

# Characterization of different germplasm of jackfruit

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**Abstract:** The study was carried out at the Bangladesh Agricultural University Germplasm Centre and the laboratories of the Department of Horticulture, Bangladesh Agricultural University, Mymensingh during March to August, 2014 to evaluate the physical and chemical properties of thirty six jackfruit accessions and to find out better quality jackfruit germplasm following randomized complete block design (RCBD) with three replications. Mature jackfruits were used as experimental material. Fruit characteristics such as weight of fruits, bulbs, seeds, rind and rachis; shape, type, eating quality, weight of edible and non-edible portion; fruit attractiveness, sweetness, flavor, juiciness, color, fibrousness, total soluble solids, total sugar of pulp, titratable acidity, moisture and dry matter content, leaf size, sex ratio, shape and vivipary of seed were studied. Data were analyzed to determine the significant difference among the accessions in respect of characters mentioned above. The results of the study indicated that the accession no. 85, 86, 88, 196(50), 80(68) were superior to others while accession no. 63(3), 204(57), 74, 71(19) were inferior in respect of the physical characteristics studied. Chemical characteristics such as total sugar, reducing sugar, non-reducing sugar and total soluble solids varied significantly among the accessions. Considering TSS and total sugar, the prominent accessions were 85, 196(50), 80(68). The studied accessions were classified into Khaja, Ghila and Dorasa. In respect of all characteristics investigated, the promising accession were 85, 196(50) and 80(68) and amongst them the Ghila contained the highest edible portion (63.22%) and the lowest was in Khaja (32.56%). However, the germplasm No. 85(Ghila) was found to be the best in relation to the important physical, chemical and nutritional parameters investigated. This variation might be due to genetic differences and climatic conditions.

**Key words:** Jackfruit, *Artocarpus heterophyllus* L., characters, Biochemical, Accession.

## Introduction

Jackfruit (*Artocarpus heterophyllus* L.) is the national fruit of Bangladesh. It is one of the important and popular fruits in Bangladesh (Haque, 1977). Jackfruit is considered to be the largest fruit in the world (Naik, 1949; Sturrock, 1959). In Bangladesh, it ranks second in production and third in area among the fruits. It is a member of the family Moraceae. The family comprises of 55-67 genera and 900-1000 species (Bally, 1949). The genus *Artocarpus* contains eight species which bear edible fruits.

Jackfruit originated from the western Ghats of India (Samaddar, 1990) and then spread to Malaysia and East Africa (Dutton, 1976). At present it is cultivated in Bangladesh, India, Burma, Southern China and to a limited extent in Queensland (Australia) and Mauritius (Morton, 1965). Jackfruit is cultivated in Bangladesh from time immemorial and it is distributed throughout the country. The jackfruit grows well in Dhaka, Mymensingh, Rangpur and Jessore regions of the country. Bhaluka, a place in Mymensingh is famous for jackfruit production and marketing in Bangladesh. The production of jackfruit in Bangladesh was 2,67,495 tons, from an area of 66,765 hectares (BBS, 2012).

Jackfruit is considered as a multipurpose fruit tree because each and every part of it is utilized. Pulp of the fruit is eaten fresh and tender fruit is also used as a popular vegetable. Ripe fruit also can be used as sugar syrup, jam, beverage, candies, leather and other hydrated form in industry like chips (Rahim and Alamgir, 2011). Bulb of young fruit contains 11.9% protein (dry), 58% carbohydrate (dry), 4.7% minerals (total) and 0.014% vitamin-C where as the ripe fruit contains 4.8% protein (dry), 82.5% carbohydrate (dry), 82.4% sugar (total) and 3.5% minerals (total) vitamin C and A (Azad and Haq, 1999). The fruit also contain 250-1740 µg carotene per 100 g pulp (Hossain and Haque, 1979)

Jackfruit seed is also an important part of the fruit. Raw seeds are used as a vegetable in Bangladesh. It also helps in digestion after heavy eating of jackfruit pulp (Kamaluddin, 1966). Roasted seeds are very tasty. Now a day it is an important part of the homestead agroforestry

program in Bangladesh (Haque, 1994). Rahman *et al.* (1994) studied on physio-chemical characteristics of three types of jackfruit under three storage conditions. Hassan *et al.* (1994) also studied on physio-chemical changes of jackfruit during ripening. Although, jackfruit is the national fruit, unfortunately it has few recommended varieties in Bangladesh (FTIP, 2012 report). Samaddar (1990) reported that there is no recommended variety of jackfruit for production, there are many types of jackfruit available in local name and originated as cultivars but high yielding and good quality varieties are rarely found for cultivation.

Haque (1993) reported that three types of jackfruit in Bangladesh namely the “Khaja” with a firm and crispy pulp, “Gala” with soft and juicy pulp and “Dorasa” with pulp intermediate in texture between the two. Being cross-pollinated and mostly seed propagated, the fruit has innumerable types or forms in terms of fruit characteristics, density of spines on the rind, bearing habit, size, shape, quality of fruit and period of maturity (Kamaluddin, 1966).

The jackfruit is a seasonal fruit and is available from May-July. In Bangladesh there exists many types of jackfruits. Kamaluddin (1966) and Samadder (1990) identified two types of jackfruit in Bangladesh namely, Khaja with a firm and crispy pulp and Ghila with soft and juicy pulp. Haque (1993) identified three types of jackfruit such as Khaja, Ghila and Dorosa. The bulb of Dorosa is medium soft to soft, juicy and fairly sweet.

Considering above facts an attempt has been made to study the possibility of selecting variety through characterization of some jackfruit accessions.

## Materials and Methods

These experiments were conducted at the BAU-GPC of Fruit Tree Improvement Project (FTIP) of the Department of Horticulture, Bangladesh Agricultural University, Mymensingh from March, 2014 to August, 2014. Biochemical analysis was done in the department of Biochemistry & Molecular biology, BAU, Mymensingh. The experimental area was under the subtropical climate, characterized by heavy rainfall, high temperature, long

day and low sunshine period during the months from April to September and scanty rainfall, low humidity, low temperature, short day and bright sunshine during October to March.

**Materials:** Thirty six accessions of jackfruit labeled as 59(1), 61(2), 62(2), 63(3), 67(10), 69(27), 70(19), 71(19), 76(26), 80(68), 82(68), 84(2), 89(11), 92(14), 93(15), 165(73), 184(18), 185(18), 187(32), 189(38), 190(42), 194(43), 196(50), 204(57), 206(56), 67, 71, 73(BAU), 74, 77, 78, 80, 85, 86, 88, 90 were used as treatments in the study. There was one plant in each treatment.

**Characterization of accession:** Different fruits ripe in different days. Different characters were selected from ripened fruits. Organoleptic test was also conducted in the laboratory of the Department of Horticulture, BAU, Mymensingh by the teachers and postgraduate students of this department.

**Physical characters:** Weight of fruit, Fruit size, Leaf size, Number of bulbs per fruit, Weight of different parts of the fruits, Percent edible portion and non-edible, Fruit type, Fruit shape, Fruit eating quality, Fruit attractiveness, Fruit attractiveness, pulp characteristics, seed characters. flavor, sweetness, juiciness, color, fibrousness, seed characteristics, seed shape, vivipary were measured.

**Table 1.** Leaf characteristics and sex ratio of different jackfruit accessions

Ac. no.	Leaf length with petiole (cm)	Leaf length without petiole (cm)	Leaf width (cm)	No. of male flowers	No. of female flowers	Sex ratio (male: female)
59(1)	16.53	14.80	8.10	40.00	3.00	13.3: 1
61(2)	11.43	10.20	5.37	32.00	5.00	6.4: 1
62(2)	13.83	11.93	6.77	30.00	5.00	6.0: 1
63(3)	17.83	15.60	8.07	15.00	4.00	3.75: 1
67(10)	13.23	11.90	5.77	20.00	3.00	6.7: 1
69(27)	14.10	12.03	6.53	3.00	1.00	3.0: 1
70(19)	15.30	13.70	6.77	30.00	4.00	7.5: 1
71(19)	13.60	11.67	6.03	15.00	1.00	15.0: 1
76(26)	18.00	16.27	8.30	17.00	2.00	8.5: 1
80(68)	16.23	14.40	8.23	42.00	8.00	5.3: 1
82(68)	22.30	19.53	10.03	12.00	1.00	12.0: 1
84(2)	14.83	13.40	6.63	15.00	3.00	5.0: 1
89(11)	14.70	13.37	7.10	60.00	12.00	5.0: 1
92(14)	17.63	14.93	7.83	30.00	8.00	3.75: 1
93(15)	14.80	12.73	7.10	20.00	6.00	3.3: 1
165(73)	8.83	8.00	4.60	3.00	1.00	3.0: 1
184(18)	18.27	16.33	9.43	21.00	7.00	3.0: 1
185(18)	12.53	11.07	7.28	31.00	2.00	15.5: 1
187(32)	14.63	13.00	5.93	14.00	1.00	14.0: 1
189(38)	10.37	9.50	5.63	37.00	3.00	12.3: 1
190(42)	14.07	11.90	8.40	40.00	2.00	20.0: 1
194(43)	14.87	13.10	6.90	35.00	3.00	11.7: 1
196(50)	14.10	12.35	7.25	20.00	2.00	10.0: 1
204(57)	12.43	10.97	7.20	4.00	1.00	4.0: 1
206(56)	13.73	11.80	8.87	12.00	8.00	1.5: 1
67	13.9	12.00	7.07	20.00	4.00	5.0: 1
71	10.63	9.57	5.77	495.00	33.00	15: 1
73 (BAU)	13.50	12.37	6.07	45.00	16.00	2.8: 1
74	13.70	12.27	6.63	42.00	13.00	3.2: 1
77	13.13	11.53	6.60	15.00	2.00	7.5: 1
78	15.83	14.37	7.62	28.00	6.00	4.7: 1
80	10.90	9.58	6.9	85.00	21.00	4.05: 1
85	11.77	10.50	6.57	20.00	4.00	5.0: 1
86	12.70	11.43	5.63	8.00	2.00	4.0: 1
88	17.57	15.80	7.80	21.00	2.00	10.5: 1
90	10.77	10.13	5.90	10.00	1.00	10.0: 1
LSD <sub>0.01</sub>	1.303	1.276	0.611	1.982	1.316	0.607
Level of sign.	**	**	**	**	**	**

\*\* =Significant at 1% level of probability, LSD=Least Significant Difference

**Leaf size:** Leaf length with petiole was maximum (22.30 cm) in accession no. 82(68) and minimum (8.83 cm) in accession no. 165(73). Highest petiole length (2.77 cm) was found in accession no. 82(68) while lowest (0.83 cm) in accession no. 165(73). Leaf length without petiole was maximum (19.53 cm) in accession no.82 (68) and minimum (8.00 cm) in accession no. 165(73). Maximum leaf width (10.03 cm) was observed in accession no. 82(68) and minimum (4.60 cm) in accession no. 165(73) (Table 1). Ullah (2005) reported that petiole length ranged

**Chemical characters:** Moisture content, Dry matter content, Total soluble solids (% Brix), Titratable acidity, Total sugar content of jackfruit pulp, Reducing sugar of jackfruit pulp, Non reducing sugar were measured.

**Statistical analysis:** The recorded data on different parameters of the study were analyzed statistically using MSTAT computer package program. The means for all the treatments were calculated and analyses of variances (ANOVA) for all the parameters were performed by (F) variance test. The significance of difference between the pair of means was compared by least significant difference (LSD) test at the 1% and 5% levels of probability.

### Results and Discussion

These experiments were conducted to study the physico-chemicals characteristics of thirty six accessions of jackfruit. The results of the present study on characterization of jackfruit germplasm have been presented separately under the following heads.

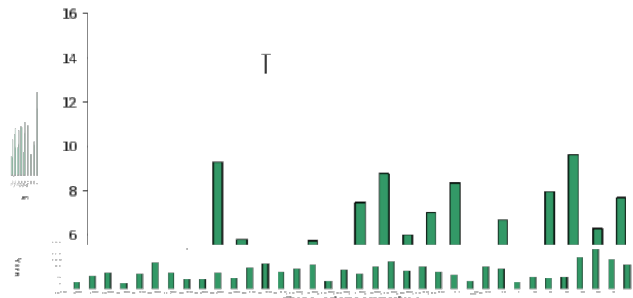
#### Physical characters:

The results of these experiments have been presented under the following heads.

from 1.1 cm to 2.00 cm that was more or similar with present study.

**Sex ratio:** Maximum sex ratio (20.0: 1) was found in accession no. 190(42) and minimum sex ratio (1.5: 1) in accession no. 206(56) (Table 1). Mannan (1988) reported that sex ratio of jackfruit ranged from 21:1 to 32.7:1. Srivastava (1961) stated that the ratio of male and female spike varied from 3.2: 1 to 4.5: 1. From the above discussion, it was found that the sex ratio varied among accessions.

**Fruit weight:** It was found that the maximum fruit weight (13.62 kg) was in accession no. 85 while, it was minimum (2.15 kg) in accession no 63(3) (Fig.1). These results are closed to that of Haque (1977), who reported that the individual fruit weight ranged from 3.5 to 12.6 kg. The present results are also close to the findings of Azad (1998) who reported that the fruits were larger (7.1 kg) while those were smaller (4.6 kg).



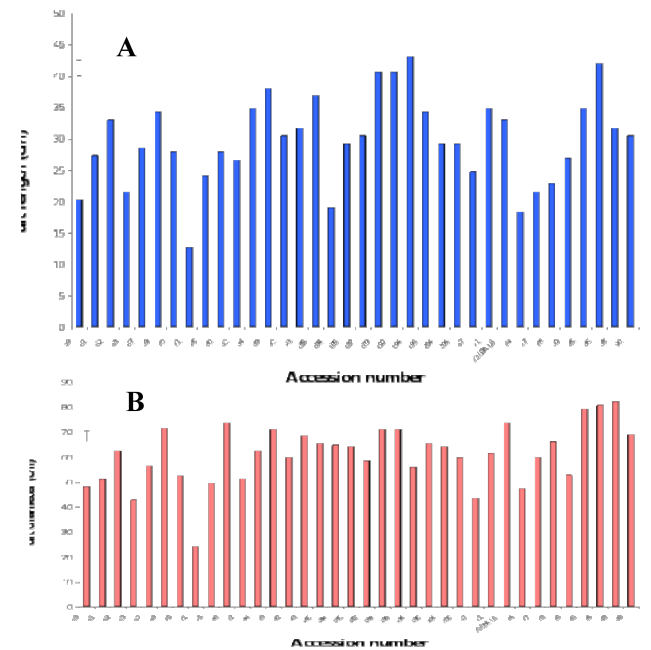
**Fig. 1.** Individual fruit weight of jackfruit accession. The vertical bar represents LSD at 1% level of significance.

**Fruit size:** Fruit size includes fruit length and fruit diameter. The longest fruit (43.18 cm) was found in accession no. 194(43) and the shortest fruit (12.70 cm) was found in accession no. 71(19) (Fig.2). The maximum diameter (82.08 cm) was found in accession no. 88 and minimum diameter (24.13 cm) was obtained from accession no. 71(19) (Fig 2). The present results are in agreement with that of the findings of Bhatia *et al.* (1955) and Mowry *et al.* (1953) who reported that the jackfruits could be 20.32 to 91.44 cm long and 15.24 to 50.80 cm wide. Hossain and Haque (1977) stated that the mean length and diameter of jackfruits were 31.6 and 22.4 cm.

**Table 2.** Quantitative characters of jackfruit accessions

Ac. No.	No. of fruits	Wt. of edible portion (kg)	Wt. of rachis/fruit (kg)	Wt. of rind/ fruit (kg)	Wt. of non-edible portion (kg)	% edible part	% non edible part
59(1)	3.00	0.96	0.21	1.61	1.82	34.53	65.47
61(2)	4.00	2.51	0.25	1.75	2.00	55.65	44.35
62(2)	5.00	2.75	0.34	2.43	2.77	49.82	50.18
63(3)	2.00	0.70	0.10	1.35	1.45	32.56	67.44
67(10)	2.00	2.92	0.25	2.02	2.27	56.26	43.74
69(27)	1.00	5.26	0.54	3.50	4.04	56.56	43.44
70(19)	4.00	3.59	0.29	1.88	2.17	62.61	37.39
71(19)	1.00	1.52	0.30	1.59	1.89	44.57	55.43
76(26)	2.00	1.43	0.37	1.68	2.05	41.09	58.91
80(68)	6.00	2.87	0.73	2.15	2.88	49.91	50.09
82(68)	1.00	1.91	0.17	1.73	1.90	50.13	49.87
84(2)	3.00	4.23	0.42	2.72	3.14	57.39	42.61
89(11)	11.00	4.39	0.86	3.52	4.38	50.06	49.94
92(14)	8.00	3.46	0.32	2.23	2.55	57.57	42.43
93(15)	6.00	3.69	0.63	2.67	3.3	52.79	47.21
165(73)	1.00	4.60	0.67	3.05	3.72	55.29	44.71
184(18)	5.00	1.62	0.15	1.58	1.73	48.36	51.64
185(18)	2.00	3.46	0.32	2.90	3.22	51.80	48.20
187(32)	1.00	1.71	0.67	2.83	3.5	32.82	67.18
189(38)	3.00	3.51	0.92	3.50	4.42	44.26	55.74
190(42)	2.00	4.62	0.81	4.17	4.98	48.13	51.88
194(43)	3.00	2.80	0.91	2.47	3.38	45.31	54.69
196(50)	1.00	4.12	0.64	2.89	3.53	53.86	46.14
204(57)	1.00	3.55	0.25	2.31	2.56	58.10	41.90
206(56)	4.00	2.35	0.58	2.11	2.69	46.63	53.37
67	4.00	1.34	0.28	1.12	1.40	48.91	51.09
71	33.00	3.65	0.59	2.75	3.34	52.22	47.78
73 (BAU)	12.00	3.72	0.71	2.51	3.22	53.60	46.40
74	12.00	1.40	0.14	0.94	1.08	56.45	43.55
77	2.00	2.27	0.89	1.07	1.957	59.55	40.40
78	6.00	1.83	0.78	1.14	1.921	48.80	51.20
80	21.00	2.16	0.27	2.07	2.34	48.00	52.00
85	2.00	8.61	0.89	4.12	5.01	63.22	36.78
86	1.00	6.54	0.72	3.66	4.38	59.89	40.11
88	1.00	6.25	0.89	3.21	4.1	60.39	39.61
90	1.00	4.70	0.63	2.98	3.61	56.56	43.44
LSD <sub>0.01</sub>	0.736	0.563	0.068	0.507	0.374	1.47	2.08
Level of sign.	**	**	**	**	**	**	**

**Weight of fruit rachis:** Maximum weight of rachis (0.92 kg) was observed in accession no. 189(38) while minimum (0.10kg) was in accession no. 63(3) (Table 1).



**Fig. 2.** Leaf length(A) and Leaf width (B) of jackfruit accessions. The vertical bar represents LSD at 1% level of significance.

Present results do not agree with the findings of Nazrul *et al.* (2004) who reported that the highest weight (0.32 kg) of rachis was recorded from fruits and the lowest (0.28 kg) was in some fruits.

**Weight of fruit rind:** The rind weight of jackfruit was also influenced significantly by different accessions. Maximum weight of rind (4.17 kg) was found in accession no. 190(42) while minimum (0.94kg) in accession no. 74 (Table 2).

**Number of fruits per plant:** The number of fruits per plant ranged from 1 to 33. Maximum number of fruit was found in accession No. 71 while minimum was in 204(57).

**Number of bulbs per fruit:** The number of bulbs per fruit ranged from 2 to 250. Maximum number of bulbs was found in accession No. 85 while minimum was in 71(19). Haque (1992) found that minimum and maximum number of bulbs per fruit 79 and 126. Present results do not agree with the findings.

**Weight of edible portion:** It was noticed that the maximum weight of edible portion (8.61kg) of jackfruit was obtained from accession No. 85 while minimum (0.70kg) was from Accession No. 63(3) (Table 2). Edible portion consists of pulp and seed. Present results agree with the findings of Haque (2001) who reported greater weight of edible portion (8.30 kg) and minimum (1.1 kg).

**Weight of non-edible portion:** The maximum weight of non-edible portion (5.01 kg) was found in accession No 85 followed by No. 190(42) (4.98kg) and the minimum weight (1.08 kg) was noted in accession no. 74 (Table 2). Haque (2001) found the maximum and minimum weight of non-edible portion 8.7 kg and 1.3 kg respectively. This findings more or less support the results of the present study.

**Percentage of edible portion:** The maximum edible portion (63.22%) was found in the accession No. 85 followed by accession no. 70(19) (62.61%) while the minimum (32.56%) was observed in accession no. 63(3) (Table 2). Present results agree with the findings of Haque (2001) who reported edible percentage to be from 29.17 to 60.0%.

**Percentage of non-edible portion:** The highest non-edible portion (67.44%) was found in the accession No. 63(3) and the lowest (36.78%) was found in accession no. 85 followed by accession no. 70(19) (37.39%) (Table 2). Haque (2001) found the percentage of non edible portion was 40.0% to 70.83%. This findings more or less support the results of the present study.

**Fruit type:** Thirty six accessions were classified into three types, namely Khaja, Ghila and Dorasa. Fourteen accessions were classified as Ghila, Fifteen accessions were classified as Dorasa; and seven accessions were classified as Khaja (Table 3). Khaja crispy, Ghila soft and Dorasa is intermediate in textured.

**Fruit shape:** On the basis of fruit shape, the fruits of different germplasm were classified into different categories such as oblong, clavate, spheroid, elongate etc. Most of the fruits (nineteen accessions) were oblong in shape while seven were clavate, four were spheroid and six were elongate (Table 3). Dutta (1956) reported that shape of fruit ranged from ovate-oblong, obovate, oval, irregular, verciform and spherical while Acedo (1992) observed oval, oblong, ellipsoid shaped fruit.

**Fruit eating quality:** Eating quality of the germplasm was divided into four categories such as excellent, good, fair and poor. Fruits of twenty two accessions were found

good in quality, excellent in one accession and fair was found in twelve accessions, poor was in one accession (Table 3). In the category excellent, the fruit had the highest total soluble solids (30 %) and total sugars (19.30%) compared to other.

**Fruit attractiveness:** Fruit attractiveness was measured visually and categorized as excellent, good, intermediate, fair and poor. The judgment of attractiveness occurred on the basis of shape, size, color and spine structure of fruit. Most of the fruits (16 out of 36) were good in terms of attractiveness, intermediate in ten accessions (10 out of 36), fair in seven and poor in one accession (Table 3).

**Table 3.** Fruit characteristics of collected jackfruit accessions

Accession No.	Fruit type	Shape	Edible quality	Attractiveness
59(1)	Ghila	Oblong	Fair	Fair
61(2)	Dorasa	Oblong	Good	Fair
62(2)	Ghila	Clavate	Fair	Good
63(3)	Khaja	Oblong	Good	Fair
67(10)	Ghila	Oblong	Good	Good
69(27)	Dorasa	Spheroid	Good	Poor
70(19)	Ghila	Oblong	Good	Good
71(19)	Ghila	Oblong	Good	Good
76(26)	Dorasa	Oblong	Fair	Good
80(68)	Ghila	Oblong	Good	Intermediate
82(68)	Dorasa	Clavate	Good	Good
84(2)	Dorasa	Oblong	Fair	Intermediate
89(11)	Khaja	Spheroid	Good	Good
92(14)	Ghila	Oblong	Fair	Good
93(15)	Dorasa	Elongate	Fair	Intermediate
165(73)	Ghila	Clavate	Fair	Good
184(18)	Khaja	Clavate	Good	Intermediate
185(18)	Ghila	Oblong	Fair	Intermediate
187(32)	Khaja	Elongate	Good	Good
189(38)	Dorasa	Oblong	Good	Intermediate
190(42)	Khaja	Oblong	Good	Fair
194(43)	Ghila	Elongate	Good	Good
196(50)	Ghila	Clavate	Fair	Intermediate
204(57)	Ghila	Oblong	Poor	Good
206(56)	Khaja	Oblong	Good	Good
67	Dorasa	Elongate	Fair	Fair
71	Dorasa	Clavate	Good	Intermediate
73 (BAU)	Dorasa	Oblong	Fair	Good
74	Dorasa	Oblong	Good	Intermediate
77	Dorasa	Spheroid	Good	Good
78	Dorasa	Spheroid	Good	Intermediate
80	Dorasa	Oblong	Good	Good
85	Ghila	Clavate	Excellent	Fair
86	Khaja	Elongate	Good	Good
88	Dorasa	Oblong	Good	Good
90	Khaja	Elongate	Fair	Fair

#### Pulp characteristics

**Flavor:** Pulp flavor was categorized as mild, strong and very strong. Most of the fruits were found mild in flavor in 23 accessions, strong in 8 accessions and very strong in flavor was found in 5 accessions (Table 4).

**Sweetness:** Perhaps, sweetness is the most important factor that makes jackfruit valuable to human consumption. It was justified on the basis of Less sweet, sweet and very sweet. Fruits of eight accessions were found very sweet. Most of the fruits were found sweet in taste in nineteen accessions while less sweet was found in nine accessions (Table 4).

**Juiciness:** Juiciness differed in different accessions as less juicy, juicy and very juicy. Very juicy was found in only seven accessions. Juicy type pulp was found in thirteen accessions, less juicy was found in sixteen accessions (Table 4).

**Color:** Pulp color was categorized as deep yellow, yellow and light yellow. Most of the fruits of pulp color were found light yellow in fifteen accessions, deep yellow color in eight accessions and yellow in thirteen accessions (Table 4). Haque (1992) studied on twelve germplasm and found light yellow color in eight germplasm, yellow in two and light yellow color in two germplasm.

**Fibrousness:** Fibrousness was measured as low, medium and high. Medium fiber content was found in sixteen accessions, high fiber content in seven accessions and thirteen accessions were found in lower fiber content (Table 4).

**Seed shape:** Various shaped seeds were found such as elongate, oblong, spherical etc. Elongate shaped seeds were found in six accessions, oblong shape in fifteen

accessions and spherical shape seeds were found in fifteen accessions (Table 4).

**Vivipary:** Viviparous seeds were present in thirteen accessions that was 36.11%. On the other hand, viviparous seeds were absent in twenty three accessions. Azad (1989) reported that jackfruit plants produced fruit having 46.50% viviparous seed.

**Table 4.** Qualitative characteristics of Pulp and seed of jackfruit accessions

Accession no.	Flavor	pulp			seed		
		Sweet ness	Juiciness	Color	Fibrous ness	Shape	Vivipary
59(1)	Mild	Sweet	Less juicy	Yellow	Low	Spherical	Absent
61(2)	Strong	Less sweet	Less juicy	Light yellow	Low	Elongate	Present
62(2)	Strong	Very sweet	Juicy	Yellow	High	Oblong	Absent
63(3)	Mild	Less sweet	Less juicy	Deep yellow	Medium	Spherical	Absent
67(10)	Strong	Sweet	Juicy	Light yellow	Medium	Spherical	Absent
69(27)	Mild	Sweet	Less juicy	Deep yellow	Low	Oblong	Absent
70(19)	Mild	Sweet	Less juicy	Light yellow	Medium	Oblong	Absent
71(19)	Mild	Sweet	Less juicy	Light yellow	Low	Spherical	Present
76(26)	Mild	Sweet	Less juicy	Light yellow	Medium	Spherical	Present
80(68)	Very strong	Very sweet	Very juicy	Light yellow	High	Elongate	Present
82(68)	Mild	Sweet	Juicy	Yellow	Medium	Spherical	Present
84(2)	Strong	Sweet	Juicy	Deep yellow	Medium	Elongate	Absent
89(11)	Mild	Sweet	Less juicy	Deep yellow	Low	Spherical	Absent
92(14)	Very strong	Very sweet	Very juicy	Light yellow	High	Oblong	Absent
93(15)	Mild	Sweet	Less juicy	Light yellow	High	Spherical	Present
165(73)	Mild	Very sweet	Less juicy	Light yellow	High	Oblong	present
184(18)	Mild	Less sweet	Juicy	Light yellow	Medium	Spherical	Absent
185(18)	Mild	Very sweet	Very juicy	Yellow	High	Oblong	Present
187(32)	Mild	Less sweet	Less juicy	Yellow	Low	Spherical	Absent
189(38)	Mild	Sweet	Less juicy	Light yellow	Low	Oblong	present
190(42)	Mild	Less sweet	Juicy	Yellow	Medium	Spherical	Absent
194(43)	Strong	Sweet	Very juicy	Yellow	Medium	Spherical	Absent
196(50)	Very strong	Very sweet	Very juicy	Deep yellow	Low	Oblong	Present
204(57)	Very strong	Less sweet	Less juicy	Light yellow	Medium	Oblong	Absent
206(56)	Mild	Less sweet	Juicy	Light yellow	Low	Elongate	Absent
67	Strong	Sweet	Juicy	Yellow	Low	Oblong	Absent
71	Mild	Sweet	Very juicy	Yellow	Medium	Oblong	Absent
73 (BAU)	Mild	Sweet	Juicy	Deep yellow	Medium	Spherical	Present
74	Mild	Sweet	Juicy	Deep yellow	Low	Oblong	Absent
77	Mild	Less sweet	Less juicy	Deep yellow	Medium	Elongate	Absent
78	Strong	Very sweet	Juicy	Light yellow	Medium	Oblong	Present
80	Strong	Sweet	Very juicy	Yellow	High	Spherical	Absent
85	Very strong	Very sweet	Very juicy	Yellow	Medium	Oblong	Absent
86	Mild	Less sweet	Very juicy	Yellow	Low	Oblong	Present
88	Mild	Sweet	Juicy	Light yellow	Medium	Elongate	Absent
90	Mild	Sweet	Less juicy	Yellow	Low	Spherical	Absent

### Chemical characteristics of pulp

The chemical characteristics of different jackfruit accessions are as follows.

**Percent dry matter and moisture content:** The accession no. 88 contained the highest amount of moisture (93.01%) and hence the lowest amount of dry matter (6.99%); while the accession 194(43) had the lowest moisture content (69.42%) and had the highest dry matter (30.58%) (Table 5). Hossain *et al.* (1979) reported that the ripe jackfruit pulp contained 76.37% moisture and 23.63% dry matter. Purseglove (1968) reported 26.90% dry matter in jackfruit pulp. Moisture content and dry matter varies from varietal characters.

**Total soluble solids:** The total soluble solids in bulbs of jackfruit ranged from 16.10% to 30%. Haque (2001) found that the total soluble solids in jackfruit ranged from 13% to 30%. The maximum total soluble solids was obtained from accession no. 85 (30%), while it was minimum (16.10%) in accession no. 204(57) (Table 5).

**Titrateable acidity:** A little variation and significant difference was observed in relation to titrateable acidity of different accessions. Among them the highest (0.29 %) was found in accession no. 204(57) and the lowest (0.18%) was in accession no. 82(68) (Table 5). The variation would be attributed to the varietal difference. Ullah(2005) reported that titrateable acidity did not vary much among the accessions and it ranged from 0.20 % to 0.35% that support the present study.

**Reducing sugar:** Maximum reducing sugar was found (8.60%) from the accession No. 85, while minimum from accession no. 204(57) (3.27%) (Table 5). Ullah (2005) found that the range of reducing sugar as 4.21% to 9.20%. The present results are agreeable with the above findings of Ullah (2005).

**Non-reducing sugar:** The non-reducing sugar ranged from 6.22 to 10.70%. Minimum non-reducing sugar (6.22%) was obtained from accession no. 90, while maximum (10.70%) from accession no. 85 (Table 5). Haque (1979) reported that the range of non-reducing sugar was 3.98% to 12.50%. The results of the present study are supported by the above findings. Karim (1997) also found that non reducing sugar content ranged from 7.17% to 9.04%.

**Total sugar:** The highest percentage of total sugar content was found in the accession no. 85 (19.30%) followed by accession no. 80(68)(17.87%) and accession no. 78(16.99%) while minimum (9.80%) was found in accession no. 204(57) (Table 5). Haque (1993) reported that total sugar content in ripe jackfruit was 15% while Hossain (1976) reported a wide range from 15.38% to 26.30%. The present results are close to the above findings. Total sugar content 18.18% was found in some jackfruits and 13.93 % in other jackfruit pulp (Karim, 1997).

**Table 5.** Chemical characteristics of jackfruit accessions

Ac. no.	% moisture content	% Dry matter	% Total sugars	%reducing sugars	% non -reducing sugars	Tritatable acidity (%)	TSS (%Brix)
59(1)	72.69	27.303	14.97	5.34	9.63	0.19	25.50
61(2)	87.71	12.287	11.68	5.29	6.39	0.21	19.60
62(2)	82.58	17.420	15.99	6.65	9.34	0.22	27.00
63(3)	84.97	15.030	11.83	5.35	6.48	0.25	22.90
67(10)	86.14	13.860	12.98	5.68	7.30	0.25	23.50
69(27)	85.81	14.190	15.00	6.66	9.34	0.19	25.00
70(19)	83.24	16.760	12.85	5.48	7.37	0.20	23.60
71(19)	74.38	25.62	14.71	4.46	10.25	0.25	25.00
76(26)	85.57	14.430	13.80	5.69	8.31	0.23	24.25
80(68)	88.58	11.420	17.87	7.50	10.37	0.20	28.10
82(68)	81.93	18.070	13.95	4.45	9.50	0.18	23.50
84(2)	87.37	12.630	11.92	4.56	7.36	0.23	23.00
89(11)	92.71	7.294	12.96	5.47	7.49	0.19	25.00
92(14)	87.69	12.310	15.89	6.60	9.30	0.22	27.65
93(15)	81.63	18.370	13.96	4.79	9.17	0.21	25.00
165(73)	81.74	18.260	14.92	5.47	9.45	0.24	26.30
184(18)	82.69	17.310	11.87	3.43	8.44	0.23	22.40
185(18)	90.53	9.475	15.88	6.41	9.47	0.20	26.00
187(32)	71.30	28.700	9.95	5.51	6.44	0.28	16.50
189(38)	84.08	15.920	14.82	4.47	10.35	0.24	25.20
190(42)	82.27	17.723	11.86	5.64	9.22	0.25	21.00
194(43)	69.42	30.580	14.90	6.52	8.38	0.21	25.90
196(50)	82.99	17.010	16.97	7.48	9.49	0.20	28.10
204(57)	84.27	15.730	9.80	3.27	6.53	0.29	16.10
206(56)	84.65	15.350	11.81	6.41	5.41	0.24	21.30
67	83.46	16.540	13.96	5.53	9.44	0.20	24.50
71	88.50	11.500	12.99	4.48	8.51	0.22	23.30
73 (BAU)	86.77	13.230	14.95	5.45	9.50	0.21	25.00
74	88.07	11.930	14.98	6.64	8.35	0.23	25.75
77	82.29	17.710	11.90	4.68	7.33	0.24	22.00
78	87.93	12.070	16.99	7.80	9.19	0.19	27.80
80	86.57	13.430	14.96	6.65	8.31	0.21	25.10
85	90.40	9.598	19.30	8.60	10.70	0.18	30.00
86	88.29	11.710	10.88	3.42	7.46	0.27	20.00
88	93.01	6.992	12.91	6.56	6.35	0.22	24.40
90	81.69	18.307	11.87	4.65	6.22	0.24	23.10
LSD <sub>0.01</sub>	5.21	5.21	0.497	0.304	0.512	0.053	2.196
Level of sign.	**	**	**	**	**	**	**

## References

- Azad, A.K. and Haq, N. 1999. Germplasm catalogue of jackfruit in Bangladesh. International Centre of Underutilized Crops, University of Southampton, Southampton. p. 35.
- BBS 2012. Year Book of Agricultural Statistics of Bangladesh. Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning. Government of Peoples' Republic of Bangladesh. pp. 88-89.
- Bhatia, B.S., Siddappa, G.S. and Lal 1955 Composition and nutritive value of jackfruit. *Indian Journal Agricultural Science* 25 303-306.
- Dutta, S. 1956. Cultivation of jackfruit in Assam. *Indian Journal of Horticulture* 13(4) 189-197.
- Dutton, P.R. 1976. Jackfruit: The Propagation of Tropical Fruit Trees. Common wealth Agricultural Bureau, Farm Royal, Slough, England. pp. 269-290.
- Haque, M.A. 1977. Notes on variability in fruit characteristics of selected jackfruit plants (*Artocarpus heterophyllus* L.). *Bangladesh Journal of Agricultural Science* 4(1) 111-120.
- Haque, M.A. 1979. Nutritive value of jackfruit. *Bangladesh Journal of Agricultural Science* 4(1) 9-12.
- Haque, M.A. 1992. Improvement of jackfruit in Bangladesh. Proc. Bangladesh Agricultural University Research Program 6 140-144.
- Haque, M.A. 1993a. Collection and evaluation of different jackfruit clones of Bangladesh. Bangladesh Pro. Bangladesh Agricultural University Research Program, pp. 6-7.
- Haque, M.A. 2001. Germplasm evaluation, Production and Storage Technology of Jackfruit. Jackfruit Research Project, Department of Horticulture, Bangladesh Agricultural University, Mymensingh, Council. pp. 1-28.
- Hossain, M.M. 1976. Studies on the physical characteristics and nutritive value of jackfruit (*Artocarpus heterophyllus* L.) M.S. (Ag.) thesis, Department of Horticulture, Bangladesh Agricultural University, Mymensingh. p. 55.
- Hossain, M. and Haque, A. 1977. Studies on physical characteristics of jackfruit. *Bangladesh Journal of Horticulture* 5(1) 9-14.
- Hossain, M.M., Haque, M.A. and Hossain, M. 1979. Nutritive value of jackfruit. *Bangladesh Journal of Agricultural Science* 4(1) 9-12.
- Hossain, A.K. and Haque, M.A. 1996. Status reports on genetic resources of jackfruit in Bangladesh. IPGRI Regional Office, Singapore. p. 30.
- Kamaluddin, A.S.1966. "Phaler Chash" (In Bengali) (1<sup>st</sup> ed), Kamrunnahar, 41F, Ajimpur Housing Estate. Dhaka-2. pp. 198-211.
- Karim, M.R. 1997. Study on the physico-chemical characteristics of jackfruit at different harvesting times. M.S. thesis, Bangladesh Agricultural University, Department of Horticulture, Mymensingh, p. 53.
- Nazrul, M.I., Alam, M.S., Hossain, M.S. and Rahman, M.A. 2004. Fruit characteristics of jackfruit as influenced by bearing position. *Journal of Subtropical Agricultural Research Development* 2(3) 63-66.
- Samaddar, H.N. 1990. Jackfruit. In: T. K. Bose and B. Mitra (eds.). Fruits of India, Tropical and Sub-tropical. (1<sup>st</sup> edn.) Naya Prakash, 206 - Bidhan Sharani, Calcutta. pp. 638-649.
- Ullah, M.A. and Haque, M.A. 2008. Studies on fruiting, bearing habit and fruit growth of jackfruit germplasm. *Bangladesh Journal of Agricultural Science* 33 391-397.