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A CASE STUDY

Processing and value addition in jackfruit

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SUMMARY : Jackfruit is a typical Indian fruit mainly grown in Maharashtra, West Bengal, Bihar, Assam and the west coast. Fully ripe jackfruit is sweet and has exotic flavour. The bulbs (edible flakes) contain 7.5 per cent sugar on dry weight basis and a fair amount of carotene which is Vitamin-A. Apart from better utilisation of perishable fruit this would also result in considerable value addition. Many products could be made from ripe jackfruit like nectar, jam, pickle, chips and canning etc. Jacalin is the major protein from the jackfruit is useful tool for the evaluation of immune status and also a good source of vitamin A, vitamin C and pectin; jackfruit also helps in alleviating the pancreatic ailments and aid in blood purification. With all these medicinal values and efficient ingredients in value added products the utilization of jackfruit in convenience food has a long way to utilize the jackfruit products with value addition for marketability and to create employment among rural peoples for economic empowerment.

Key Words : Jackfruit, Value addition in jackfruit, Jackfruit powder

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Jackfruit *(Artocarpus heterophyllus* Lam.) is a species of tree in family Moraceae. Jackfruit originated in the Western Ghats region of India and grown wildly many parts of Southern and Southeast Asia, such as Bangladesh, Burma, Sri Lanka, Malasia, Indonesia, Phillippines and Thailand. It is grown extensively in the coastal region of Maharashtra, Assam, West Bengal, Orissa and Bihar. Jackfruit has been in cultivation in India from ancient times. It was probably taken by Arab traders to the East African coast, and now it has spread throughout the tropics. The jackfruit tree is adapted to humid, tropical and subtropical climates. It is sensitive to frost and cannot tolerate drought. Jackfruit is a lowland tree thriving below altitudes of 1000m. Above this altitude, the fruits are of poor quality and usually cooked before eating. The tree will grow well on almost any type of soil. It prefers a wet environment but cannot tolerate water logging and poor drainage.

The true fruit is normally originated from carpel (ovary) and surrounded by a fleshy perianth, a main bulky portion of the fruit, which has three different regions *i.e.* middle fused region forms the rind of syncarp and the upper free horny region spikes. The lower fleshy edible portion is known as 'bulb'. It has very unique, pleasant aromatic flavor and distinct taste. The ripe fruits and seeds of jackfruit are bestowed with certain chemical and aphrodisiac properties, which are important from health point of view. The nutritive value of jackfruit is shown in Table 1.

Jackfruit has four stages of maturity: tender, slightly grown, unripe and ripe. In the earlier three stages, it is a very good vegetable. It can be converted into hundreds of value-added products, most of them for day-to-day use and a considerable number of them with months-long shell life.

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Table 1 : Composition of jackfruit (100 g edible portion)

Sr. No	Composition	Young fruit	Ripe fruit	Seed
A	Proximate analysis			
1.	Water (g)	76.2-85.2	72.0-94.0	51.0-64.5
2.	Protein (g)	2.0-2.6	1.2-1.9	6.6-7.04
3.	Fat (g)	0.1-0.6	0.1-0.4	0.40-0.43
4.	Carbohydrate (g)	9.4-11.5	16.0-25.4	25.8-38.4
5.	Fibre (g)	2.6-3.6	1.0-1.5	1.0-1.5
6.	Total sugars (g)	-	20.6	-
B	Minerals and vitamins			
1.	Total minerals (g)	0.9	0.87-0.9	0.9-1.2
2.	Calcium (mg)	30.0-73.2	20.0-37.0	50.0
3.	Magnesium (mg)		27.0	54.0
4.	Phosphorus (mg)	20.0-57.2	38.0-41.0	38.0-97.0
5.	Potassium (mg)	287- 323	191- 407	246
6.	Sodium (mg)	3.0-35.0	2.0-41.0	63.2
7.	Iron (mg)	0.4-1.9	0.5-1.1	1.5
8.	Vitamin A (IU)	30	175-540	10-17
9.	Thiamine (mg)	0.05-0.15	0.03-0.09	0.25
10.	Riboflavin (mg)	0.05-0.2	0.05-0.4	0.11-0.3
11.	Vitamin C (mg)	12.0-14.0	7.0-10.0	11.0

Despite its tremendous food value, we are wasting the Jackfruit in a big way. According to one 'guesstimate', we are allowing Rs. 215 Crore worth of jackfruit to rot. This is on the assumption that only 50 per cent is wasted and each fruit costs only Rs.3. There is no organized marketing or steady supply chain for jackfruit. Harvesting and transportation from interior villages poses problems. The fruits are in high demand in the cities. There are also buyers for value-added products. The traditional products of jack pappad, jack chips, jack poli, jack jam, jack squash, jack leather etc. have good market.

According to an estimate Kerala exports about 500 MTs of jackfruit, valued at Rs.6.75 Crore. An equal quantity is sold in the State, fetching Rs.4.5 Crore. Karnataka produces about 1000 MTs of chips earning about Rs. 12 Crore. Though India is only second in Jackfruit production in the world, we are pathetically slow in commercializing this wonder fruit. According to the experience of CARD, Krishi Vigjan Kendra at Pathanamthitta, a 10-kg Jackfruit, by value addition, can fetch Rs. 600.

The Ministry of Agriculture had identified it as one the main fruit commodity under its Agricultural based industry and agro-food sector's Balance of Trade (BOT) Action Plan 2000-2010. The objective of this action plan was to reduce the nation's agro food trade deficit through increasing commodity products, decrease import and increase export (www.moa.gov.my). According to crop statistics produced by the Department of Agriculture in 2008, the total production of jackfruit increased from 18,510.7 metric tones in 2003 to 19,882 metric tones in 2008 (www.doa.gov.my).

Processing of jackfruit:

In view of its important properties, ripe jackfruit bulbs are consumed worldwide as a dessert fruit or processed in various forms like canned segments (with syrup and honey), jackfruit flavors, drum-dried powder, osmo-air dried segments, enzyme liquefied juice, candy, jam, spread, jelly, ready to serve beverage (RTS), squash, syrup, nectar, slab or bar and chips are also prepared by frying the ripe and semi ripe flakes in margarine. Fig. 1 shows some value added products from jackfruit.

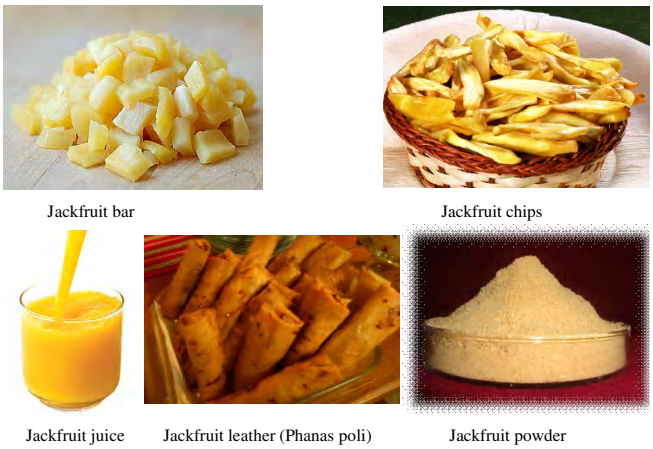

Fig. 1 : Value added jackfruit products

Jackfruit leather:

It was observed that of the more than 95 per cent households were preparing jackfruit leather and jackfruit chips. At the overall level, per household quantity and value realized in jackfruit processing for leather was 41.38 kg and Rs. 4669.10 and 98 kg and Rs. 14452.08, respectively. This revealed that sample households were supplemented in gross income from jackfruit processing. The capital investment per household was Rs. 10553.49 of which 18.51 per cent was fixed capital and 81.49 per cent was working capital. Of the total capital investment share of raw material was highest (62.16 %) followed by labour charges (19.69 %). In case of jackfruit leather and jackfruit chips benefit cost ratio were 2.13 and 1.67, respectively at the overall level. Net value addition was 262.70 per cent and 303.54 per cent in the same order. Thus, jackfruit processing was profitable subsidiary business activity for providing gainful employment and income to processing households.

Crisp bulbs:

The crisp bulbs of the ripe Jackfruit are used for canning in sugar syrup. Yield of bulbs varies from 20 to 25 per cent depending upon the weight of fruit. After cutting the fruit in several pieces, the bulbs are removed with hand. As the fruit contains white highly sticky latex, a little gingili oil or any vegetable oil is smeared on the hands as the latex is soluble in the oil. The seeds are removed from the bulbs. The bulbs are then canned either as whole or as halves or quarters. Syrup of 40ºB with 0.5 per cent citric acid is used to increase acidity level as the pH value of the fruit is very high (5.2). The canned jackfruit has an exotic flavour and is relished by all sections.

Jackfruit seed flour:

The seeds are generally eaten in boiled or roasted form or used in many culinary preparations, as it contains similar compositions as that of grains. As jackfruit is highly seasonal and seeds have shorter shelf life, hence go waste during the seasonal glut. So, the seed flour can be an alternative intermediately 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 (Rajarajeshwari and Jamuna, 1999). The ripened fruit is a normally fibrous and composed of sugars like glucose, fructose, xylose, rhamnose, arabinose and galactose. The seeds are also rich source of carbohydrates and proteins and good source of fibre and B-complex vitamins.

Jackfruit pulp:

Jack fruit pulp is useful in overcoming the effects of alcohol, jack fruit seed also an important ingredient in antidote preparation for heavy drinkers.

Jackfruit latex:

The latex from the bark contains resin which is used sometimes to plug holes in earthern vats and in other products. The latex from the leaves has got capacity to kill bacteria.

Jackfruit protein (Jacalin):

Jacalin, the major protein from the jack seeds has proved useful tool for the evaluation of immune status of patients infected with HIV (Morton, 1987). Being a good source of vitamin A, vitamin C and pectin, jackfruit also helps in alleviating the pancreatic ailments and aid in blood purification.

Jackfruit powder:

Jackfruit powder could be prepared by drying seedless jackfruit bulbs at osmotic drying with sugar solution of 70 ^{0}B followed by convective drying at 60^0 C temperature for 15-18 hrs. Alternatively jackfruit bulb powder could be prepared by drum drying for 7 hrs at 60^{0}C. Treatment with sugar solution (70^0 B for 1 h) followed by convective drying resulting better quality jackfruit bulb powder. Jackfruit powder could be used in ice-cream, beverages, cake etc.

Jackfruit nectar:

The jackfruit nectar can be prepared by removing the bulb from ripe jackfruit and passed through a pulping/ fruit mill. They are then mixed with about 10 per cent hot water and passed through a pulper having a fine sieve of 1 mm hole. The pulp is used for preparing nectar.

Jackfruit chips:

Raw jackfruit is the basic raw material for fried jack chips. First of all, raw jack fruit are cut into large pieces. The bulbs are then removed with hand. The seeds are also removed. The raw bulbs are then cut into suitable length wise pieces. These pieces are fried in coconut oil or refined vegetable oil. Salt may be added to the frying pieces to enhance its taste and preservation. They are packed in polythene bags and sealed with sealing machine.

Minimally processed jackfruit will boost the fruit's potential both locally and internationally. The unique flavour and crisp texture, coupled with the diverse ways it can be incorporated into a meal, will make minimal processed jackfruit an important export commodity. A method that can preserve the fresh fruit's characteristics; enhanced its shelf stability yet keep cost at a minimum will achieve this purpose.

Jackfruit juice:

In jackfruit juice often found starch. It is normally present in ripe fruit in the form of microscopically small, insoluble granules. When the juice is heated, the starch becomes hydrated and gelatinized. However, after filtration of the juice, the starch once again becomes insoluble and it retrogrades

and precipitates (Gates and Sandstedt, 1953). This causes an unattractive post-bottling clouding of the juice or concentrate. Complete enzymatic degradation of the starch by means of special amylases is only possible if the juice was previously heated to at least 85^{0}C. The heat treatment hydrates and gelatinizes the starch and make it ready for enzymatic degradation (Ray *et al*., 2002).

The jackfruit pulp was macerated with new enzyme formulation (1.25% w/v) and incubated at RT for 120 min. The free run juice was filtered using muslin cloth. The remaining residue was pressed through hydraulic press in order to recover some more quantity of juice. The enzyme formulation was quite effective and feasible at pilot scale level. Hence, remarkable juice recovery (80.14%) was achieved from the pectinase CCM1: AMG treated jackfruit pulp. The jackfruit juice was then clarified using centrifugation technique (Westfalia centrifuge) in order to remove the suspended particles. The clarified juice was pasteurized (85 °C for 15 min) and hot-filled into pre sterilized glass bottles. These bottles were sealed and cooled overnight. The clarified jackfruit juice stored at 4 °C was more acceptable in terms of colour, flavour and overall quality.

Health drink from jackfruit:

The health drink is also made from a mixture of jackfruit seed flour (35%) defatted soya flour (30%), wheat malt (10%), whole milk powder, (10%) and Glucon D (5%). The mix is packed in laminated pouches and stored for a period of 6 months.

Jackfruit powder:

Another value added product *i.e.* spray dried powder was prepared from clarified jackfruit juice using spray drying technique. The droplet size was optimized to 1.5 mm and the feed rate was maintained at 60 ml/min. The inlet and outlet temperatures of 140 °C and 60 °C, respectively were maintained. 10 per cent maltodextrin addition was quite enough to prevent stickiness in the product. The acid: sugar ratio plays a vital role in the spray dried powder preparation. Hence, the sugar/ acid ratio is very critical for spray dried jackfruit powder preparation with the addition of spray drying carrier like maltodextrin, which can prevent stickiness. Due to its hygroscopic nature, proper care should be taken while packaging to prevent uptake of moisture. Hence, spray dried jackfruit powder can be packed in metallized polyester pouches which can prevent ingress of moisture and also it can extend the shelf life of the spray dried powder.

Jackfruit bar:

Jackfruit is consumed in its many forms as fresh fruits and in preserved forms; fruit bar is one of the preserved form of fruits. The jackfruit bars were developed from varieties Varriccan and Chempavarriccan (orange coloured pulp jackfruit) and packed in polythene bags of 40ì. The fruit bars were stored at room temperature (30+2^{o}C) for two months.

Of late, farm level jackfruit processing is gaining importance and mostly practiced in Maharashtra state. About more than 100 small scale processing units have been established and are in operation in this state. On farm jackfruit processing is a household technology package tailored to enhance the economic status of farm sector.

There is a prospective market for these products in Maharashtra as well as outside the State. It is also learnt that there is a good export market potential for these items especially in Middle East countries. In view of the above, it is envisaged that there is a good scope for setting up jackfruit processing units in jack growing areas. This will not only help the farmers to utilize the perishable raw material but also generate more employment opportunities in rural areas. About 20 to 25 units are engaged in unorganized sector manufacturing jack chips and jackfruit preserves in Kerala state. Jackfruits are marketed locally as whole-fruit or minimally processed products whereby the fruitlet are separated from the whole-fruit. The current practice does not emphasize sanitation and cleanliness aspects during preparation, which resulted in short shelf-life of only 1 day at ambient temperature and only 3-4 days at 10-15^0 C. Jackfruits destined for export market are usually sent abroad as whole fruit. Transportation through air will give the produce 5-6 days of market quality when they arrived to their destination. However, the air freight is very costly and the edible part of the fruit is only 50-60 per cent of the total cost. Furthermore, the size and shape of the fruits are not consistent, making the design of packaging very difficult (http:// agromedia.mardi.gov.my).

Although extensive work has been done on the various aspects of jackfruit processing and value addition concerted efforts are required. The future lines for research are suggested bellows.

– Setting up a jackfruit mission in the state

– Developing gene pool at taluk level with farmer participation

– Research emphasizing standardization of minimal processing and processing technologies be developed to produce ready-to-cook and ready-to-eat jackfruit.

– Jackfruit has to be taken out of the 'minor fruit' list and brought under the focus area of NFM and NHB.

– Top priority should be given to creating farmer-friendly supply chain and making jackfruit available for ready use and consumer-friendly.

– "Status addition" is to be given combined with value addition to increase accessibility

Conclusion:

Jackfruit is rich in many nutrients like vitamin A, vitamin C, thiamine, riboflavin, vitamin B6, calcium, magnesium, phosphorus, potassium, manganese, zinc, dietary fiber, protein,

carbohydrates etc. jackfruit seed is having high nutritional values. So you must try to include the jackfruit in your diet also jackfruit is an important source of phytonutrients which are good for our health. Jackfruit is very important crop for food security. There is a lack of information on the economics of jackfruit, a situation which is surprising to many considering that the fruit is valued as a staple in times of scarcity in some countries. There is a distinct possibility of marketing the jackfruit products in other states of India as well as in foreign countries.

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