International Network on Preserving Safety and Nutrition of Indigenous Fruits and Their Derivatives

Report on Mini Research Project

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MATURITY INDICES AND QUALITY CRITERIA OF JACKFRUIT

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Presented By

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Aims and Objective (s)

Aims

To minimize quantitative and qualitative post-harvest losses of jackfruit and uplift food and nutritional security

Objectives

- To determine the maturity indices of Jackfruit
- To extend the storage life of Jackfruit
- To study the physico-chemical composition of Jackfruit

Project Personnel

Principal Investigator

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Materials and Methods

Material: Jackfruit (Local variety)

Treatments: 10 Harvesting time

T_1 = 40 days after fruit set
T_2 = 50 days after fruit set
T_3 = 60 days after fruit set
T_4 = 70 days after fruit set
T_5 = 80 days after fruit set
T_6 = 90 days after fruit set
T_7 = 100 days after fruit set
T_8 = 110 days after fruit set
T_9 = 120 days after fruit set
T_{10} = 130 days after fruit set

Soil and weather condition

Number of rainy day: Twenty one rainy days was recorded during conducting the experiment.

Climatic condition:

Maximum temperature: 30-35ºC
Minimum Temperature: 19-21ºC
Relative humidity: 91-95%

Soil texture of orchard: **Red terrace soil**

Data recorded on

Physico-morphological Characters

- Fruit weight
- Circumference
- Length and diameter of fruit
- Bulb (fruitlet) weight
- Pulp (flesh) weight
- Seed weight
- Number of bulb
- Total weight of pulp/flesh
- No. of Seed
- Spine spreading
- Spine density
- Spine flatness

Data on----------

Biochemical traits

- Total sugar
- Reducing sugar
- Non-reducing sugar
- Ascorbic acid content
- Total soluble solids
- % Moisture
- Dry matter

Data on----------

Postharvest parameters

- Storage life and
- Sensory evaluation (Peel colour, pulp colour, texture, flavour, sweetness, taste and overall acceptability)

Data on----------

Residue analysis

Ethephon, the ripening agent with different concentrations;

- 500 ppm
- 1000 ppm
- 1500 ppm
- 2000 ppm

Results and Discussion

Table 1. Criteria of jackfruit chosen as vegetable through participatory appraisal

Criteria	Preferable score (1-9) Respondent groups					
	Farmers (10)	Traders/ Beparies (10)	Household Women (10)	Consumer (10)	Average score	Rank
External features						
Fruit size						
Small	6	6	6	7	6.25	11th
Medium	9	9	9	9	9.00	1st
Bigger	5	5	4	4	4.5	14th
Spine density						
Low	3	3	2	2	2.5	15th
Moderate	8	8	8	9	8.25	4th
High	5	6	6	6	6.25	11th
Spine flatens						
Less/Not so spreading	8	7	8	7	7.50	6th
Slightly	7	8	8	8	7.75	5th
Moderately	6	6	5	5	5.5	12th
Widely	3	3	2	2	2.5	15 th

Table 1. Cont.....

Criteria	Preferable score (1-9) Respondent groups					
	Farmers (10)	Traders/ Beparies (10)	Household Women (10)	Consumer (10)	Average score	Rank
Internal features						
Bulb formation						
Not formed	1	2	1	2	1.5	17th/last
Formed	9	9	9	9	9.00	1st
Bulb size/weight						
Small	7	7	7	6	6.75	10th
medium	8	8	9	9	8.50	3rd
Bigger	5	5	6	5	5.25	13th
Bulb colour						
White	7	7	7	6	6.75	6th
Creamy white	9	8	9	9	8.75	2nd
Yellowish	2	3	2	2	2.25	16th

Table 1. Cont.....

Criteria	Preferable score (1-9) Respondent groups					
	Farmers (10)	Traders (10)	Household Women (10)	Consumer (10)	Average score	Rank
Internal features						
Seed size/weight						
Small	7	6	6	7	6.50	10th
Medium	8	8	8	9	8.25	4th
Bigger	5	5	4	4	4.50	14th
Seed softness						
Soft	7	8	6	7	7.25	7th
Medium /Semi-hard	9	8	9	9	8.75	2nd
Hard	4	4	3	3	3.50	10th

Preferable scoring

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

Table 2. Criteria of jackfruit chosen as fruit through participatory appraisal

Criteria	Preferable score (1-9) Respondents					
	Farmers (10)	Traders/ Beparies (10)	Household Women (10)	Consumer (10)	Average score	Rank
External features						
Fruit size						
Small	5	5	6	6	5.50	13th
Medium	7	7	8	7	7.25	8th
Bigger	8	8	8	8	8.00	4th
Spine density						
Low	9	8	8	9	8.50	3rd
Moderate	8	8	7	7	7.50	6th
High	5	6	5	4	5.00	14th
Spine flatness						
Less/Not so flatenned	3	4	3	2	4.00	16th
Slightly	6	6	5	3	5.00	14th
Moderately	8	8	7	8	7.75	5th
Widely	9	9	9	9	8.75	2nd
Metallic sound while tapping on fruit						
Absent	3	4	2	3	3.00	17th/Last
Slightly sensible	7	7	7	7	7.00	9th
Moderately sensible	8	8	7	8	7.75	5th
Clearly sensible	9	9	7	7	8.00	4th

Table 2. Cont.....

Criteria	Preferable score (1-9) Respondents					
	Farmers (10)	Traders/ Beparies (10)	Household Women (10)	Consumer (10)	Average score	Rank
Internal features						
Bulb size/weight						
Small	7	7	7	6	6.75	10th
medium	8	8	8	8	8.00	4th
Bigger	9	8	9	9	8.75	2nd
Bulb colour						
Not coloured	1	1	1	1	1.00	18th/Last
Yellowish/Reddish/ slightly coloured	4	5	4	4	4.25	15th
Bright coloured (Yellow/Red)	9	9	9	9	9.00	1st
Seed size/weight						
Small	7	5	6	7	6.25	12th
Medium	7	7	7	7	7.00	9th
Bigger	7	5	7	7	6.50	11th

Fig. 1. Showing (1) observation; (2) selection; (3) tagging of fruits at fruit setting stage

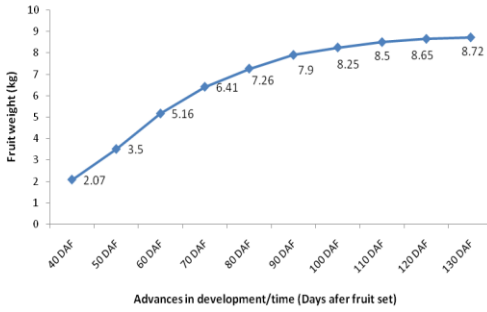

Fig. 2. Fruit weight of jackfruit with advances in development (Days after fruit set)

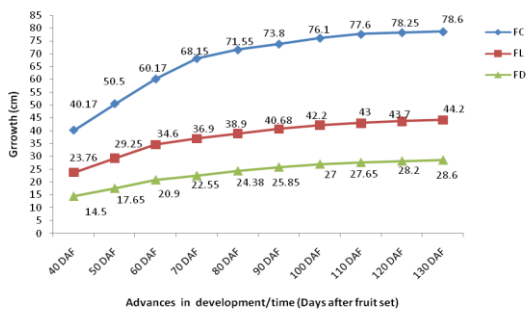

Fig.3. Circumference, length and diameter of jackfruit with advances in time (Days after fruit set)

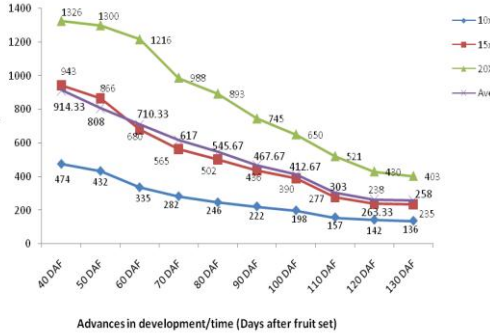

Fig. 4. No. of spine counted from selected area of jackfruit with advances in time (Days after fruit set)

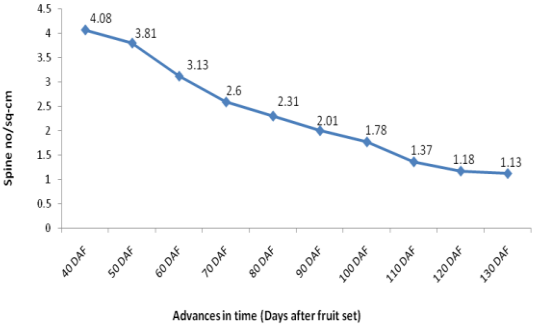

Fig. 5. No. of spine per unit area (cm2) on jackfruit rind with advances in time (Days after fruit set)

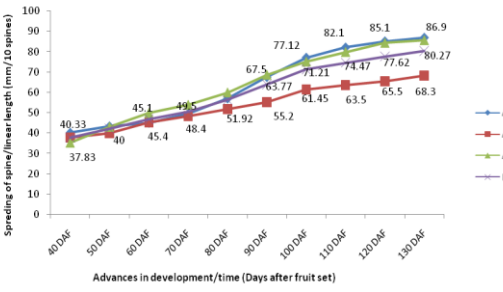

Fig. 6. Spreading of spine (average linear length of 10 spines) of jackfruit rind with advances in time (Days after fruit set)

Table 3. Internal parts of jackfruits along with preference for utilizing as vegetable or fruit

Advances in time	Non-fleshy Perianth and floral parts (Rags)	Bulb formation	Flesh (fleshy perianth) nature		
	Colour	Status	Colour	Size	Texture
40 DAF	Whitish	less	white	Smaller	Semi- hard
50 DAF	Whitish	sufficient	White	Small	Hard
60 DAF	Whitish to white	Abundant	Creamy white	Medium	Hard
70 DAF	White	Abundant	Creamy white	Extra Medium	Hard
80 DAF	White	Abundant	Whitish to yellowish	Medium large	Hard
90 DAF	White	Abundant	Yellowish	Large	Hard to firm
100 DAF	Yellowish to yellow	Abundant	Yellowish to yellow	Larger	Firm
110 DAF	Yellow	Abundant	Yellow	Larger	Firm
120 DAF	Yellow	Abundant	Yellow	Larger	Firm to soft
130 DAF	Yellow	Abundant	Yellow	Largest	Soft

Table 3. Cont.....

Advances in time	Seed					Preference As vegetable or fruit
	Testa*		Tegmen*		Cotyledon	
	Colour	Texture	Colour	Texture	Texture	
40 DAF	Yellowish	Soft and non-papery	Yellowish	Soft and easily removable	Soft	Vegetable but not good in quality
50 DAF	Yellow	Soft, thick and non-papery	Yellowish	Soft and removable	Semi-hard	vegetable
60 DAF	Yellow	Soft, thickened non-papery	Yellow	Soft and removable	Semi-hard	Well vegetable
70 DAF	Yellow	Soft and non-papery	Yellow	Still removable	Semi-hard	Still vegetable
80 DAF	Yellowish to Translucent	Harsh and papery	Yellowish/ Coppery/ Reddish	Not removable easily	Semi-hard to Hard	Transition
90 DAF	Translucent	Papery	Coppery/ Reddish	Intact	Hard	About to mature for fruit
100 DAF	Translucent	Papery	Coppery/ Reddish	Intact	Hard	Mature for fruit
110 DAF	Translucent	Papery	Coppery/ Reddish	Intact	Hard	Fruit
120 DAF	Translucent	Papery	Coppery/ Reddish	Intact	Hard	Fruit
130 DAF	Translucent to white	Papery	Coppery/ Reddish	Intact	Hard	Fruit

Table 4. Characteristics of different jackfruit parts with preference score as vegetable

Advances in time	Bulb No.	Single bulb wt (g)	Single seed wt (g)	Total Bulb wt (kg)	Rags wt (kg)	Rags-bulb ratio	%Edible portion	Edible-Non-edible portion ratio	Preference score (1-9)
40 DAF	80.00 ±2.45	2.69 ±0.17	0.87 ±0.17	0.21 ±0.12	0.65 ±1.77	4.00 ±1.31	48.68 ±2.69	0.97 ±0.53	4.19 ±0.41
50 DAF	130.67 ±3.32	6.1 ±0.32	2.35 ±1.22	0.80 ±0.32	0.80 ±1.03	1.33 ±0.22	53.73 ±3.34	1.25 ±0.76	5.67 ±0.58
60 DAF	172 ±2.65	8.8 ±0.63	2.75 ±1.22	1.52 ±0.63	1.15 ±1.18	0.91 ±0.43	59.97 ±4.14	1.89 ±1.19	8.56 ±0.71
70 DAF	187.67 ±1.52	11.05 ±0.39	3.98 ±0.17	2.08 ±0.39	1.16 ±1.24	0.76 ±0.16	55.98 ±1.38	1.27 ±0.31	8.22 ±0.71
80 DAF	192.00 ±2.00	12.54 ±0.32	4.05 ±0.23	2.41 ±0.32	1.19 ±1.26	0.65 ±0.14	54.85 ±1.35	1.21 ±0.30	5.33 ±0.62

Fig. 7. Showing (1) harvested Jackfruit; (2) longitudinal section; (3) bulb; (4) edible part (rags with bulb and seeds inside) at 40 DAF (AH-002)

Fig. 8. Showing (1) Harvested Jackfruit; (2) longitudinal section; (3) edible part (rags, bulb, and seeds); (4&5) bulbs and seeds at 50 DAF (AH-002)

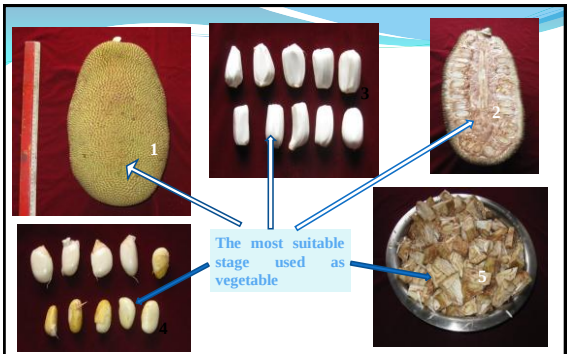

Fig. 9. Showing (1) harvested Jackfruit; (2) longitudinal section; (3) bulbs; (4) seeds; (5) edible part (rags with bulb and seeds inside) at 60 DAF (AH-002)

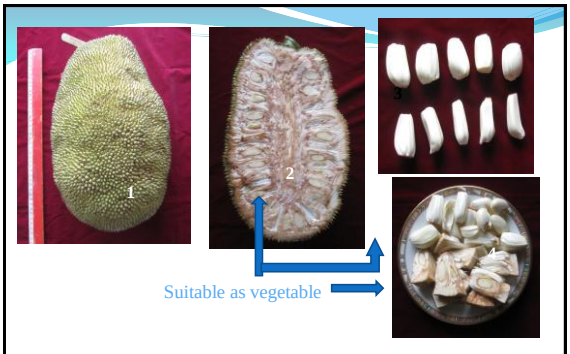

Fig. 10. Showing (1) Harvested Jackfruit; (2) longitudinal section; (3) bulb; (4) edible part (rags and bulbs: seeds inside) at 70 DAF (AH-001)

Fig. 11. Showing (1) harvested Jackfruit; (2) edible part; (3) bulbs and (4) seeds at 80 DAF (AH -001 & AH-002)

Table 5. Rind colour, presence of metallic sound and fruit stalk attachment layer of jackfruit as dessert purpose

Advances in time	Rind colour			Metallic sound			Fruit stalk attachment layer		
	AH-001	AH-002	AH-003	AH-001	AH-002	AH-003	AH-001	AH-002	AH-003
90 DAF	Greenish	Greenishh brown	Green	1.00	1.33	1.00	NF	SF	NF
100 DAF	Slightly yellowish green	Brownish green	Greenish	2 .40	2.67	2 .67	SF	SF/MF	SF
110 DAF	Slightly yellowish green	Brownish	Greeniish	2.75	3.25	2.80	SF/MF	MF	MF
120 DAF	Yellowish green	Brownish	Yellowish green	3.00	3.75	3.25	MF	MF/WF	MF
130 DAF	Yellowish green	Yellowish Brown	Yellowish green	3.50	4.00	3.67	MF/WF	WF	WF

Degree of metallic sound:
1= Non sensible (Absent), 2= Slightly sensible,
3 = Moderately sensible, 4 = Clearly sensible (Hollow)

Flatness Nature :
NF=Not flattened, SF = Slightly flattened,
MF= Moderately flattened, WF=Widely flattened

Table 6. Characteristics of different jackfruit parts with preference of jackfruit as dessert purpose

Advances in time	Bulb no.	Single bulb wt. (g)	Single Flesh wt. (g)	Single seed wt.	%Edible portion	Edible, Non-edible portion ratio	Preference score (1-9)
90 DAF	205 ±2.00	17.13 ±1.41	10.2 ±1.38	4.88 ±0.24	43.74 ±2.65	0.83 ±0.50	4.19 ±0.41
100 DAF	215 ±2.44	19.44 ±1.56	12.48 ±1.27	5.25 ±0.32	50.59 ±1.82	1.03 ±1.82	6.67 ±0.71
110 DAF	209.33 ±3.26	20.5 ±1.81	13.32 ±1.47	5.28 ±0.26	50.77 ±3.02	1.08 ±3.02	6.78 ±0.23
120 DAF	215.67 ±2.01	21.2 ±1.42	14.3 ±0.79	5.32 ±0.20	52.91 ±1.75	1.13 ±1.75	7.89 ±0.44
130DAF	200.00 ±2.24	22.55 ±1.50	15.65 ±0.37	5.41 ±0.27	51.78 ±2.24	1.09 ±2.24	8.67 ±0.58

Fig. 12. Showing (1) harvested Jackfruit;(2) longitudinal section; (3 &4) bulb and seeds at 90 DAF (AH-001)

Fig. 13. Showing (1) harvested Jackfruit ; (2) longitudinal section; (3) spine spreading/flatness; (4 & 5) bulb and seeds at 100 DAF (AH-002)

Fig. 14. Showing (1) harvested Jackfruit;, (2) spine flatness; (3) bulb and (4) seeds at 110 DAF (AH-003)

Fig. 15. Showing (1) harvested Jackfruit; (2) fruit stalk attachment layer; (3) spine flatness; (4 &5) bulb and seeds at 120 DAF (AH-001)

Fig. 16. Showing (1) harvested Jackfruit; (2)spine flatness; (3) longitudinal section; (4) fruit stalk attachment layer; (5 & 6) bulb and seeds at 130 DAF (AH-002)

Table 7. Biochemical traits of jackfruits harvested at different days after fruit set

Advances in time	Dry matter (%)	Moisture (%)	Total sugar (%)	Reducing sugar (%)	Non-Reducing Sugar (%)	Vitamin C (mg/100g)
40 DAF	12.12	87.88	5.25	1.51	3.74	4.48
50 DAF	12.82	87.18	6.31	1.85	4.46	6.27
60 DAF	14.49	85.51	7.45	2.34	5.11	9.30
70 DAF	19.48	80.52	8.87	2.89	5.98	9.73
80 DAF	21.50	78.50	10.47	3.60	6.86	10.77
90 DAF	23.47	76.53	11.44	4.13	7.31	12.70
100 DAF	27.35	72.65	14.35	5.24	9.11	13.42
110 DAF	29.89	70.11	15.10	5.81	9.30	10.07
120 DAF	30.15	69.85	16.11	6.35	9.76	9.62
130 DAF	30.18	69.82	17.22	7.02	10.19	7.65

Table 7. Cont.....

Advances in time	TSS (%)	Acidity %)	Sugar-Acid ratio	TSS-Acid ratio
40 DAF	4.00	0.13	40.74	30.93
50 DAF	5.60	0.15	42.04	37.33
60 DAF	8.80	0.17	44.94	52.97
70 DAF	11.27	0.19	46.81	59.52
80 DAF	12.27	0.21	49.04	57.76
90 DAF	13.27	0.22	51.21	59.47
100 DAF	14.80	0.23	63.92	66.39
110 DAF	15.00	0.24	63.04	62.65
120 DAF	15.47	0.24	66.89	64.07
130 DAF	15.26	0.25	68.42	60.52

Table 8. Time required for ripening, ripening status, and storage life of jackfruit harvested at different days after fruit set

Treatments	Time required for ripe (Days)	Ripening status	Storage life after ripe	Total storage life
90 DAF	3	Uneven	1.67	4.67
100 DAF	3.67	Fairly ripe	2.33	6.00
110 DAF	2.67	Fairly ripe	2.00	4.67
120 DAF	2.33	Fully ripe	2.00	4.33
130 DAF	1.67	Fully ripe	1.33	3.00

Table 9. Sensory evaluation of harvested jackfruit at ripe stage

Treatments	Flesh colour	Flesh texture	Flavour	Taste	Overall Preference score
90 DAF	Pale yellow to yellowish	Not acceptably soft	Not good	Not acceptably good	4.67
100 DAF	Yellow	Soft	Good	Good	7.67
110 DAF	Yellow	Soft	Good	Good	7.67
120 DAF	Yellow	Soft	Good	Very good	9.00
130 DAF	Yellow to deep/bright yellow	More soft	Very good	Good	8.33

Table 10. Bio-chemical traits of ripe jackfruits on the day of ripening

Treat.	Total sugar (%)	Reducing sugar (%)	Non-Reducing Sugar (%)	Vitamin C (mg/100g)	TSS (%)	Acidity %)	Sugar-Acid ratio	TSS-Acid ratio
90 DAF	14.14	4.52	9.62	8.67	15.47	0.21	68.48	74.89
100 DAF	15.69	5.90	9.79	5.27	17.88	0.21	74.78	85.16
110 DAF	17.31	7.06	10.25	4.70	19.91	0.23	76.69	88.4
120 DAF	18.26	8.09	10.16	4.25	20.03	0.21	77.61	94.24
130 DAF	19.04	8.37	10.67	4.12	22.29	0.22	76.04	100.07

Table 11. Ripening status of harvested matured jackfruit (100 DAF) affected by ethephon (Promote* a.i. 48%) along with respective residue level

Maturity stage	Doses of ethephon (ppm)	Time required for ripe (hrs)	Ripening status	Preference score at ripe	Residue level at ripe (ppm)		MRL (mg/kg)	Total storage life (Days)
					Peel	Pulp	2.00	
100 DAF	500	36	Fairly ripe	7.67	0.095	0.157		3.00
	1000	30	Well ripe	8.50	0.104	0.186		3.00
	1500	24	Well ripe	9.00	0.129	0.228		3.00
	2000	24	Well ripe	8.33	0.144	0.249		2.50

Conclusion and Recommendation

- Considering quality and biochemical traits and preferable scores, the best commercially matured jackfruit for vegetable purpose could be obtained between 60-70 DAF when the rags-bulb ratio was found near to be 1.00, edible and non-edible portion ratio > 1.00 and TSS-acid ratio > 50.00.
- On the other hand, considering quality, physico-chemical characteristics and subjective parameters i.e. low spine density and moderately spreading of spines, presence of sensible hollow metallic sound, and moderately flattened fruit stalk might be used as the indicator of maturity of jackfruit for dessert purpose.
- Hence jackfruit harvested at 100 DAF exhibited physiologically as well as commercially matured fruits having higher storage life which may be recommended for dessert purpose.