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Chemical composition of different accessions of jackfruit

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Abstract
An analysis into the chemical characteristics of eleven jackfruit accessions at harvesting time was conducted. The chemical composition of eleven accessions were explored. It was held at the Bangladesh Agricultural University's Graduate Program Center (BAU-GPC) in Mymensingh from March to December. Moisture, dry matter, TSS, pH, titrable acidity, Ascorbic acid, reducing sugar, non-reducing sugar and total sugar contents differed significantly in the bulbs of the eleven jackfruit variants investigated in this research. The findings of the study are useful for crop improvement and selecting superior desirable jackfruit genotypes for cultivation.

Keywords: Transplanted rice, weed menace, herbicides, yield, nutrient uptake, succeeding crop Blackgram

Introduction
Jackfruit is the world's largest tree-borne fruit, weighing between 10 and 100 pounds and containing hundreds of seeds rich in protein, potassium, calcium, and iron-all of which are essential for bodily growth. This troubling fruit is native to South and Southeast Asia. The jackfruit is a multi-fruit comprised entirely of hundreds to thousands of individual flowers, the fleshy petals of which are digested. The jackfruit tree is a widely cultivated and popular food source throughout the world's tropical regions. Bangladesh, like its national fruit, has jackfruit. A single jackfruit plant can produce hundreds of small, yellow fruit lobes (or bulbs), each containing a highly nutritious seed. The fruit contains a lot of Vitamin C, while the seeds are crowded with protein, potassium, calcium, and iron. One-fifth of a pound of the fruit has about 95 calories. The popularity of jackfruit as a commercial crop seems to be quite low because to the wide variation in fruit quality, the longer growing period of seedlings grown from seeds and the general idea that binge eating of bulbs causes various stomach disorders (Samaddar, 1985) [7]. The fruit is popular in the eastern and southern parts of India. Ripe fruit flakes are nutritional, comprising 18.9 g carbohydrates, 0.8 g minerals, 30 IU vitamin A, and 0.25 mg thiamine per 100 gm (Samaddar, 1985) [7]. In eastern and southern India, despite its high nutritional value, jackfruit is incorrectly referred to as "poor man's food." Jackfruits typically weigh 10–25 kg when fully mature (Rahman, Enamal, Mian, & Chesson, 1995). The weights of individual fruits have been reported to range between 2.10 and 20 kg (Mitra& Mani, 2000; Reddy *et al*., 2004). Large jackfruits, on the other hand, can attain weight values of up to 50 kg (Selvaraj& Pal, 1989).The bulbs, seeds, and rind of ripe jackfruit account for 29 percent, 12 percent, and 59 percent of the total weight, respectively (Bhatia, Siddapa, &Lal, 1955). The edible bulbs have a pH of 5.1, a carbohydrate content of approximately 25%, and a total ash content of 1%. (Nanjundaswamy, 1990). TSS of 13 jackfruit clusters (44 genotypes) ranged from 15.1 to 25.9 Brix on average (Maiti, Wangchu, &Mitra, 2002). However, the highest TSS of 40.5 Brix was recorded in ACC. No. G-18 (Reddy *et al*., 2004). The starch, total sugar, and reducing sugar contents of soft and firm jackfruits differ (Nandini, 1989; Rahman, Nahar, Mian, & Mosihuzzaman, 1999).The total acidity of ripe jackfruit is low (0.13 percent as citric acid) and changes little during ripening (Bhatia *et al*., 1955). It has also been reported that the aroma volatiles of two types of jackfruit differ (Maia, Andrade, &Zoghbi, 2004). According to many authors, consumers dislike jackfruit because of its strong flavor (Bhatia, 1953; Schnell, Olano, Campbell, & Brown, 2001).The crop has a relatively high productivity (25.71 t/ha). But even so, because the variations are largely of seed origin and of traditional varieties, most fruits' quality is not approved by consumers (Anonymous, 1992).

However, jackfruit is gaining in popularity in the United States as a result of new ethnic and mainstream marketing options (Campbell & El-Sawa, 1998; Campbell, El-Sawa, & Eck, 1998; Schnell *et al*., 2001). As a result, the current study at BAU-GPC, Bangladesh Agricultural University Mymensingh aimed to find the diversity in chemical composition of eleven jackfruit accessions.

Materials and Methods

Methods used for studying chemical characters

The chemical analysis was performed out from the Department of Biochemistry and Molecular Biology at Bangladesh Agricultural University (BAU) in Mymensingh. Chemical characteristics like moisture, dry matter, total soluble solid, pH, titrable acidity, total sugar, reducing sugar and non-reducing sugar can be assessed to use the following methods:

Fruit samples: Fruit samples were gathered at Bangladesh Agricultural University's BAU-Germplasm Centre in Mymensingh from March to December. BAU's Department of Biochemistry and Molecular Biology in Mymensingh carried out the biochemical analysis.

Moisture

In a steam bath, ten grams of jackfruit pulp were placed in porcelain crucibles and evaporated for 12 hours. For 72 hours, or until the weight became consistent, the porcelain crucibles and their contents were placed in an oven set to a constant temperature of 800 degrees Celsius. The sample crucibles were then placed in an 8-hour desiccator that contained anhydrous calcium chloride.

The final weights were then taken. Percent moisture content was calculated according to the following formula-

$$\% \text{ Moisture} = \frac{FW}{IW} \text{ x } 100$$

Where,
IW = Initial weight of pulp and
FW = Final weight of oven dried pulp.

Dry matter: Using the following formula, the percentage of dry matter in the pulp was determined from the data received during moisture estimation:

% Dry matter = 100 -% moisture content

Total soluble solids: A refractometer has been used to determine the total soluble solids (TSS). The percent total soluble solid was measured by placing a drop of juice squeezed from the jackfruit bulb on the prism of the refractometer. Ranganna's directions for temperature modifications were followed (19)

PH: A pH meter was used to measure the pH of one gram of fruit juice homogenized in 1 ml of boiling water and 1 ml of demonized water with a pH of 7.0.

Titratable acidity

The Ranganna technique was used to determine the titratable acidity of jackfruit pulp (1994). The following reagents were used to determine titrable acidity:

- Standard NaOH solution (0. 1N)
- 1% phenolphthalein solution

Extraction of jackfruit juice

In a 100 mL beaker, ten grams of fresh jackfruit pulp were placed and homogenized with distilled water in a blender. The blending materials were filtered and transferred to a 100 mL volumetric flask, which was then filled with distilled water to the required volume.

Procedure: Ten milliliters of pulp solution were placed in a conical flask. The conical flask was vigorously shaken after adding two to three drops of phenolphthalein indicator. It was then promptly filtered through a burette with a 0.01 N NaOH solution until a persistent pink color developed. The volume of NaOH solution required for titration was calculated using the burette reading. The following formula was used to calculate percent titratable acidity.

$$\% Tritatable\ acidity = \frac{T \times N \times V_1 \times E}{V_2 \times W \times 1000} \times 100$$

Where,
T = Titre,
N = Normality of NaOH,
V_1 = Volume made up,
E = Equivalent weight of acid,
V_2 = Volume of extract and
W = Weight of sample.

Sugar in fruit pulp

It was necessary to calculate the volume of an unknown sugar solution in fruit pulp, which required the complete reduction of standards. The solution suggested by Fehling. The following procedures were used to determine the sugar content in fruit pulp: (Lane and Eynon, 1923) [4].

Standardization of Fehling's solution

50 mL Fehling's solution A and Fehling's solution B were mixed in a beaker. A ten-milliliter solution was pipetted into a conical flask with a capacity of 250 milliliters, which was then filled with 25 milliliters of distilled water. A normal sugar solution was taken in a burette. The conical flask containing the mixed solution was heated on a hot plate. Without removing the 11ask from the hot plate, three drops of methylene blue indicator solution A-as were added to the boiling solution. The blended solution was titrated with a standard sugar solution. The indicator's decolorization signaled the end of the process. Fehling's Factor was calculated using the formula below.

$$\text{Fehling's Factor (g of invert sugar)} = \frac{\text{Titre} \times 25}{1000}$$

Preparation of sample

20 gram of fresh fruit pulp was placed in a beaker and homogenized with distilled water in a blender machine. After that, the mixed material was transferred to a 250 mL volumetric flask. The volume was made up to tile niark with distilled water. On the pulp, filtration was performed. 100 mL of filtrate was placed in a 250 mL volumetric flask. After adding five nil of 45 percent neutral lead acetate solution, it was shaken and waited for 10 minutes. The flask was filled with distilled water and filtered after five milliliters of 22 percent potassium oxalate solution were added.

Titration of reducing sugar

Ten milliliters of mixed Fehling's solution and 50 milliliters of distilled water were placed in a 250 ml conical flask. A purified pulp solution (filtrate) was taken in the burette. A conical flask containing the mixed Fehling's solution was heated on a hot plate. A 250 ml conical flask was filled with ten milliliters of mixed Fehling's solution and fifty milliliters of distilled water. In the burette, a purified pulp solution (filtrate) was taken. On a hot plate, a conical flask containing the mixed Fehling's solution was heated.

$$\% \text{ Reducing sugar content of fruit pulp} = \frac{F \times D \times 100}{T \times W \times 1000}$$

Where,
F = Fehling's Factor,
D = Dilution,
T = Titre and
W = Weight of sample

Titration of total sugar

50 ml of purified (filtrate) was added to a 250 ml conical flask. It was diluted with 50 mL of distilled water and 5 mL of citric acid. The sugar solution in the conical flask was boiled for sucrose inversion and then cooled. The solution was then transferred to a 250 ml volumetric flask and neutralized with 1 N NaOH using phenolphthalein as an indicator. Distilled water has been used to make up the difference in volume. The mixed Fehling's solution was then titrated using the same procedure as described previously for invert sugar (reducing sugar). The percentage of invert sugar was calculated using the same formula as for reducing sugar.

Estimation of non-reducing sugar: % Non-reducing sugar =% Total invert sugar -% reducing sugar

Estimation of total sugar

% Total sugar =% Reducing sugar +% Non-reducing sugar

Statistical analysis: The recorded data on the study's various parameters were statistically analyzed using the MSTAT computer package program. The (F) variance test was used to analyze the variance of various parameters. To calculate differences between means at 1% and 5% of probability, the Least Significance Difference (LSD) test was used.

Results and Discussion

Chemical characteristics

The chemical characteristics of jackfruit pulp of different Accessions are presented in Table 1.

Moisture content

Harvesting times had a significant impact on the moisture content of the bulb. As harvesting was postponed, the percentage of moisture content decreased. The bulb of early harvested fruit had the highest moisture content (79.39 percent) in accession no. Ah18 and the lowest (68.51 percent) in accession no. Ah19. Purseglove (1968) [5] and Sturrock (1959) [8] determined the moisture content of the bulb to be 73.1 and 81.08 percent, respectively. As a result, the current findings are more comparable to Sturrock's findings. There was a significant difference in the percentage of moisture due to the selections (Table 1). Karim (1997) [3]. Discovered that early harvesting jackfruit had a moisture content of 80.40 percent and late harvesting jackfruit had a moisture content of 78.34 percent. Purseglove (1968) [5] and Sturrock (1959) [8]. Discovered that jackfruit pulp has a similar moisture content.

Dry matter content: Differing Accessions had different dry matter content. The maximum percentage (31.49%) was identified in Ah19, while the lowest percentage (21.34%) was found in Ah2. Table 1 shows data on changes in dry matter content of different accessions based on moisture content percentage. The results revealed that the dry matter content gradually increased from early to late harvesting. The accessions' dry matter composition did not differ significantly. According to Karim (1997) [3], as harvesting progressed from early to late, dry matter content increased.

Total soluble solids: Total soluble solids (TSS) content varied between jackfruit Accessions. It ranged from 18.88 to 26.00 percent. The highest percentage (26.00%) was found in Ah68, while the lowest (18.88%) was found in Ah3.The total soluble solids content of the bulb did not change significantly as a result of the harvesting timings. Total soluble solids in green jackfruit were 18% and 20% in ripe jackfruit bulb, according to Haque (1993) [1]. The total soluble soilds content observed in this study agreed with the previous report. There was no significant difference in total soluble solids content between the accessions (Table 1).

PH: The pH content of different jackfruit accessions differed only slightly. It was about 5 p.m. However, the highest (5.82) was recorded in Ah15, while the lowest (5.0) was recorded in Ah19. There was no discernible difference in pH as a result of harvesting times (Table 1). The current findings revealed that the pH of bulb juice at various harvesting times ranged from 5.00 to 5.82. (Table 1).

Table 1: Chemical composition of jackfruit pulp of different accessions

Accession No.	Moisture (%)	Dry matter (%)	TSS Brix (%)	PH	Titrable Acidity (%)	Ascorbic acid	Reducing sugar	Non reducing sugar	Total sugar
Ah1	77.40	22.60	22.50	5.17	0.16	5.05	7.90	12.41	20.31
Ah2	78.60	21.40	21.84	5.36	0.18	4.85	5.96	13.42	19.38
Ah3	76.53	23.47	18.88	5.08	0.17	5.07	5.40	9.71	15.31
Ah12	73.61	26.39	22.75	5.10	0.19	4.93	6.41	11.56	18.07
Ah14	77.70	22.30	22.55	5.30	0.16	4.97	8.06	9.74	17.80
Ah15	75.32	24.68	20.41	5.82	0.11	5.04	5.06	8.32	13.38
Ah18	79.39	20.61	24.00	5.03	0.17	5.02	8.21	12.61	20.82
Ah19	68.51	31.49	20.83	5.00	0.19	4.99	5.06	5.92	10.98
Ah26	76.31	23.69	22.22	5.18	0.16	4.87	6.43	9.96	16.39

Ah27	78.49	21.51	25.50	5.09	0.15	4.78	6.95	11.09	18.04
Ah68	74.17	25.83	26.00	5.71	0.13	5.01	6.73	11.30	18.03
LSD0.05	1.04	0.844	0.519	0.15	0.017	0.186	0.274	0.420	0.630
LSD0.01	1.42	1.15	0.708	0.20	0.023	0.254	0.374	0.573	0.859
Level of significance	**	**	**	**	**	**	**	**	**

Titratable acidity (%)

The titratable acidity concentrations of different Accessions differed. It did not, however, surpass 0.19 percent. Ah14 and Ah19 had the highest percentage (0.19 percent), while Ah15 had the lowest percentage (0.11 percent).

Ascorbic acid

Ascorbic acid levels in various accessions ranged from 4.85 to 5.07. The highest concentration of ascorbic acid (5.07) was found in Ah3, while the lowest (4.78) was found in Ah27. The highest vitamin C concentration was found in Ah3 (5.07 mg/100g), while the lowest was found in Ah27 (4.48 mg/100g) (Table 1). Hossain and Haque (1979) determined that the bulb's average ascorbic acid concentration was 5.56 mg/100g. The levels of Vitamin C in the options are not significantly different.

Reducing sugar content (%)

The percentage of reducing sugar varied between Accessions. It was discovered that Ah18 had the highest (8.21 percent) percentage of reducing sugar of jackfruit bulb, while Ah3 had the lowest (5.40 percent) percentage of reducing sugar of jackfruit bulb (Table 1). As harvesting time was extended, the sugar content gradually decreased. The proportion of reducing sugar differed between Accessions. It was discovered that Ah18 had the highest percentage of reducing sugar of jackfruit bulb (8.21%), while Ah3 had the lowest percentage of reducing sugar of jackfruit bulb (5.40%). (Table 1). The sugar content gradually decreased as the harvesting time was extended.

Non-reducing sugar content (%)

Non-reducing sugar content was also discovered in various accession. The percentage of non-reducing content ranged from 5.92 to 13.42 percent. Ah2 had the highest percentage of non-reducing sugar content (13.92 percent), while Ah19 had the lowest (5.92 percent) (Table 1). Karim (1997) [3] realized that the non-reducing sugar content ranged around 7.17 and 9.04 percent.

Total sugar content (percentage)

Ah18 (20.82%) had the highest percentage of total sugar (Table 1), while Ah19 had the lowest (10.98). Haque (1993) [1] found 15% sugar content in ripe fruit, while Hossain (1976) found a range of 15.38 to 26.30 percent. The current results are within the latter's specified range. There was no statistically significant difference in total sugar content percentage (Table 1). The total sugar content of jackfruit pulp varies depending on harvesting time, with early harvested jackfruit pulp containing 18.18 percent and late harvested jackfruit pulp containing 13.93 percent (Karim, 1997) [3].

Conclusion

Jackfruit comes in a variety of types with different fruit attributes. It is widely cross pollinated and mostly seed propagated. Color, sweetness, acidity, flavor, and flakes taste differ throughout fruits. The chemical properties of jackfruit pulp involve moisture, dry matter, total soluble solids, titrable acidity, ascorbic acid, reducing sugar, non-reducing sugar, and total sugar. These chemical properties are being used to determine the variety of jackfruit varieties. Accession No. Ah19 exhibited the best chemical properties. The study's findings are useful for clearer grasp variability and choosing superior desirable jackfruit genotypes for commercial farming.

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