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ARTOCARPUS LAKOOCHA : A GOLDEN FRUITS FROM FOREST AREAS OF EASTERN INDIA

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Keywords	Abstract
<i>Artocarpus</i>, TSS, Acidity, Total Sugar, Vitamin A, Vitamin C	<i>Artocarpus lakoocha</i> L., sometimes known as barhar, is a small fruit that is commonly used medicinally and cultivated in subtropical areas throughout India. Fruits of <i>Artocarpus lakoocha</i> were obtained from various eastern Indian states, including Jharkhand, West Bengal, and Bihar. The results showed that the TSS of this fruit ranged from 22.0 to 26.50B. Total sugar levels ranged from 9.09% to 10.87%. The fruit had 26.70 to 42.44 mg of vitamin A and 41.76 to 54.72 mg of vitamin C per 100g of pulp. Plants cultivated in basic soils (pH 7.0-7.4) have greater Vitamin C and TSS levels than those grown in acidic soils (pH 5.0-6.5). Based on the findings of this study, it may be concluded that <i>Artocarpus lakoocha</i> was a nutrient-rich sub-acidic fruit with traits that promote human immune system, growth and development, as well as some horticultural fruit quality attributes.

1. Introduction

Artocarpus lakoocha Roxb, belongs to the family *Moraceae* and it is a tropical tree species native to India and other countries of south east Asia. It is grown widely in the forest areas. The fruit matures during June and July. People of rural India consumed this ripe and firm mature fruits that were sun dried



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and sold as a souring agent in culinary preparations and is believed to lower blood lipid, liver coolant and reduce inflammation. Photochemical screening reveals the presence of sterols, terpenoids, flavonoids and phenolic compounds in *Artocarpus spp.* Results of the antioxidant activity of the *Artocarpus* extract was compared with ascorbic acid and vitamin E by two methods, namely ferric ion reduction and phosphomolybdate reduction. It is fair source of 1.94 ± 0.78 mg/gm of extract was equivalent with 2.56 ± 0.34 mg/gm Ascorbic acid and 9.64 ± 1.04 mg/gm of extract was equivalent with 0.67 ± 0.05 mg/gm Vitamin E (Tarbiat, 2018). The extract showed anti-oxidative properties and free radical scavenging activities as well as inhibited enzymes involved in fatty acid synthesis and pro-inflammatory enzymes. The extract also inhibited oxidation of HDL and LDL in vitro and showed anticoagulant activity. The bioactive phytochemical (s) in *A. lakoocha* extract need to be identified, to be able to establish a mechanism of hyper-lipidemia. According to Jahan et al., 2011), *A. lakoocha* is a very important minor fruit plant from the forest areas of north eastern India and rich in vitamin C, β -carotene. It is a fair source of micronutrients like zinc, manganese, copper and iron. Suwannalert et al., 2012) mentioned that a bio-compound Phyto-oxy-resveratrol (POV) at a concentration of 25 μ g/ml has been found to be non-toxic and having anti-ageing properties. In a different work, Krishnamurthy and Sarala (2013) have reported presence of various alkaloids, phenols, flavonoids, tannins and steroids in lakoocha. Hence, lakoocha is a very important species from a pharmacological point of view also and might prove to be a source of novel drugs in the future. Therefore, it can play a crucial role in alleviation of malnutrition arising due to deficiency of vitamins and micronutrients. Anti-inflammatory, antiviral, anticancer and anti-HIV properties have also been reported by (Kirtikar and Basu, 2007). The intestinal absorption of iron is greatly increased by adequate Vitamin C. Vitamin C is present in most fresh fruits and vegetables (Dunne, 1990). It has been established that oxidative stress is among the major causative factors in the induction of many chronic and degenerative diseases including atherosclerosis, ischemic heart disease, ageing, diabetes mellitus, cancer, neuro degenerative diseases, immune suppression and others. (Squadriato and Pelora 1998; Shahidi and Wansundhara 1992) Vitamin C is essential for humans because it has several critical functions as an enzyme Co factor; Vitamin C is involved with collagen synthesis, carnitine synthesis, converting dopamine to noradrenalin and cholesterol metabolism. Vitamin C is a potent electron donor and reducing agent and also acts as water soluble antioxidant; Vitamin C helps to maintain DNA, proteins, lipids, enzymes and other antioxidants in their normal form. It does this by scavenging oxygen and nitrogen radicals and reducing metal ions. (Carr and Feri, 1999).

2. Materials and Methods

2.1 Collection of Samples

Samples were collected from different parts of Jharkhand (Ranchi) and West Bengal (Purulia) and from Bihar (Darbhanga and Samastipur) for morphological and physico-chemical studies.

2.2 Extraction of Fruit Juice

Ripe fruits of *Artocarpus lakoocha* were procured from different states of Eastm India. The fruits were sorted, washed and ripened by dipping in 250 ppm ethrel solution for 10 min and stored at room temperature for 2-3 days. The ripened fruits were washed, sliced and passed through pulp extractor fitted



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with a stainless steel sieve having a pore diameter of 0.4 mm diameter, to extract pulp, which is then pressed to extract juice.

2.3 Total Soluble Solid (0 Brix)

Total soluble solids in the fruits were determined at room temperature using ATAGO digital refractometer and were expressed in terms of degree Brix (0B). Five fruits per replication were taken from each treatment for enumerating the average value.

2.4 Acidity (%)

Ten ml of juice was taken and volume made up 100 ml with distilled water. Then 10 ml of this solution was taken for the purpose of titration with 0.1 N NaOH as per method described by

$$\text{Titrateable acidity (\%)} = \frac{\text{Titre} \times \text{Normality of alkali} \times \text{equiv. wt. of acid} \times 1000}{\text{Volume of Sample taken} \times \text{weight or Volume of sample}}$$

Ranganna (1996) using phenolphthalein as indicator. Titrateable acidity of *Artocarpus* fruits was calculated by using the following:

2.5 Estimation of Sugars

The reducing sugar and total sugar were estimated by Lane and Eynon method (Rangana, 1996) and expressed in percentage. The extract was taken and titrated against 10 ml of mixed Fehling solution A and B using methylene blue as indicator. The results were expressed as percent of reducing sugar. The sugar extract was hydrolyzed with concentrated hydrochloric acid and titrated against 10 ml of mixed Fehling's solution (5 ml Fehling A + 5 ml Fehling solution B) using methylene blue as indicator. Results were expressed as per cent total sugar. The amount of non-reducing sugar was calculated by subtracting reducing sugars from total sugar and multiplying the difference by factor 0.95 as suggested by **AOAC (1980)**.

2.6 TSS/acidity ratio

It was calculated by dividing the total soluble solids (%) with titrateable acidity(%).

2.7 Vitamin A (mg/100g pulp)

Analysis of β -carotene content in *Artocarpus lakoocha* was carried out using the UV-Vis spectrophotometric method. Extraction of samples was carried out to separate β -carotene compounds from other compounds contained in Barhar. In Local varieties, β -carotene were extracted using a solvent hexane: acetone: ethanol (2:1:1, v/v/v) and stirred using a magnetic stirrer for 30 minutes and filtered using a Buchner funnel. The results of β -carotene analysis obtained by the UV-Vis spectrophotometric method

of *Artocarpus lakoocha* were 11.80 $\mu\text{g/g}$. These results indicate that the highest levels of β -carotene are found in barhar fruits (Putri et al., 2018).



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2.8 Vitamin-C (mg/100g pulp)

Ascorbic acid was determined by 2, 6-Dichlorophenol indophenol titration method, based on the reduction of ascorbic acid by the dye in the pH range of 1–3.5. Ascorbic acid content was estimated by the visual titration method as described by Ranganna (1996). Twenty two mg of sodium bicarbonate and 25 mg of 2,6 dichlorophenolindophenols were added to 100 ml distil water and mix thoroughly. This reagent was kept in an amber colour bottle and stored in freeze and used within a week of its preparation.

$$\text{Ascorbic acid (mg/100gm)} = \frac{\text{Volume made up} \times \text{Dye factor} \times \text{Titre value} \times 100}{\text{Aliquot of extract taken for estimation} \times \text{Volume of sample taken for estimation}}$$

2.9 Statistical Analysis

Data were statistically analyzed following Completely Randomized Design (CRD) and Fisher Protected Least Significance Difference (Fisher-LSD) with four replications.

Table:-1: Physical properties of fruits of *Artocarpus lakoocha*

Sl. No	Fruits collected from	Length (cm)	Breadth (cm)	Weight (g)	Volume (c.c.)	Seed No.	Seed Weight (g)	Pulp Weight (g)*
1	ICAR-RCER, Ranchi,	7.8	7.3	205.00	200.0	91.0	50.0	97.2
2	Purulia, W.B,	7.1	6.6	303.00	280.4	97.0	45.0	172.5
3	ICAR RCER , 2 nd Farm	7.3	7.2	169.00	163.33	90.0	43.0	74.7
4	Darbhangha, (Bela) Bihar.	7.2	7.1	175.0	152.00	50.0	29.0	93.4
5	Samastipur (Pusa) Bihar.	8.0	7.5	223.0	204.00	90.0	40.0	102.9
CRD CD at 5%		0.42	NS	6.32	8.25	4.62	3.38	10.87

*Pulp weight= total weight – seed weight - skin weight –peduncle weight.

***Results were expressed as mean of quadruplicate measurements. Significance at (P<0.05)

3. Results and Discussion

Research conducted at ICAR-RCER, Research Centre Ranchi and Research centre for Makhana, Darbhanga revealed that there were significant variation in fruit morphology and fruit physic-chemical properties of *Artocarpus lakoocha* obtained from different geographical locations of Jharkhand, Bihar and West Bengal. A close perusal of the table-1 reflected that the maximum fruit weight was observed in sample collected from Purulia, West Bengal followed by sample taken of Samastipur (Pusa) Bihar. Similar trends were also found in case of pulp weight. The maximum pulp weight was found in Samples from purulia (180.5 g) followed by Sample from Pusa Bihar(111.9g). Samples collected from Basic soil (pH .7.2) is having less seeds as compared samples collected from Ranchi and West Bengal. Data pertaining



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to table-2 reflected that the highest TSS of the fruits was ranged from 25-26.50B. However, total sugar was found maximum in sample collected from Ranchi HARP Plandu farm (10.00 %). The maximum sugar acid ratio was found in sample collected from Pusa, Samstipur (24.70). *Artocarpus lakoocha* was

very acidic in nature. The maximum acidity of 1.07 % was observed in samples collected from Purulia, West Bengal. The vitamin A and C content of the fruit varied from 26.70 to 42.44 mg/100g pulp and 41.76 to 54.72 mg /100g pulp, respectively. Plants grown in basic soils (pH 7.0-7.4) had higher Vitamin C content and TSS than that grown in acid soils (pH 5.0-6.5). The fruit samples collected from Darbhanga Bihar showed the highest Vitamin A content 42.44 mg/100g pulp whereas Samstipur sample content the maximum vitamin C content of 54.72 mg /100g pulp.

Table-2: Physico-chemical properties of *Artocarpus lakoocha* from eastern India 2014-16

Sl. No.	Fruits collected from	TSS (°B)	Acidity (%)	Reducing Sugar(%)	Non Reducing Sugar (%)	Total Sugar(%)	Sugar: Acid ratio
1	ICAR RCER, Ranchi	22.8	0.98	5.20	3.70	10.00	10.20
2	Purulia, W.B.	22.0	1.07	4.70	3.40	9.09	8.49
3	ICAR RCER 2nd Farm	24.0	0.57	6.10	3.90	10.42	18.28
4	Darbhangha, (Bela) Bihar	25.0	0.48	4.57	3.70	9.62	20.04
5	Samastipur (Pusa) Bihar	26.5	0.44	5.70	4.02	10.87	24.70
CRD CD at 5%		0.62	0.24	NS	NS	0.36	7.52

***Results were expressed as mean of quadruplicate measurements. Significance at ($P < 0.05$)

Table-3: Nutraceuticals content of *Artocarpus lakoocha* collected from Eastern India

Sl. No.	Fruits collected from	Vitamin A (mg/100g)	Vitamin C (mg/100g)
1	ICAR RCER, Ranchi	32.50	43.20
2	Purulia, W.B.	26.70	46.80
3	ICAR RCER, 2nd Farm	29.88	44.64
4	Darbhangha, (Bela) Bihar	42.44	41.76
5	Samastipur (Pusa) Bihar	40.33	54.72
CRD CD at 5 %		2.09	1.57

***Results were expressed as mean of quadruplicate measurements. Significance at ($P < 0.05$)

Table-4: Major soil types in eastern India and *Artocarpus lakoocha* fruit quality



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Sl.No.	Soil Type	Soil Depth(m)	Vit-A (mg/100g)	TSS (⁰ B)	Acidity (%)	Flesh Colour
1.	Acid Soil (pH,5.8-6.5)	1-1.5m	30.11	23.37	2.34	Yellow
2.	Basic Soil (pH,6.5-7.5)	2-2.5m	41.35	25.75	0.86	Orange
Fisher LSD P=0.05			4.28*	1.16*	0.82*	

***Results were expressed as mean of quadruplicate measurements. Significance at ($P < 0.05$).



Figure-1: Pusa Samastipur Collection, Bihar



Figure-2: Colour- Orange Fleshed

4. Conclusions

The lakucha fruit is very nutritious and contains antioxidants like vitamin C and beta-carotene (Vitamin A).. This specific antioxidant aids in the preservation of normal human health, guards against coronary heart disease, and mounts a formidable defence against cancer. Apart from vitamins it contains high TSS and total sugar. It sub-acidic fruits, eaten as raw or inform of pickle or dried powder.

5. Author(s) Contribution

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6. Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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