2.2133	0.0654	0.1378	0.5783	0.1759
SEM	8.0371	0.2050	0.0067	0.0088	0.0389	0.0136
CD	27.3239	0.6460	0.0211	0.0277	0.1226	0.0429

Mineral composition

The study revealed that the concentration of potassium was significantly higher (326.47 mg / 100 g) in dark yellow color pulp followed by red color pulp (322.7 mg / 100 g) compared to orange (216.07 mg / 100 g), light yellow (212.87 mg / 100 g) and cream color pulp (196.86 mg / 100 g). There were no significant differences in concentration of sodium among different pulp colors and it varied from 1.82 g / 100 g in cream color pulp to 2.84 mg / 100 g in red color pulp, where as the composition of manganese, zinc, iron and copper among different pulp colors did not show much variations. Similar reports have been made by Manjeshwar *et al.* (2011); Srikanth *et al.* (2012) and Tang *et al.* (2013) in jackfruit pulp. The variation in mineral composition could be due to varietal differences and environmental conditions (Table III).

Jackfruit being an important nutritious underutilized fruit, its productivity is relatively high (25.71 tones / hectore), however it is not used by many due to wide variations in pulp characteristics and taste. Most of the people prefer orange and red color pulp compared to yellow and cream color pulp, this could be a color preference of the consumers. Interestingly these types are found to contain higher concentration of carotenoids and minerals. Hence, they can be promoted as desirable jackfruit genotypes for further multiplication and commercial cultivation. The fruits

from such genotypes can be used to develop nutritious health drinks which are rich in natural minerals and pro vitamin A content as the product of fruit is huge and easily available in most of the South Indian states.

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