

RESEARCH PAPER

## Socioeconomic potential of monkey jack: a promising underutilized fruit in Bangladesh

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### ARTICLE HISTORY

Received: July 07, 2016  
Revised : July 30, 2016  
Accepted: August 10, 2016  
Published: August 31, 2016

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### ABSTRACT

Monkey jack is an important fruit species of coastal region of Bangladesh. Survey and collection were undertaken to study the extent of variability and socioeconomic importance of Monkey jack germplasm in diversity rich areas of Patuakhali coastal region. A total of 399 accessions of this important tree species were collected from surveyed regions, of which 15 diverse accessions were selected for morphological characterization showing wide range of variation in agro-morphological traits. During the survey, sizable variability in morphological characters and high socio-economic potential of monkey jack was recorded. Fresh fruits and seed have high nutritional and medicinal value. Tree provides significant livelihood support to local residents as collected fresh fruits from natural populations fetch good price in local markets. Besides livelihood support species, *A. lakoocha* contributes in the nutritional security of the women and children of this area by fulfilling the need of micronutrients specially vitamin C.

**Key words:** Conservation, costal region, diversity, Moraceae, physical traits

### Introduction

*Artocarpus lakoocha* belonging to the family Moraceae, is a socio-economically important underutilized fruit species of costal area in Bangladesh. It is locally known as ‘Dewa’ that is believed to be originated from India. This tree is found as natural wild in the southern or costal part of Bangladesh. It has commercial and medicinal important and is a significant source of livelihood and nutritional support for local population. In Bangladesh, this plant is occasionally cultivated in backyards, homestead gardens. This tree has high commercial value due to its hardness and it also used for piling, centering etc. purposes. The dried aqueous extract prepared from the heartwood of this plant, also known as ‘Puaghaad’, has been traditionally used as an antihelminthic (Mongolsuk et al., 1957). Previous phytochemical investigations of *A. lakoocha* have established the presence of several polyphenolic compounds in the heartwood (Mongolsuk et al., 1957), roots (Puntumchai et al., 2004) and root bark (Sritularak et al., 2010). Several interesting biological studies on this plant have been reported with emphasis on the stilbeneoxyresveratrol as the active principle, including tyrosinase inhibitory activity (Sritularak et al., 1998; Likhitwitayawuid, 2008), antiviral activity against human immunodeficiency virus (HIV), herpes simplex virus (HSV) and varicella-zoster virus (VZV)

(Likhitwitayawuid et al., 2005; Chuanasa et al., 2008; Sasivimolphon et al., 2009; Lipipun et al., 2011), and anti-oxidant and DNA protective effects (Chatsumpun et al., 2011). The tree is generally propagated by seeds. Recently vegetative propagation methods have also been attempted using softwood or hard root stem cutting and grafting. Micropropagation were developed for the production of monkey jack. Due to predominance of seed propagation over a long period of time, it gives immense opportunity to locate elite trees having important horticultural traits. In spite of the fact, that monkey jack can withstand adverse climatic conditions and can be grown in various types of soils; no attempts have been made to improve its varietal wealth. There are no advance cultivars available or selected in this important minor fruit species due to the lack of characterization and evaluation studies. Genetic variability of this fruit species is under threat due to the large scale urbanization, developmental activities and need of agriculture land in marginal and tribal areas especially in the developing costal region. Complementary conservation strategy following in situ and ex situ approaches is the best method for successful long-term conservation of such underutilized tree species. Therefore, this study was taken to understand the socio-economic potential of this fruit.

## Materials and methods

### Survey

Survey and exploration trips were undertaken to diversity-rich areas of Patuakhali Sadar, Kalapara, Dumki, Dasmina, Mirzagong and Galachipa Upazila for the systematic localization of various populations and collection of Monkey jack germplasm from the natural populations. Collection was made on selective sampling strategy and each collection was allotted an accession number (Acc. no.). Acc. numbers were allotted as the first digit of acc. no. indicates the name of Division, second digit indicates District name and then Upazila, Union, Village, and number of plant(s) respectively. Data were collected from three homesteads in each village, three villages in each union, three unions in each upazila. Information about indigenous traditional knowledge regarding the use of various parts, socio-economic value and livelihood contribution of this fruit species was collected from the senior people and women of tribal and local inhabitants of the marginal areas. Information on genetic variability, population structure, market value and support system was gathered during the survey of field, local markets and weekly markets. Information on present status of tree count in a population viz-a-viz past status during last 2–3 decades was obtained to assess the population size of Monkey jack over the years. Discussions were made with the farmers, nursery men and local inhabitants to have their input on the value addition prospects, market support system and policy issues related to conservation and sustainable utilization of this fruit tree species.

### Species richness

Species richness measures the number of species within an area. Monkey jack in the homestead of 189 locations were taken. Data were collected according to

$$\text{Percent Homestead} = \frac{\text{Total no. of homesteads} \times \text{frequency}}{100}$$

### Species diversity

The most common used formula of species calculating species diversity Simpson index (D) suggested by Simpson (1949) was used in this study which was as follows-

$$D = 1 - P_i^2$$

Where,  $P_i$  is the proportional abundance of the  $i^{\text{th}}$  species such that

$$P_i = N_i / N$$

$N_i$  = Fruit population of  $i^{\text{th}}$  species and

$N = N_1 + N_2 + N_3 + \dots + N_n$  where  $n$  is the number of species.

### Morphological characterization

Ten accessions of *A. lakoocha* have been characterized for fruit and seed characters to analyze the existing variability in Monkey jack germplasm. Data of important fruit and seed characters of these accessions were recorded after harvesting in the laboratory. Quantitative data of five fruits and seeds per accession was analyzed for mean, standard error and coefficient of variance using SPSS software.

### Fruiting behavior

#### Fruit shape

The shapes of the fruits were determined by eye estimation and were expressed in language as spheroid and irregular. Randomly selected 120 (3 fruits  $\times$  4 branches  $\times$  10 plants) matured fruits were used to estimate the shape of fruits.

#### Fruit size

The size of fruits were measured from basal to polar by using slide calipers and a total of 12 fully matured fruits were used to determine the length of fruits in centimeter

#### Fruit weight

Fully matured 12 fruits were collected to find out the mean weight and outer measurement of fruits. The weight was taken in gram with the help of (DJ-220A, Japan) balance sensitive to ten grams.

#### Weight of different parts of the fruits

Weight of pulp, seed, rachis and peel were taken separately by a top loaded balance and expressed in gram (g). Weight of edible portion was counted with pulp weight and non-edible portion was counted with seed, rachis and peel.

#### Percentage of edible portion

The percentage of edible (pulp) portion of fruit was calculated by the following formula:

$$\text{Percent of edible portion} = \frac{\text{Weight of edible parts}}{\text{Weight of whole fruit}} \times 100$$

#### Percentage of non-edible portion

The percentage of non-edible (seed, rachis and peel) portion of fruit was calculated by the following formula:

$$\% \text{ of non-edible portion} = \frac{\text{Weight of non-edible parts}}{\text{Weight of whole fruit}} \times 100$$

## Results

### Survey in homestead

Monkey jack, is a medium-sized to large deciduous tree and makes a handsome ornamental. The oblong-acute leaves are 4 to 10 inches long (10 to 20 cm), shiny green on the upper surface. Trees are 10-15 m tall, with brownish gray and deeply furrowed bark; leaves are oblong, 15-20 cm long and 10-15 cm broad, apex, glabrous, dark green, midrib more prominent beneath, monkey jack are 3-6mm thick densely covered with sticky pale brown to yellow velvety hairs. Flowers are tiny yellowish fused into a round flower body. The orange yellow male flowers and greenish female flowers of monkey jack are grown separately on the same tree. The compound fruits are derived from swollen flower heads which are nearly round or irregular in shape. The male flowers are mostly 3.5 cm long and 3.1 cm wide and the female flowers are mostly 1.8 cm long and 1.3 cm wide when fully open. The fruits are developed with spine in the skin. Some people find the odor unpleasant, similar to that of strong cheese, but the pulp has pleasant taste. The main crop of the monkey jack is produced in late summer. Flowering occurs in the month of February–April and fruit setting during May–July

### Survey in Local Market

The fruit is usually eaten fresh, complete with skin, after the hairy covering is rubbed off. Good cultivars are popular. The people in all classes are eaten it in more or less. In ripening stage fruits are available in market. The price of each monkey jack fruit in the local market is 5-20 taka. The market price is higher in first time and lower when available in market. The price of each monkey jack fruit in the Capital market is 25-40 taka.

### Distribution and cultivation

#### Species richness

This species is widely distributed in Patuakhali coastal region of Bangladesh. In Patuakhali District, the highest amount (88.88%) of monkey jack species was observed in Patuakhali Sadar and the lowest (70.37%) in Galachipa (Table 1). Species are widely grown at homestead (Table 2). A total 399 accessions were collected from Patuakhali Sadar, Kalapara, Dumki, Dasmina, Mirzagong and Galachipa Upazila out of which 10 diverse accessions were selected for characterization study (Table 2).

Table 1. Distribution of *Artocarpus lakoocha* in seven upazilas in Patuakhali coastal region

Name of Upazila	Total no. of popln.	% homestead containing species	Diversity of fruit of the homesteads
Dumki	45	77.77	0.64
Patuakhali Sadar	75	88.88	0.906
Mirzagong	61	70.37	0.903
Galachipa	43	70.37	0.576
Kalapara	54	48.14	0.818
Bauphal	47	74.07	0.592
Dasmina	74	81.41	0.846
Total/All	399	73.02	0.799

### Indigenous traditional knowledge

Different parts of *A. lakoocha* is used in different indications as traditional medicines which can be summarized as – the edible fruit pulp is derived to act as tonic and liver. Raw fruits and male flower spikes are utilized in pickles and sauces. The wood of monkey jack is very for outdoors as well as under water. It also used for construction furniture, boat making and cabinet work. Tree bark containing 8.5% tannin is chewed like beetle nut. The wood and roots yield a lavish color dye. Lakoocha seeds and milky latex are purgative. Seeds contain artocarpins, theisolectins which exhibit high haemagglutination activity (Wongkham 1995). However, the agglutinin (ALA) from *Artocarpus lakoocha* is not organ specific. Moreover, the haemagglutination activity of ALA was demonstrated in

various organs of the plant except fruit flesh. Seedling price of fruit is normally fifty taka.

Table 2. *Artocarpus lakoocha* germplasm collected from different places of Patuakhali coastal region

SI. No.	Acc. no.	Localities	Status
1	622111	KalaparaSadar, Kalapara, Patuakhali	Wild
2	621221	Dumki, Patuakhali	Wild
3	624331	Chairmaishadi, Patuakhali	Wild
4	621222	Lebukhali, Dumki, Patuakhali	Wild
5	625441	Kalagachia, Galacipa, Patuakhali	Wild
6	621223	Dumki, Patuakhali	Wild
7	624332	Chairmaishadi, Patuakhali	Wild
8	623551	Mirzagong, Patuakhali	Wild
9	623552	Mirzagong, Patuakhali	Wild
10	621224	PSTU Campus, Dumki, Patuakhali	Wild

### Fruiting behavior

#### Fruit shape

The fruit shape of different monkey jack acc. no. varied. Most of the accessions were spherical shape and rest was irregular. Six acc., viz. 623552, 621222, 621223, 624332, 623551 and 622111 were spherical shape and four acc., viz. 621224, 624331, 625441 and 621221 were irregular shape (Table 3). The size of fruits differed with each other due to different types of genotype and pollination. Due to natural pollination shape of fruits may be irregular in shape (Samad, 2005).

#### Fruit size

Fruit width and length differed significantly among the acc. no. (Table 3). The largest fruit size (8.96 cm x 8.86 cm) was obtained from Acc. No. 624332 followed by No. 621223 (8.58 cm x 8.81 cm) while the smallest fruit from 621222 (5.97 cm x 6.45 cm). The present result compared with the findings of Haque (2001) who studied in Jackfruit.

#### Fruit weight

The highest fruit weight (329.6g) was found in 624332 followed by 299.3g in 621223. Significantly the lowest (217.5 g) fruit weight was recorded in 621222. Fruit weight of 621222 and 624332 was comparatively uniform than other accessions ( $SD \pm 0.18$  and  $SD \pm 0.32$ , respectively) from table 3.

#### Weight of edible and non-edible portion, and their percentage of monkey jack

##### Weight of edible portion (pulp)

It was noticed from the results on the weight of edible portion that the maximum weight of edible portion (200.8g) of monkey jack was obtained from acc. no. 624332 while minimum (121.6g) from 621222 (Table 4).

Table 3. Fruiting behavior of fifteen *Artocarpus lakoocha* germplasm

Acc. No.	Fruit shape	Size of fruit (cm)		Weight of fruit (g)			
		Length x Width		Mean	Range		SD ( $\pm$ )
					Maximum	Minimum	
622111	Spheroid	8.99 x 6.98		258.2	258.89	257.50	0.57
621221	Irregular	6.97 x 6.00		227.3	228.77	226.50	1.05
624331	Irregular	6.93 x 6.37		277.2	231.72	217.80	6.39
621222	Spheroid	5.97 x 6.45		217.5	217.80	217.43	0.18
625441	Irregular	8.03 x 8.93		271.1	272.40	269.73	1.32
621223	Spheroid	8.58 x 8.81		299.3	300.40	297.67	1.23
624332	Spheroid	8.96 x 8.86		329.6	329.97	329.20	0.32
623551	Spheroid	7.18 x 6.53		240.5	242.10	238.70	1.40
623552	Spheroid	7.68 x 7.60		247.2	249.10	245.70	1.42
621224	Irregular	7.25 x 6.05		229.3	231.20	227.60	1.53
LSD <sub>(0.05)</sub>	-	0.28	0.23	2.67	-	-	-
CV(%)	-	3.84	3.41	1.10	-	-	-

#### Weight of non-edible portion (peel, seed and rachis)

It was noticed from the results on the weight of non-edible portion that the maximum weight of non-edible portion (128.81g) of monkey jack was obtained from acc. no.624332 while minimum (95.9g) from 621222 (Table 4).

#### Morphological characterization

*A. lakoocha* of collected from different regions showed wide genetic variability in most of the quantitative characters of fruits and seeds. Significantly high coefficient of variation (CV) was observed in the pulp weight and fruit width, indicating that wide variation exists in the *A. lakoocha* germplasm for these traits. Accessions, i.e. Acc. no. 624332, 621223, 624331, 625441 and 622111 were identified as superior genotypes based on both the qualitative and quantitative traits, which may be utilized for crop improvement and breeding programmes. Among these acc. no. most of the superior genotype is acc. no. 624332. This plant produce delicious, large size monkey jack. The largest fruit size is recorded as 329.6 gm. weight during harvesting and its length is 8.96 cm, width is 8.86cm, peel weight 28.29 gm. and pulp weight is 200.8 gm. As this species is predominantly cross pollinated, seed conservation only ensures the gene pool conservation due to the heterozygous nature of seeds. Most of the portion of pulp is edible due to sweet in taste. Its pulp color is orange yellow, medium pleasant aroma, sweetness is medium acidic and juicy, soft texture. From the study, it can be said that this genotype is best among all of these accessions.

#### Discussion

*Artocarpus lakoocha* is an important minor fruit crop, having high horticulture potential due to the importance of fruits among the local people and also in the urban folks still having connect with the villages. Attractive velvety orange skin fruit color, high pulp content which is soft and acidic in taste and high nutritive value makes

this underutilized fruit as most promising for the main stream horticulture. Monkey jack is found to grow in natural wild conditions and mainly propagated through seeds. Presently only wild seedling populations are existing in natural habitats. Grafting is being attempted for vegetative propagation of monkey jack germplasm. This species plays significant role in the sustainable livelihood for tribal and local people as its fruits and timber. Fresh fruits and timbers are collected from natural wild populations. Major drawback in such fruits is the highly perishable nature of fresh fruits, absence of background support system with no processing facilities, low market reach. Fresh fruits harvested from the trees are to be consumed or marketed within 3-4 days of harvesting. Therefore, the harvested fruits are either consumed by the family members, relatives or friends in the village itself or sold to the market at very nominal cost. Systematic survey to the diversity rich areas in the coastal population of different areas of Patuakhali coastal regions observed high socio-economic potential of this species. Harvesting of fruits from the natural wild populations at large scale could be one of the main reasons for poor regeneration in the natural habitat. In the surveyed areas, no commercial or organized cultivation of this fruit species was observed, however, few trees were found to exist occasionally under semi-domesticated form.

#### Acknowledgements

The financial support of the Higher Education Quality Enhancement Project of Bangladesh (CP3521) is greatly acknowledged.

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