



## Research Article

# DEVELOPMENT OF JACKFRUIT SEED FLOUR INCORPORATED JACKFRUIT HALWA (*Artocarpus Heterophyllus* Lam)

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**Abstract:** This study was aimed at developing a healthy, diabetic friendly, low calorie recipe for jackfruit (*Artocarpus heterophyllus* Lam) halwa (sweet meat), involving ripe jack fruit, jack seed flour, virgin coconut oil, coconut milk, jaggery, honey and other natural ingredients, and evaluating its acceptability by consumers. Twelve untrained panelists performed sensory and general acceptability test using 9 points hedonic scale of jack halwa together with a commercial halwa as control. The results revealed significant difference in hedonic score between jackfruit halwa and control. Overall acceptability of jack halwa varied from 7.25 to 7.81 and control has 6.05. The organoleptic studies showed significant differences ( $P>0.05$ ) in sweetness, aroma and color attributes between jackfruit halwa and the commercial halwa. Jackfruit halwa had mild yellow to brown color, it spread well and had strong jackfruit aroma compared to control. The panelists preferred the taste of jack fruit halwa prepared from jaggery than the sweetness of commercial halwa derived from cane sugar. Jack seed flour was subjected for proximate analysis and was added as an ingredient in different proportions. The study indicated that jack seed flour at 10.0% and fruit pulp at 90.0 percent yielded best results with respect to color, flavor, consistency and overall acceptability of the product by the panelists. The information obtained from this study concluded that jackfruit (*A. heterophyllus*) and its seed powder has exhibited favorable sensory attributes that can be used for making halwa and other processed products along with other natural ingredients to add value to the fruit.

**Keywords:** Jackfruit halwa, Commercial halwa, Proximate analysis, Sensory analysis

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## Introduction

Jackfruit (*Artocarpus heterophyllus* Lam.) is a multi-purpose tree species popular in South India and is an inevitable fruit tree in the traditional homesteads of Kerala. It is a versatile crop which provides multiple products for food, fodder, fuel, timber, medicine and industry. It is popularly known as poor man's fruit as it supplements other staple foods in times of scarcity and could literally save millions of people from starvation, especially during heavy monsoon periods in southern parts of India. In India, the total area under jackfruit is approximately 102,000 ha [1] and jack tree is largely grown in southern states viz., Kerala, Tamil Nadu, Karnataka and Andhra Pradesh besides, in other states like Assam, Bihar, Orissa, Maharashtra and West Bengal. Jackfruit is used at various stages as tender, immature, semi-mature, unripe mature and ripe stages, and seeds are used as vegetables. Jackfruit seeds have nutritional composition similar to that of grains and can be consumed in boiled or roasted form. In spite of such a vast potential and usefulness, jackfruit remains as an underutilized fruit species grown in homesteads and plantations in South India without much cultural interventions. The crop is yet to gain wide acceptance as a commercial fruit and is rarely grown on a regular orchard scale, like other popular fruits [2]. As jack fruit is highly seasonal and seeds have shorter shelf life, hence go waste during the seasonal glut. So, the seed flour can be an alternative intermediary product, which can be stored and utilized, both for value addition and to blend with other grain flours without affecting the functional and sensory profile of the final product. Moreover, the incorporation of seed flour to deep fat fried products has found to reduce the fat absorption to a remarkable extent [3]. A single jackfruit seed is enclosed in a white aril encircling a thin brown spermoderm, which covers the fleshy white cotyledon. Jackfruit cotyledons are fairly rich in starch and protein [4, 5].

Reported that jackfruit constitutes 30 percent of edible portion (bulb), 12 percent seed and 50 percent rind on weight basis. The major constituents present in ripe bulbs are sucrose and fructose which helps in providing instant energy to the body then consumed. It is a nutritious fruit, as the bulbs are rich in carbohydrates, proteins, minerals like potassium, calcium, iron, magnesium, manganese and vitamin A, B, and C [6]. The fruit is a rich source of potassium with 303 mg / 100 g of fruit and vitamin C which is an antioxidant that protects the body against free radicals, strengthens the immune system, and keeps the gums healthy. It is one of the rare fruits that are rich in B-complex group of vitamins. It contains very good amounts of vitamin B-6 (pyridoxine), niacin, riboflavin, and folic acid [7]. Jackfruit is also a rich source of dietary fiber. This makes it a good laxative improving digestion and help cure ulcers. The fibre content also helps to protect the colon mucous membrane from cancer causing chemicals. Jackfruit has a low calorific content where 100 g of jackfruit contains only 94 calories. It also possesses various other medicinal properties such as anti-inflammatory, anti-hypertensive, anti-microbial, and immuno-modulatory properties. Recently, its therapeutic properties against diabetes mellitus has been established when immature fruits consumed after cooking reduce blood sugar levels. Also, purification of blood can be achieved by jackfruit as they have been being a good source of vitamin A, vitamin C and pectin. Jacalin, the major protein present in jackfruit seeds inhibit Herpes Simplex Virus type 2, [8] and is useful in improving the immune status of patients infected with human immunodeficiency virus (HIV)-1 [9]. The crop occupies an area of 90,225 ha of land in Kerala and produces 294 million fruits [10]. Fruiting season in Kerala extends from November to August depending on location and variety, and the peak season being June which coincides with rain which leaves the fruits even without harvesting.

Due to its highly seasonal and perishable nature, there is seasonal glut and hence low prices and a high degree of wastage during peak seasons with more than 50% of the fruits get wasted without consumption. Long gestation period, limited choice of suitable varieties and non availability of elite planting materials, unpredictable yield, problems in harvesting and variability in the yield and quality are some of the negative attributes in cultivation of jackfruit, while large size, gummy nature, cumbersome processing and labor involved in cutting and extraction of bulbs/flakes, and lack of mechanization acts as constraints in processing. Scattered farms, irregular availability of raw material, small scales of operation, limited markets, and continued use of traditional processing are the bottlenecks in production and marketing of value added products.

In order to reduce postharvest losses and also availability of the fruit in off season to the people, Value addition of this fruit is highly essential. Recently, a number of scientific and economic interests have emerged to promote and commercialize jackfruit products because of its evolving image as a naturally grown organic fruit with distinct medicinal properties. Nevertheless, jack fruit has remained the most underutilized fruits with respect to processing and research work on product diversification are scanty. Jackfruit bulbs have been processed into various value-added products such as canned juice [11], fruit bar [12], minimally processed bulbs [13], hurdle technology-preserved bulbs [14] and Mature jackfruits are cooked as vegetables, and used in curries or salads [15]. They can be consumed either in raw form or in cooked form as a desert also jack fruit candies, jackfruit leathers, jackfruit jam etc., can be prepared from this ripened jackfruit bulbs. In addition to these value-added products, there is also a scope for dehydrated crisps from jackfruit. Utilization of the fruit and seed for commercial processing and value addition to convenience food has a long way to go for marketability and for employment generation. Barring efforts from a few corners, jack fruit still lack the attention of researchers that it deserves in terms of the much needed thrust on value addition of this versatile crop. Halwa (sweet meat) is a mouth watering sweet delicious dessert which is popular among Indians. Halwa in supermarkets are mixed with a generous amount of sugar, which increases the risk for diabetes. This study aims at developing a healthy recipe for diabetic friendly low calorie jackfruit halwa involving ripe fruit and seed flour along with other ingredients and evaluating its acceptability by consumers. This will add knowledge on how to process and preserve jackfruit for long term and will improve wider utilization of nutrients present in jackfruit. Processing can reduce bulk and transport costs, prevent spoilage, increase shelf life and usually command higher prices especially during the off-peak season. Also, post-harvest processing will increase demand for jackfruit and consequently stimulate increased jackfruit production in the areas where it is grown and possibly introduced in the areas where there is potential. Thus, the increased intake of processed jackfruit products will contribute to the nutrition and health benefits of the people throughout the year. Those engaged in jackfruit business will also earn more income through employment and product selling. This will in turn contribute to improve household food security, nutritional security and livelihood. So, by keeping these points in view, an attempt was made to develop jackfruit halwa at Regional Agricultural Research Station, Kerala Agricultural University, Pilicode.

## Materials and Methods

### Preparation of Jack seed powder

Fresh semi ripe or just ripe jackfruits of variety Singapore (varikka type) were collected from RARS, Pilicode, Kasargod, Kerala, washed thoroughly and cleaned in tap water. The fruits are kept for one or two days to attain the correct stage of ripening and then sliced diametrically into pieces using a manual slicer device. Fresh bulbs were extracted manually and separated from seeds and other unwanted materials. Seeds extracted are cleaned in water and the slimy seed coat was manually peeled off. Seeds were peeled, soaking in 3 percent sodium hydroxide solution for 4-5 minutes to remove the thin brown testacovering the cotyledons by rubbing the seeds between the hands and washing thoroughly under running water. Lye peeled seeds were sliced into thin chips and dried in a cabinet dryer at 60-70°C to a constant moisture content. Dried chips were powdered in a Hammer mill and sieved (ISS 35 mesh) to obtain fine flour. The flow diagram for processing of jackfruit seed into flour is shown in [Fig-1].

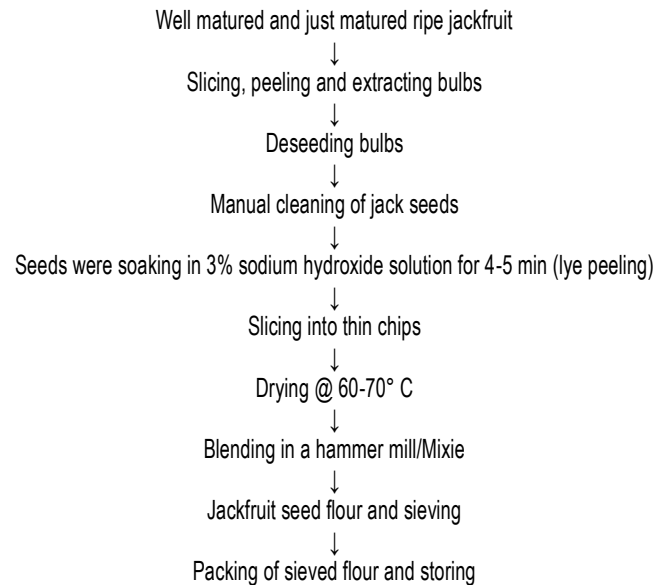


Fig-1 Flow diagram for the processing of jackfruit seed into flour

### Preparation of Jack fruit halwa

Ingredients used: Jackfruit pulp, Jaggery, Honey, Jack seed flour, Virgin coconut oil, coconut milk, Cashew Nuts, Coconut pieces, Cardamom powder.

**Preparation:** Deseeded bulbs extracted from jackfruit weighing 1kg is steamed and blanched in a cooker for about 10 min till it becomes soft. Blanched bulbs are made into the form of a pulp and homogenized using a blender. Thick coconut milk (500ml) is added to Jaggery (750 g) and made into the form of syrup by boiling and straining. Virgin coconut oil (120 ml) is added to a pan and heated. When oil is hot, blanched pulp and jaggery/ coconut milk syrup added to it. The contents (pulp and syrup) were fried in virgin coconut oil with constant stirring for about one hour till the mixture thickens and become semi solid. Stir continuously and add jack seed flour at various levels, viz. 0% (control), 5%, 10% and 15% cook for another 30 minutes. At this point, the mixture will attain a semisolid consistency. Add there maining ingredients like cardamom powder, fried coconut pieces, cashewnut pieces and stir it continuously till it becomes thick or halwa consistency. Allow the mixture to cool and when it becomes solid, can be cut into shapes, weighed and packed. The flow diagram for processing of jackfruit halwa is shown in [Fig-2].

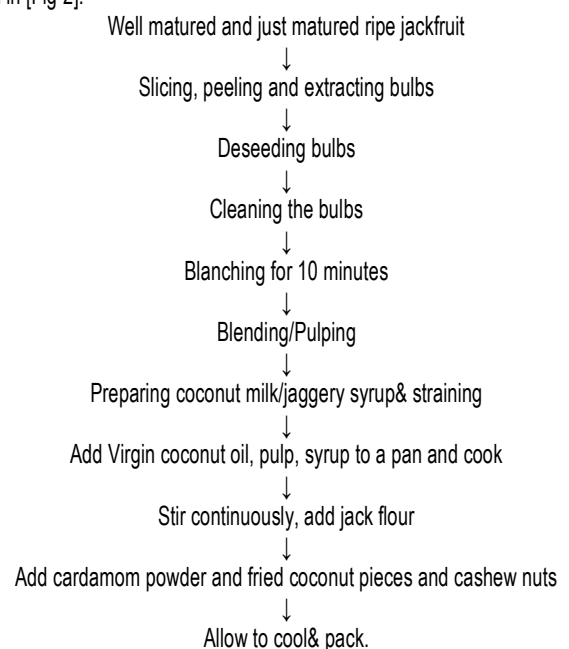


Fig-2 Flow diagram for halwa preparation

## Preparation of Commercial Halwa

Commercial halwa is prepared based on a local recipe available.

### Ingredients:

Maida – 2 cups  
Sugar – 1.5 cups  
Ghee - ½ cups  
Cashew nut – 50 gm

### Preparation procedure

1. Mix the Maida flour with water and make it into a chapatti like dough. It should not be too thick or too thin.
2. Keep it covered with wet cloth for one hour. Add 2 cups of water in a vessel (measurement equal to flour).
3. Keep the dough inside the water and knead the dough well so that flour milk is extracted.
4. The dough which remains after extracting the milk should be removed and thrown away. It requires some 10 minutes to extract. Then allow the extracted milk to stand for 1 hour.
5. A thin portion of the milk will be floating on top and the thick portion will settle down. Remove the thin portion and throw it away.
6. Now pour this thick milk in a heavy bottomed vessel or a non-stick pan and add sugar and orange colour. Let it boil for 15 minutes.
7. When it becomes thick like halwa, add ghee and cashew nuts.
8. Once the halwa starts leaving from kadai, mix well and once it is thick, transfer to a plate which is coated with ghee.
9. Once it is cool, cut into desired shape.

### Proximate analysis

The proximate analysis of processed seed flour like crude protein (by Kjeldahl method), crude fat (solvent extraction method) crude fibre, ash and moisture content was determined according to the standard methods [16].

### Sensory evaluation

The qualities of developed halwa prepared from various levels of seed flour incorporated to jackfruit pulp and control samples were subjected to sensory evaluation using a 9 points hedonic scale. Twelve panelist members were selected randomly within RARS, Pilicode to perform consumer test where commercial halwa was used as a control. Panelist fall on the age group of 24-55 years. All samples were presented before the panelists at room temperature under normal lighting conditions in white disposable plastic cups and coded with three-digit numbers. Spoons were provided to the panelists and drinking water was provided for oral rinsing. The samples attributes assed were taste, color, texture, taste, aroma, spreadability and overall acceptability.

Table-1 Proximate analysis of jackfruit seed flour sieved through ISS 35 mesh

Proximate analysis (%)	Jack Seed flour
Moisture content	9.97
Crude protein	12.1
Ash	2.04
Crude fibre	1.23
Crude fat	3.12

Table-2 Mean sensory scores of jack seed flour incorporated halwa

Parameter	Incorporation level with jackfruit pulp				
	Control	0%	5%	10%	15%
Colour	7.83	8.32	6.67	7.90	6.38
Texture	6.94	6.52	6.41	7.67	7.45
Taste	6.87	6.76	7.08	7.11	6.41
Flavour	7.25	6.77	6.41	7.76	7.16
Overall acceptability	6.05	7.25	7.38	7.81	7.43

### Results and discussion

The sieved jack seed flour was subjected for proximate analysis and the results indicated that the seed flour contains 9.97 percent of moisture, 12.1 percent of crude protein, 2.04 percent of ash, 1.23 percent of crude fibre and 3.12 percent of fat [Table-1]. Further, value added product i.e., Halwa have been developed by

incorporating this jack seed flour. Mean hedonic scores of jackfruit halwa and commercial halwa are shown in [Table-1]. The results show that there is significant difference at ( $p>0.05$ ) between commercial halwa and the jackfruit halwa in terms of acceptance with respect to taste, aroma and color. Among the panelists, 74.5% of them preferred jackfruit halwa. On the other hand, only 25.5% panelists preferred commercial halwa. The reason why the panelist preferred jack fruit halwa is the aroma which appeared to be attractive and resemble the taste of the jackfruit. They would not prefer commercial halwa compared to the other is because it appeared to have too much sugar in it. This means the panelists had accepted the developed jackfruit halwa than commercial halwa at levels between like very much and like much.

The quality of halwa prepared from seed flour incorporated to jackfruit pulp was evaluated for sensory attributes by the panel of 12 judges. Overall acceptability of halwa varies from 6.05 to 7.81. The organoleptic quality of the halwa from seed flour indicated that halwa made out of 10 percent seed flour and 90 percent jack fruit pulp were quite good with respect to colour, flavour, consistency and very good acceptability for consumption [Table-2].

An average consumer is mostly guided by the price, visual appearance and claims of the advertisement regarding the product. He still has to grasp the idea of good quality in his mind with respect to nutritive value and the impact of the product on human health. Food products of excellent taste may have some ingredients that may cause numerous health hazards that can adversely affect the consumer. There are instances where commercial sweet meat products available in the market using ingredients like saccharine for sweetening in unacceptable levels. Additives which are either not permitted or restricted such as colorings, preservatives, flavourings, anti-toxicants, emulsifying and stabilizing agents, anti-microbial agents, if exceeds the minimum amount permissible, may have harmful effects, and may also cause health hazards. Sugar when added in pure form may shoot up the blood sugar levels in diabetic patients. Similarly, excess fat contributed by adding ghee in sweet meat can raise the cholesterol content and may impair fat metabolism. So, attempts to develop products like jack fruit halwa will facilitate to cater the demands of today's consumers who are health conscious and willing to pay premium price for healthy and nutritious products.

### Conclusion

From the results of the study, it can be concluded that the developed jackfruit halwa is accepted by consumers. It also indicates the immense scope for utilization of jack fruit and seed flour in the preparation of this value added product by partial replacement of jack pulp in halwa. Based on the results of sensory evaluation, partial replacement of jackfruit pulp with jack seed flour at 10: 90 is selected as the best combination out of all combinations tried.

Jackfruit offers exciting possibilities for adding novel products to the food processing industry and contributes towards enhancing the farm income of rural people. Jackfruit and seed have lots of nutrients both macro and micronutrients and other healthy ingredients like virgin coconut oil, coconut milk will add to its nutritive value, taste and flavor to the prepared halwa. It also offers the possibility of diversifying the value added products in jack fruit and preserve it during off seasons and reducing post-harvest losses. Further research is needed in order to understand more about jackfruit processing because it has many local types and varieties so that we can identify the types that are good for developing specific products which have health benefit potential.

**Application of research:** Study of jackfruit seed flour incorporated jackfruit halwa

**Research Category:** Horticulture

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**\* Research Guide or Chairperson of research:** Dr K. N. Satheeshan  
University: Kerala Agricultural University, 671310, Kerala, India  
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**Author Contributions:** All authors equally contributed

**Author statement:** All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

**Study area / Sample Collection:** RARS, Pilicode, Kasargod, Kerala

**Cultivar / Variety / Breed name:** *Artocarpus Heterophyllus* Lam

**Conflict of Interest:** None declared

**Ethical approval:** This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

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