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Assessment of jackfruit-based squash preparation methods

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Abstract

Agriculture and horticulture is main occupation of farmers of Bokaro district. In Jharkhand state, Bokaro district is famous as vegetable belt. Jack fruit is produced in huge amount in Bokaro district. When jack fruit starts to ripe, rural people consumed it happily in beginning. But, after sometime, rural people left ripe jack fruit on their tree which fall down on ground and decompose after being over ripe. In this way, a huge wastage of ripe jack fruit occurred. The basic reason behind this huge wastage was lack of knowledge regarding value addition and preservation of ripe jack fruit among local rural farm families. Therefore, an OFT was conducted in Koh panchayat in year 2020 with an objective to maximum utilization of ripe jack fruit as well as to prevent its huge wastage. Three treatment were taken named as Farmers Practice (F.P.), Technological Option I (T.O.I) and Technological Option II (T.O.II). In F.P., local consumption pattern of ripe jack fruit was considered. Local rural people consumed bulbs of ripe jack fruit just as fruit. In T.O.I, squash was developed by the use of ripe jack fruit only and in T.O.II, squash was developed from ripe jack fruit blended with ripe mango. After that, calculation of all three food produce nutritive value was done. Along with this, sensory evaluation and economics was analyzed. Regarding, both nutritive value and sensory evaluation different parameters like appearance, color, taste, flavor and overall acceptability, mango blended jack fruit squash (T.O.II) found best, whereas Farmers Practice (F.P.) was cost effective among all three treatments. So, it is concluded that this ripe jack fruit based squash could help in preventing huge wastage of ripe jack fruit as well as be potential source of rural income generation for the deprived farming communities.

Keywords: Jackfruit, value addition, chemical preservation squash and income generation

Introduction

Agriculture and horticulture is main occupation of farmers of Bokaro district. In Jharkhand state, Bokaro district is famous as vegetable belt. Approximate 39.21 per cent of the total area is presently under agriculture land and under horticulture area is approximate 9.09 per cent of the cultivable land (<https://bokaro.nic.in>, dated 5/11/2023). Jack fruit is produced in huge amount in Bokaro district. Tender jackfruit is a popular vegetable. Unripe jackfruit is used for pickles while ripe one is eaten fresh just as fruit. Baby jack fruit are made into a variety of cuisines in the rural tribal and urban cultures (<https://www.nbpg.ernet.in> cited on 1/11/2023). In Holi, jackfruit sabji is most favorite dishes in Jharkhand. Jack fruit plant is widely distributed on waste land, marginal land and on road side in rural areas. Yet, jack fruit heavily produced even in neglected condition.

Production status of Jackfruit in India

Jack fruit (*Artocarpus heterophyllus*) is indigenous to India (Shakuntala Manay, 1987) [18]. India is the first major producer of jackfruit in the world with an annual average production of 1.4 million tones with Jharkhand sitting in the eighth position in terms of total annual production (<https://sahasa.in> cited on 02/11/2023). Jharkhand's total production in jackfruit is 117.46 tones and the shares is 6.78% (<https://theindianblog.in>). Jharkhand data of jack fruit is updated yearly from March, 2013 to 2023, the average data was 137.54 Ton (<https://www.ceicdata.com> dated on 5/11/2023).

Jackfruit: A Powerhouse of Nutrients

Jackfruit is rich in several nutrients. Jackfruit is a rich source of minerals, vitamin C, potassium and antioxidants. As per information given by ICMR (1998) [10] jack fruit contain

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19.8 percent carbohydrate and from 100 gram fruit it gives 88 Kcal energy. It also good source of fiber, calcium, iron, potassium and sodium. It acts as source of complete nutrition for the human beings. Almost having the exact nutrients equivalent to mother's milk (Priya *et al.*, 2016)^[15].

In this way, it is clear that on one side it is rich in minerals and vitamins and can take place of other fruits and vegetable and on other hand it is good source of energy also. So, it can play role of staple food also. Both, value added products of jack fruit can help in overcome food and nutritional security related problem in rural areas.

Table 1: Nutritive value of different part of jackfruit (per 100 gram)

Nutrients Stage of jack fruit	Protein (g)	Fat (g)	Minerals (g)	Fiber (g)	Carbohydrate (g)	Energy (kcal)	Cal (mg)	Iron (mg)	Phosphorus (mg)
Jackfruit tender	2.6	0.3	0.9	2.8	9.4	51	30	1.7	40
Jackfruit seed	6.6	0.4	1.2	1.5	25.8	133	50	1.5	97
Ripe Jackfruit	1.9	0.1	0.9	1.1	19.8	88	20	0.56	41

Source: Gopalan *et al.*, 2004^[12] (Nutritive Value of Indian Foods)

Special Nutritional Properties of Jack fruit

Jack fruit is a powerhouse of nutrients and have many special nutritional properties. It plays an important role in the treatment of digestive disorder like ulcer and constipation being a complex carbohydrate and fiber rich fruit. High number of antioxidants is responsible for its anti-cancer properties. It is good source of vitamin A which is essential for good vision and magnesium also. Magnesium plays major role in calcium metabolism and maintains bone health. Jack fruit is rich in iron which helps in preventing anemia and also good source of potassium (Priya *et al.*, 2016)^[15]. The high potassium in jackfruit lowers blood pressure and reducing the risk of heart attack or stroke (<https://www.agroexporters.net> cited on 2/11/20223).

Health Benefit of Jackfruit

Apart being a highly nutritious fruit, jack fruit have so many medicinal properties also.

Jack fruit also contains many antioxidants. (Ambily and Davis, 2016)^[9]. Antioxidants plays very important role in the treatment of all kind of degenerative diseases like cancer. For example, total 14 to 18 carotenoids were reported. It is also rich in phyto-nutrients. A good amount of copper of jack fruit plays a key role in the thyroid metabolism and vitamin C, which helps in fighting against infections (Priya *et al.*, 2016)^[15]. "Jacalin" an extract of jack fruit inhibited growth of HIV infection and AIDS and also helps in cancer treatment (Rajan, 2007)^[14]. Tender jack fruit juice along with coconut milk and jiggery is used in the treatment of drug poisoning (Sanmugam, 2007)^[16].

Need of the Hour: Chemical Preservation of Jack Fruit

Jharkhand is on the eighth position in terms of total Indian annual production as per data of year 2018-19. As per a government report in 2022, India lost approximate 5 to 13 per cent of total fruits and vegetables production. If, this is converted into monetary term, it is loss of approximate of worth over Rupees 1, 52,000 crores (<https://finshots.in> cited on 3/12/223). India processes hardly 1.0 % of the total fruits and vegetables unlike other developed countries Sethi, (1994)^[17].

Bokaro district is rich in Jack fruit production. Tender jack fruit is consumed with choice as vegetable and mature unripe jack fruit is used as pickle. When jack fruit starts to ripe, rural people consumed it happily in beginning. But, after sometime, rural people left ripe jack fruit on their tree which fall down on ground and decompose after being over ripe. In this way, a huge wastage of ripe jack fruit occurred. The basic reason behind this huge wastage was lack of

knowledge regarding value addition and preservation of ripe jack fruit among local rural farm families.

In such situation, low cost processing technologies are needed to keep preserved product within the reach of a much wider section of the population. The solution lies in the use of an appropriate low cost technologies and one of the simple method is chemical preservation by the addition of simple chemicals like sugar, acid, preservatives etc. This simple method of chemical preservation are easy to follow, economical and could cater indigenous need and save losses of fruit (Sethi, 1994)^[17]. Jack fruit is very nutritive but problem is it is seasonal and perishable, which necessitates its chemical preservation (Ambily and Davis, 2016)^[9]. So, it has become an urgent need to develop value added products from jack fruit through chemical preservation suitable for rural areas and for income generation also.

Methodology

In Bokaro district, there was abundant availability of ripe jack fruit from last week of June to last week of August month of the year. Unripe jackfruit is consumed with choice as vegetable or made in to pickles. When jack fruit starts to ripe, rural people consumed it happily in beginning. But, after sometime, rural people left ripe jack fruit on their tree which fall down on ground and decompose after being over ripe. In this way, a huge wastage of ripe jack fruit occurred. The basic reason behind this huge wastage of ripe jack fruit is lack of knowledge regarding value addition and preservation among local rural farm families. Therefore, an OFT was conducted in Koh panchayat through KVK, Bokaro in year 2020 with an objective to maximum utilization of fully ripe jack fruit as well as to prevent its huge wastage. In the present study, three treatments named as Farmers Practice (F.P.), Technological Option I(T.O.I) and Technological Option II(T.O.II) were taken. In F.P., local consumption pattern of ripe jack fruit was considered. Local rural people consumed bulbs of ripe jack fruit just as fruit. In T.O.I, squash was developed by the use of ripe jack fruit only and in T.O.II, squash was developed from ripe jack fruit blended with ripe mango.

1. Steps of preparation of squash from ripe jack fruit:

In the preparation of squash, a sequence of steps was followed which is given below one by one.

- a. **Selection of study area:** Study was conducted in Koh panchayat of Bokaro district due to abundant availability of ripe jack fruit.
- b. **Purchasing of ripe jack fruit from local market:** Ripe jack fruit was available in abundance in the local market at very low price in the villages of Bokaro

district. A ripe jack fruit of approximate 10 Kg was purchased in Rs100. From last week of June month to last week of August month, ripe jack fruit was available in the local market.

- c. **Washing, cutting and slicing of fresh ripe jack fruit:** All ripe jack fruit was cleaned thoroughly. Outer cover, seeds, fibers and other unwanted parts were removed. Total bulbs were collected in bowl separately.
- d. **Extraction of fine paste of bulbs:** All bulbs were boiled in small amount of water (100 to 150 ml) for few minutes and fine paste of bulb was obtained by grinding in mixer. Whole lot of paste was filtered through muslin cloth.
- e. **Preparation of sugar syrup:** Squash was developed in T.O.I from ripe jack fruit only and in T.O.II from ripe jack fruit blended with ripe mango. First of all, sugar syrup was prepared in both cases. Sugar syrup was prepared by mixing the calculated amount of sugar, water and citric acid. Prepared sugar syrup was filtered with muslin cloth to remove any kind of residues.
- f. **Preparation of squash:** Ripe jack fruits are used for jam, jelly, juice and canned products (Janick and Paul, 2008) [11]. In the present study, squash was selected as preserved product because it is simple and easy in preparation and most suited product for intense summer season of June to August in Bokaro district, an industrial area.
In T.O.I, after preparing sugar syrup, fine paste of ripe jack fruit bulb and prepared sugar syrup was mixed and once again filtered with muslin cloth. After that, preservative(KMS) was added in it, then squash was

ready. Same procedure was followed in T.O.II, but difference was in place of using sole fine paste of ripe jack fruit bulb, ripe mango pulp was blended with fine paste of ripe jack fruit bulb was used. Rest of the procedure was same.

- g. **Bottling, packaging and storage of squash:** Since study was conducted in rural areas so bottling was done in plastic bottles and storing was done in their home at room temperature for few months.
2. **Calculation of Nutritive value of all three food produce:** Nutritive value of all three produce of the study was calculated with the help of book titled as The Nutritive Value of Indian Foods (Goplalan, 2004) as per the ingredients used in the treatments. In Farmers Practice, only bulbs of ripe jack fruit was used whereas in T.O.I and in T.O.II, squash was developed and ingredients used were ripe jack fruit, sugar and ripe mango.
 3. **Sensory evaluation through score card method:** In the present study, sensory evaluation was done with the help of score card method because it is easy and simple as compared to other scaling methods. In technical parameters of sensory evaluation, appearance, color, flavor, taste and over all acceptability were taken. In this method, scoring was done on quality characteristics of the product in whole numbers using scale given below.

Scoring scale: 1-2 Very poor, 3-4 Poor, 5-6 Fair, 7-8 Good, 9-10 Very good

Table 2: Score Card Method of Sensory Evaluation used in the study

Parameters Treatments	Appearance	Color	Texture	Flavor	Taste	Overall acceptability
Maximum Score	10	10	10	10	10	10
Farmers Practice (FP)						
T.O.I						
T.O.II						

4. **Shelf life analysis of all three-food produce:** Shelf life was analyzed by observing its appearance, color, flavor and taste of the all three food produce of the study.
5. **Cost analysis of all three produce of the study:** Cost analysis of all three produce of the study was done at the end of the study. In general, local people consume bulbs of ripe jack fruit just as fruit. Cost analysis of squash of T.O.I and T.O.II was done.

Result & Discussion

After completing all steps mentioned in the methodology, results are given below in tables and discussed in detail one

by one.

Nutritive value of all three-food produce of the study

Jack fruit is rich source of many nutrients. So, calculation of nutritional value of all three-food produce of the study was essential. Nutritive value of all three-food produce was calculated as per given method mentioned in methodology. In Farmers Practice, only bulbs of ripe jack fruit was used whereas in T.O.I squash developed from ripe jack fruit and in T.O.II, from ripe jack fruit blended with ripe mango were used. In these three food produce, ripe jack fruit, ripe mango and sugar were used as raw ingredients. Calculated nutritive value is given in Table no.4.

Table 3: Nutritive value of the three-food produce per 100g of the study

Nutrients Treatments	Protein (g)	Fat (g)	CHO (g)	Calcium (mg)	Iron (mg)	Beta-carotene (µg)	Vitamin-C(mg)
FP Farmers practice (Ripe jack fruit bulbs)	1.9	0.1	19.8	20	0.50	175	7
T.O.I (Jackfruit squash)	0.25	0.001	220.34	26.88	0.0075	2.79	0.11
T.O.II (Jackfruit & mango blended squash)	1.09	0.05	972.47	9.84	0.08	142.30	1.11

After calculating the nutritive value, it was found that bulbs of ripe jack fruit had highest value in beta-carotene. Whereas squash of T.O.II had highest carbohydrate value and squash developed from only ripe jack fruit had least

protein, fat, iron, beta-carotene and vitamin-C among all the three treatments. In this way, it could be said that T.O.II was found best from nutritional composition point of view when all three produce were compared.

Sensory Evaluation of all three-food produce of the study

Sensory evaluation is very important step which helps in advertising any new food product in the market. After calculating the nutritive value of all three-food produce,

sensory evaluation was done with the help of score card method. In Farmers Practice (FP), only bulbs of ripe jack fruit was consumed whereas in T.O.I, squash developed from ripe jack fruit and in T.O.II squash developed from ripe jack fruit blended with ripe mango were consumed.

Table 4: Sensory evaluation of all three-food produce on the date of preparation

Parameters Treatments	Appearance	Color	Flavor	Taste	Overall acceptability	Overall grading
FP Farmers practice (Ripe jack fruit bulbs)	6.00	6.37	6.77	5.87	5.87	3 rd
T.O.I. (Jackfruit squash)	7.55	7.88	8.62	7.75	7.75	2 nd
T.O.II (Jackfruit & mango blended squash)	8.87	8.75	8.87	8.77	8.75	1 st

In sensory evaluation assessment, it was revealed from the study that squash developed by the use of ripe jack fruit blended with ripe mango was best in appearance, color, flavor, taste and overall acceptability and squash developed by the use of only ripe jack fruit found second in position. Since bulbs of ripe jack fruit was very sweet in taste and have very strong sweet flavor which is responsible for its low acceptability. Finally, squash developed in T.O.II was found best in all sensory parameters mentioned above. When grading was done and it was graded as first. A study was conducted by Ambily and Davis, (2016) [9] in which

sensory evaluation of seven variations of tender jack fruit was done.

Economics involved in the Jackfruit based squash preparation

Any technology's success depends on the economics involved in the development of the new food product. So, it should be cost effective also along with other qualities. Both from entrepreneurship development and consumer point of view, its economics should be profitable for both groups.

Table 5: Economics involved in the Jackfruit based squash preparation:

Parameters Treatments	Cost of produce per unit	Market price per unit	Net Profit per unit	B:C Ratio
Farmers practice (Ripe jack fruit bulbs)	20.40Rs/kg	50 (Rs/kg)	29.60	2.45
T.O.I (Jackfruit squash)	62.91 Rs/liter	184.28 Rs/liter squash	121.37	2.92
T.O.II (Jackfruit & mango blended squash)	81.56Rs/liter	212.85 Rs/liter squash	131.29	2.60

In the present study, the price of fully ripe jack fruit of approximate 10 kg is hardly Rs 100 in local rural areas. In the present situation, it is very low price, which discourage the growers from producing more. So, the dream of double the income of the farmers cannot be fulfilled. But, when economics involved in the preparation of squash developed from by the use of only jack fruit (T.O.I) was done, it was 184.28 Rs/liter and of squash developed from ripe jack fruit blended with ripe mango (T.O.II), it was 212.85 Rs/liter, which was much higher than ripe jack fruit bulbs (Table No. 6). When net profit per unit was calculated, it was Rs29.60, Rs121.37 and Rs131.29 in case Farmers Practice, T.O.I and T.O.II respectively. The method of squash preparation is simple and easy for farm women. The present study revealed that ripe jackfruit based squash has good scope for income generation for farm women of rural areas. So, both problem i.e. prevention of huge wastage of ripe jack fruit as well as farmers poor economic condition can be solved through this way.

Assessment of Shelf life of all three produce of the study:

Shelf life assessment of all three-food produce of the study was assessed. It is very important to know till what period that particular product should be in the market for the consumption purpose. It was clear from the present study that the shelf life of bulbs of ripe jack fruit was only of few hours. Due to very strong sweet aroma of ripe jack fruit, rural people cannot keep it for long time at their home whereas the shelf life of both squash developed from only ripe jack fruit (T.O.I) and developed from ripe jack fruit blended with ripe mango(T.O.II) was upto four month. As per the study conducted by Kumar and Deen (2018) [13]

wood apple squash was safe and suitable for consumption upto 5 month.

Conclusion

Jackfruit is a rich source of several nutrients and is produced in huge amount in Bokaro district but there was no knowledge regarding its value addition and preservation. That's why large amount of jack fruit become wasted in season. There are ample opportunities for value addition and preservation of ripe jack fruit. The present study ad shown that this fruit has got good potential for preservation into simple and easy product with long shelf life like squash. So, it is concluded that jackfruit-based squash could prevent its huge wastage as well as a potential source of rural income generation for the deprived farming communities.

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