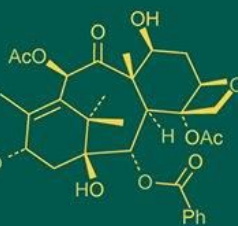
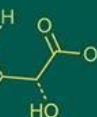
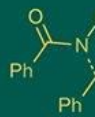


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Comparative evaluation of drying techniques for physico-economic optimization of dehydrated matured raw soft flesh jackfruit (*Artocarpus heterophyllus* Lam.) bulbs

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Abstract

The present investigation was undertaken to evaluate the effect of different drying methods on the physical parameters and cost economics of dehydrated matured raw soft flesh jackfruit (*Artocarpus heterophyllus* Lam.) bulbs. The experiment was conducted in a Completely Randomized Design (CRD) with three treatments, viz., solar drying (45-55 °C), cabinet drying (60±2 °C), and sun drying (25-35 °C), each replicated seven times. Uniformly sized jackfruit bulbs were pretreated with 0.5% KMS solution and dried to constant weight. The results revealed that drying methods significantly influenced physical attributes. Sun drying recorded the highest final weight (4443.2 g) and recovery (27.77%), while cabinet drying showed the lowest values (3833.6 g and 23.96%, respectively). Moisture content was lowest in cabinet drying (5.87%) and highest in sun drying (6.67%). Drying time decreased with increasing temperature, ranging from 26-28 hours in sun drying to 10-12 hours in cabinet drying. Economic analysis indicated that sun drying was the most cost-effective method with the lowest processing cost (₹14.27/100 g) and highest benefit-cost ratio (2.80), whereas cabinet drying had the highest cost (₹27.35/100 g) and lowest B:C ratio (1.83), despite better sensory acceptability and higher market price. Overall, cabinet drying produced superior quality products, while sun drying proved economically advantageous, suggesting that the choice of method depends on quality requirements and economic feasibility.

Keywords: Jackfruit, dehydration, drying methods, moisture content, recovery, cost economics

Introduction

Jackfruit (*Artocarpus heterophyllus* Lam.), a member of the Moraceae family, is an important tropical fruit crop believed to have originated in the rainforests of the Western Ghats of India. In India, it is cultivated over about 1, 92,000 ha with a production of 45, 77,000 metric tons (Anonymous, 2026) ^[1]. The fruit is nutritionally rich, containing carbohydrates (37.4-42.5%), protein (1.9 g/100 g in flakes; 5.3-6.8% in seeds), vitamin C (7-10 mg/100 g), and essential minerals such as potassium and calcium (Subburamu *et al.*, 1992) ^[5]. Despite its high nutritive value, its utilization remains limited due to high perishability and bulkiness. Traditional fried products from tender jackfruit are becoming less popular due to high oil absorption, health concerns, rancidity, and storage issues. Hence, there is a need for alternative processing methods that enhance shelf life while maintaining quality. Dehydration is an effective preservation technique that reduces moisture content, thereby extending shelf life and enabling long-distance storage and transportation. Dehydrated jackfruit bulbs retain much of their nutritional value and can serve as ingredients in processed foods and health products. Their reduced weight and longer shelf life make them suitable for export, especially with increasing global demand for exotic and functional foods. Additionally, dehydration helps utilize surplus and substandard fruits, reducing post-harvest losses and supporting sustainable practices. In regions like Konkan, increased jackfruit production offers scope for employment generation through processing and value addition. In this context, the present study was undertaken to evaluate the effect of different drying methods on the quality of raw jackfruit bulbs.

Material and methodology

The research was carried out in the year 2022 and 2023 at the Pomology Laboratory and Fruit Processing Unit of the College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, and Dapoli.

Fruits: Fruits of jackfruit and kokum were collected from the nursery no.10 and Rukhi block of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, and Dist.-Ratnagiri. Selected fruits were washed with running tap water to remove adhering dirt and then used for making value added products.

Packaging material

Aluminium foil pouches of 100 g capacity were used for storage of dehydrated raw soft flesh jackfruit bulbs

Experimental details

- 1) Crop: Jackfruit
- 2) No. of treatments: 3

- 3) No. of replications: 7
- 4) Design: CRD
- 5) No. of packets required/treatment/replication: 6
- 6) Total packets required: 126 no.

Treatment details

Type of drying method

T₁: Solar dryer (45-55°C)

T₂: Cabinet dryer (60±2°C)

T₃: Sun drying (25-35°C)

Preparation of dried matured raw soft flesh jackfruit bulbs

Selection of bulbs

Well matured, healthy, and disease-free soft flesh jackfruits were selected and washed with water and rinsed with distilled water. Jackfruit were cut with the knife and bulbs; rind and seeds were separated. Bulbs were dried by procedure as shown in Fig.1

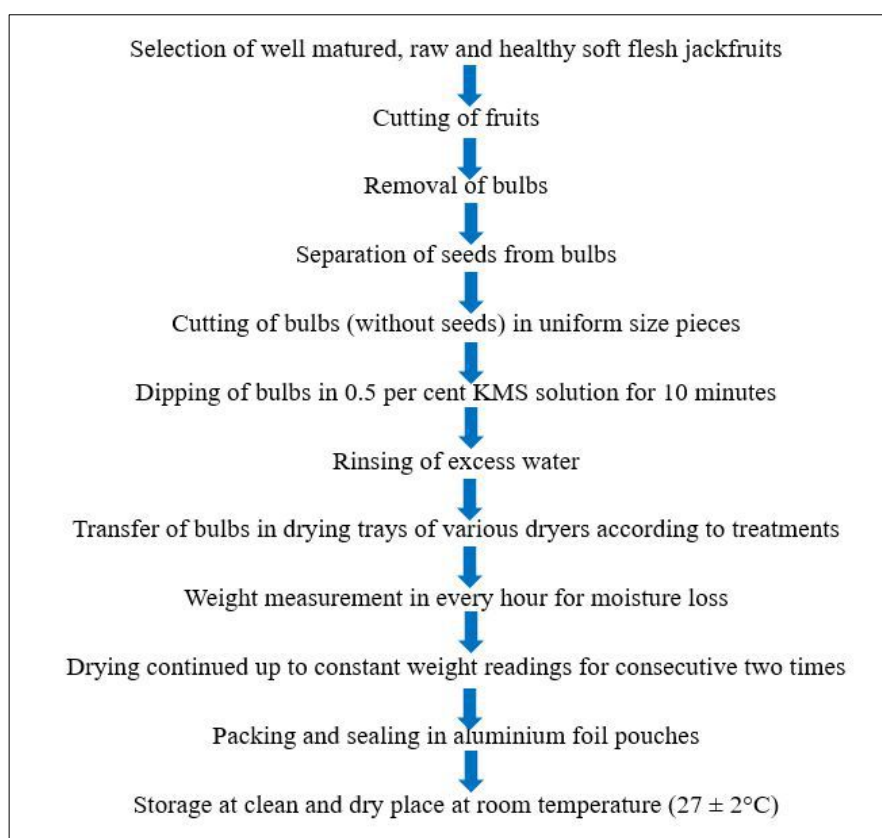


Fig 1: drying of matured raw soft flesh jackfruit bulbs

Physical parameters study

Physical parameters of dried matured raw soft flesh jackfruit bulbs

1 Initial weight of the bulbs (g)

Equal initial weight was taken for drying per treatment i.e. 16000 g per each treatment with the help of electronic weighing balance.

2. Final weight of the bulbs (g)

The selected soft fleshed raw jackfruit bulbs were dried according to treatment details till constant moisture content and then weighed on electronic weighing balance and average of 7 replications was recorded in grams

3. Dried bulb recovery (%)

$$\text{Dried bulb recovery (\%)} = \frac{\text{Final weight of the bulbs (g)}}{\text{Initial weight of the bulbs (g)}} \times 100$$

4. Moisture (%)

A required number of cleaned petri dishes were taken and weighed. Ten grams of prepared sample was taken in cleaned petri dishes and replicated seven times. The petri dishes were kept in hot air oven at 60±2°C until a constant weight was obtained. The per cent moisture content was estimated by using following formula

$$\text{Moisture (\%)} = \frac{\text{Initial weight (g)} - \text{Final weight (g)}}{\text{Initial weight (g)}} \times 100$$

Statistical analysis

The data obtained over the two-year research on different parameters was statistically analysed using conventional analysis of variance procedures according to Panse and Sukhatme (1985) [3]. The standard error of the mean (S.E.m) and critical difference at (C.D.) at 1% level in the laboratory were computed. Tables, charts and plates were used to support the data and critical outcomes.

Effect of different drying methods on physical parameters of dehydrated matured raw soft flesh jackfruit bulbs.

The data of physical parameters of dehydrated matured raw soft flesh jackfruit bulbs is given in Table 1.

1. Initial weight of the bulbs (g)

Equal initial weight was taken for recording physical observations i.e. 16000 g per each treatment.

2. Final weight of the bulbs (g)

According to pooled data, highest final weight of dried bulbs (4443.2 g) was recorded in treatment T₃ (sun drying) while lowest final weight of dried bulbs (3833.6 g) was recorded in treatment T₂ (cabinet dryer). Highest final weight of dried bulbs recorded in treatment T₃ (sun drying) might be due to lower drying temperature present inside the drier viz. 25 - 35 °C±2 °C. However, it was higher in case of other treatments (45 - 55 °C for solar drying and 60 °C for cabinet dryer). Analogous findings were also reported by Hyandavi *et al.* (2022) [2] in case of tender jackfruit powder.

3. Dried bulb recovery (%)

According to pooled data, highest dried bulbs recovery (27.77%) was recorded in treatment T₃ (sun drying) while lowest dried bulbs recovery (23.96%) was recorded in treatment T₂ (cabinet dryer). Highest dried bulbs recovery recorded in treatment T₃ (sun drying) might be due to lower drying temperature present inside the drier viz. 25 - 35 °C±2 °C. However, it was higher in case of other treatments, as stated above. The drying time showed an inverse relationship with temperature, decreasing from 26-28 hours

in sun drying (25-35 °C±2 °C) to 14 - 16 hours in solar drying (45 - 55 °C) and further to 10 - 12 hours in cabinet drying at 60 °C, indicating that higher drying temperatures, although reducing drying time, may lead to greater moisture loss and shrinkage, thereby reducing recovery. Analogous findings were also reported by Hyandavi *et al.* (2022) [2] in case of tender jackfruit powder.

4. Moisture (%)

According to pooled data of 2022 and 2023, lowest moisture (5.87%) was recorded in treatment T₂ (cabinet dryer) while highest moisture (6.67%) was recorded in treatment T₃ (sun drying). Lowest moisture (%) recorded in treatment T₂ (cabinet dryer) might be due to higher drying temperature present inside the drier viz. 60 °C±2 °C which might have evaporated more moisture as compared to other treatments. This might be due to the maintained high temperature inside the cabinet dryer, which can favor more water loss and short time for drying. Similar findings were also reported by Phyu *et al.* (2024) [4] in fresh Yinkwae mango slices and Hyandavi *et al.* (2022) [2] in case of tender jackfruit powder.

5. Cost of processing

The data regarding effect of different drying methods on cost of processing of dehydrated matured raw soft flesh jackfruit bulbs are presented in Table 2. The total cost of processing for the preparation of 100 g dehydrated matured raw soft flesh jackfruit bulbs was highest ₹ 27.35 under treatment T₂ (cabinet drying) and lowest ₹ 14.27 in T₃ (sun drying). According to sensory score for overall acceptability, the range of selling price of 3 treatments were adjusted. For overall acceptability score 7.5 and above sale price of dehydrated jackfruit bulbs was taken as 500 kg⁻¹. For overall acceptability score 7.0 - 7.5 sell price were taken as 400 kg⁻¹ and overall acceptability score 6.5 - 7.0 sell price were taken as 300 kg⁻¹. As per sensory evaluation is concerned, treatment T₂ (cabinet drying) was most acceptable. Selling price of dehydrated jackfruit bulbs was found to be highest in T₂ (₹ 50/100 g) and its benefit cost ratio was 1.83 which was lowest among all treatments under study. Depend on overall acceptability, minimum selling price (₹30/100 g) was of T₁ (solar drying) and its B:C ratio was 1.93. Highest benefit cost ratio was recorded in treatment T₃ (sun drying) i.e. 2.80. It might be due to, it did not include electricity cost.



Plate 1: Dehydrated matured raw soft flesh jackfruit bulbs

Table 1: Effect of different drying methods on physical parameters of dehydrated matured raw soft flesh jackfruit bulbs

Treatments	2022				2023				Pooled data			
	Initial weight of the bulbs (g)	Final weight of dried bulb (g)	Dried bulb recovery (%)	Moisture (%)	Initial weight of the bulbs (g)	Final weight of dried bulb (g)	Dried bulb recovery (%)	Moisture (%)	Initial weight of the bulbs (g)	Final weight of dried bulb (g)	Dried bulb recovery (%)	Moisture (%)
T ₁ : Solar dryer	16000	4203.2	26.27	6.60	16000	4152.0	25.95	6.19	16000	4177.6	26.11	6.40
T ₂ : Cabinet dryer	16000	3868.8	24.18	6.14	16000	3798.4	23.74	5.60	16000	3833.6	23.96	5.87
T ₃ : Sun drying	16000	4627.2	28.92	6.85	16000	4260.8	26.63	6.48	16000	4443.2	27.77	6.67
Average	16000	4233.07	26.46	6.53	16000	4070.40	25.44	6.09	16000	4151.47	25.95	6.31

Table 2: Effect of different drying methods on cost of processing of dehydrated matured raw soft flesh jackfruit bulbs (4200 g)

Sr. No.	Particulars	T ₁ (Solar Dryer)		T ₂ (Cabinet drying)		T ₃ (Sun drying)	
		Quantity	Cost Rs.	Quantity	Cost Rs.	Quantity	Cost Rs.
1	Soft flesh Jackfruit @ Rs.6/ Kg	61.538 kg	369	62.745 kg	376	60.377 kg	362
2	KMS @ 262 Rs/Kg	80 gm	20.96	80 gm	20.96	80 gm	20.96
3	Aluminium foil pouches @ 50 paise/ pouch	42	21	42	21	42	21
4	Electricity charges @ 9.64 Rs/unit 0.321 Rs/ min	00	00	23.33 hours	449.4	00	00
5	Labour charges @ 300 Rs per skilled labour 0.625 Rs/min	184.61 min	115.38	184.61 min	115.38	184.61 min	115.38
A	a) Variable cost	526.34		982.74		519.34	
	b) Supervision charges @ 10% on variable cost	52.634		98.274		51.934	
	c) Interest on variable cost @ 10% for 4 months	17.544		32.758		17.311	
	d) Total variable cost (a + b + c)	596.518		1113.772		588.585	
B	Fixed cost						
	Depreciation charges @ 10% on fixed cost on Rs. 37500 for cabinet dryer, Rs 50000 for solar dryer for different hour or minutes as per treatment	23.62		10.78		9.86	
	Interest on fixed cost @ 10% on fixed cost on Rs 37500 for cabinet dryer, Rs 50000 for solar dryer for different hour or minutes as per treatment	32.88		23.963		1.09	
	c) Total fixed cost (a + b) in (□)	56.5		34.743		10.95	
C	Total cost (total variable cost + total fixed cost) in (□)	653.018		1148.515		599.535	
D	Cost of processing for 1 kg dried jackfruit bulbs	155.48		273.45		142.75	
E	Cost of processing for 1 packet (100 g) of dried jackfruit bulbs	15.55		27.35		14.27	
F	Selling price of 1 kg dried jackfruit bulbs	300		500		400	
G	Selling price of 1 packet (100 g) of dried jackfruit bulbs	30		50		40	
H	Net profit for 100 g of dried jackfruit bulbs	14.45		22.65		25.73	
H	B:C ratio	1.93		1.83		2.80	

Conclusion

The study demonstrated that drying methods significantly affect physical parameters, moisture content, drying time, and economic returns of dehydrated jackfruit bulbs. Sun drying (T₃) resulted in the highest final weight (4443.2 g) and recovery (27.77%) due to lower drying temperatures, which minimized shrinkage. In contrast, cabinet drying (T₂) recorded the lowest recovery (23.96%) but achieved the lowest moisture content (5.87%), ensuring better shelf stability. Drying time decreased with increasing temperature, with cabinet drying being the fastest (10-12 hours) and sun drying the slowest (26-28 hours). Economically, sun drying was most profitable with the lowest cost (□14.27/100 g) and highest benefit-cost ratio (2.80), while cabinet drying had the highest cost (□27.35/100 g) and lowest B:C ratio (1.83) despite superior acceptability. Solar drying showed moderate results. Overall, cabinet drying is suitable for quality, whereas sun drying is best for economic feasibility.

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