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Biochemical Characterization of Custard Apple (*Annona reticulata*) Grown in Brahmaputra Valley of Assam

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ABSTRACT

An experiment was carried out during 2017-2019 to study the biochemical characterization of custard apple (*Annona reticulata*) grown in Brahmaputra valley of Assam. The experiment was carried out in the laboratory with custard apple fruits collected from 10 different locations of Assam i.e. CA-1: Bokajan, CA-2 : Guwahati, CA-3 : Titabor, CA-4: North Lakhimpur, CA-5 : Biswanath Chariali, CA-6 : Narayanpur, CA-7 : Sadiya, CA-8 : Sivasagar, CA-9 : Nagaon and CA-10 : Tezpur. The design of the experiment was completely randomized design (CRD) with three replications. The biochemical analysis reveals that the quality characters like moisture content, TSS, titratable acidity, TSS: acidity ratio and ascorbic acid content differed significantly and ranges from 52.06% to 75.92%, 20.33 °Brix to 25.33 °Brix, 0.13% to 0.29%, 73.94 to 191.22 and 24.82 mg/100g to 31.76 mg/100 g, respectively. On the other hand, the sugars like total sugar (11.77-20.39 %), reducing sugar (11.07–16.48%) and non-reducing sugar (0.70-6.96%) contents of the custard apple fruits vary significantly among the fruits of different locations. The calcium and magnesium content of the fruits ranges from 21.67 mg/100 g to 30.33 mg/100 g and 13.67 mg/100 g to 24.67 mg/100 g, respectively. The variation in the results of the present investigation in biochemical characters among the custard apple fruits might be due to the different climatic conditions and management practices.

Keywords Custard apple, *Annona reticulata*, Biochemical.

INTRODUCTION

India is blessed with a diverse agro-climatic condition due to which a large number of tropical, subtropical and temperate fruit crops are found in India. India is the second largest producer of fruit crops after China and India accounted around 10% of the fruit production. Custard apple is one of the most delicious arid fruit known mostly for its dessert and confectionery values and finds immense applications in the preparation of beverages and ice-creams. Annona fruits have edible, soft, juicy sugary pulp with mild flavor and acidity. Study on biochemical composition of fruits gives an idea quality of the fruits and thus helps in improving the quality of the crop. Brown (1988) established the fact that custard apple fruits contained higher amounts of sugar (22.77%), crude protein (2.80%), moisture (74.00%), total carbohydrates (21.50%), crude fiber (3.30%) ash (1.05%), acidity (0.63%) and minimum amount of fat content

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(0.39 %). Ghosh *et al.* (2001) recorded 27°Brix TSS and 0.12% acidity in custard apple variety Balanagar.

These fruits have many nutritional and medicinal values due to which these fruits are known as 'The new super fruit of the 21st century'. The custard apple fruit has natural anti-cancerous properties, helps to gain weight, develop better immune system, replenish energy levels, cures anemia, lowers the risk of arthritis and diabetes and helps to heal skin diseases.

MATERIALS AND METHODS

Climatic condition

The climatic condition of Assam is sub-tropical humid having hot and dry summer followed by a cold winter. The intensity of rainfall is highest during monsoon particularly during June-July. The annual maximum average temperature in different districts of Assam is between 30°C – 35°C while the minimum average temperature ranges from 6°C - 12°C. The total annual rainfall is around 2300 mm and average humidity ranges from 74%–87%.

Qualitative parameters of the fruits

Quality of the fruits was analyzed in the laboratory when the fruits ripe properly. The ripe fruit was cut in to pieces and ground in a mortar.

Total soluble solids (TSS) : TSS of the fruit was determined by Pocket Refractometer PAL-1 and the result was expressed in °Brix.

Moisture content : After freshly grated, a representative sample of 10 g was taken and dried in oven at 75°C till dryness and final weight of the dry material was recorded to calculate the respective moisture content. Moisture content was expressed in percentage and calculated as following (Saini *et al.* 2012).

$$\text{Moisture content (\%)} = \frac{\text{Fresh weight of sample (g)} - \text{Dry weight of sample (g)}}{\text{Fresh weight of sample (g)}} \times 100$$

Quality parameters namely, titratable acidity, total sugars, reducing sugars and non-reducing sugars were estimated by adopting the standard method of AOAC (1975).

Titratable acidity : 10 g of homogenized pulp was dissolved in 100 ml of distilled water and filtered. Ten ml of filtrate was titrated against 0.1 N NaOH using Phenolphthalein as indicator. Titratable acidity was expressed in percentage in terms of anhydrous malic acid.

$$\text{Titratable acidity (\%)} = \frac{\text{Titre value} \times \text{Normality of alkali} \times \text{value made up} \times \text{Eq wt of malic acid}}{\text{Weight of the sample} \times \text{Aliquote} \times 1000} \times 100$$

Ascorbic acid : Ascorbic acid content was determined by the visual titration method using 2, 6-dichlorophenolindophenol dye (Freed 1966), expressed in mg per 100 g. 10 g of sample was taken in 100 ml volumetric flask and volume made up with 4% oxalic acid and filtered. Ten ml of filtrate was taken and titrated against 1 l standard dye. The pink color indicated the end point.

It was calculated by using the following formula :

$$\text{Ascorbic acid (mg/100 g)} = \frac{\text{Titre valuex dye factor} \times \text{Volume made up}}{\text{Weight of the sample taken for estimation} \times \text{Aliquot of sample taken for estimation}} \times 100$$

Total sugars : From the solution of 250 ml made up for reducing sugar estimation, 50 ml of the solution was taken and 5 ml of concentrated HCl was added to it and kept overnight. The solution was then neutralized with 1 N NaOH and volume was made up to 100 ml with distilled water and titrated against 10 ml boiling Fehling's solution mixture using methylene blue as indicator. From the titre value, percentage of total sugar was calculated as follows :

Total sugar = Sucrose (%) + Reducing sugar (%)
Sucrose (%) = (Total invert sugar % - Reducing sugar % originally present) × 0.95

$$\text{Total invert sugar (\%)} = \frac{\text{Factor (0.05)} \times \text{Volume made up} \times \text{Volume of stock solution}}{\text{Titre value} \times \text{weight of the sample taken} \times \text{Aliquot}} \times 100$$

Table 1. Qualitative parameters of custard apple fruits.

Treatments	Moisture content (%)	TSS (°Brix)	Titratable acidity (%)	TSS : Acidity ratio	Ascorbic acid (mg/ 100 g)
CA-1	63.24	23.67	0.19	122.04	29.99
CA-2	75.92	20.33	0.27	73.94	27.15
CA-3	53.94	24.53	0.29	77.31	31.20
CA-4	52.06	25.33	0.13	191.22	31.76
CA-5	65.00	22.33	0.20	111.46	27.31
CA-6	68.95	22.17	0.22	98.61	29.22
CA-7	59.33	24.17	0.17	140.11	31.67
CA-8	64.96	23.07	0.21	107.22	28.27
CA-9	73.00	20.33	0.25	82.89	24.89
CA-10	69.57	20.67	0.15	161.17	24.82
SEd±	3.54	0.86	0.07	12.85	2.02
CD (P=0.05)	7.43	1.80	0.15	27.00	4.24

Table 2. Sugar contents of custard apple fruit.

Treatments	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)
CA-1:Bokajan	18.33	14.97	2.60
CA-2:Guwahati	11.77	11.07	0.70
CA-3:Titabor	19.18	12.03	3.98
CA-4:North Lakhimpur	20.39	15.00	1.67
CA-5:Biswanath Chariali	16.83	14.15	1.94
CA-6:Narayanpur	16.67	13.43	6.96
CA-7:Sadiya	18.57	16.48	2.70
CA-8:Sivasagar	17.57	15.60	2.97
CA-9:Nagaon	16.09	14.93	3.40
CA-10:Tezpur	16.01	12.20	4.63
SEd±	1.72	1.44	2.24
CD (P=0.05)	3.62	3.04	1.05

Reducing sugars : 10 ml of saturated lead acetate and 5 g of sodium oxalate were added to 25 g pulp and the volume was made up to 250 ml with distilled water. The made up solution was titrated against 10 ml boiling Fehling's solution mixture (5 ml of Fehling's solution A + 5 ml of Fehling's solution B) using methylene blue as indicator. Deep brick red color of the solution indicated the end point and the value were expressed as percentage.

$$\text{Reducing sugar (\%)} = \frac{\text{Factor } 0.05 \times \text{Volume made up}}{\text{Titre value} \times \text{Weight of the sample}} \times 100$$

Non-reducing sugars : Non-reducing sugar was obtained as the difference between total sugars and reducing sugars and expressed in percentage.

Calcium (Ca) and Magnesium (Mg) : For estimation of Ca and Mg, first 1 g sample was digested by following wet ashing method (Saini *et al.* 2012). Then 5 ml aliquot was taken in a china clay dish and pH of the aliquot was adjusted to 10 by adding 15 ml NH_4Cl + NH_3OH buffer solution. 10 drops of Erichrome black-T indicator was added and titrated with 0.01 N EDTA solutions till color changes from red to bright blue. A blank was carried out exactly the same manner. 5 ml of NaOH solution and 50 mg of murexide indicator was added to 5 ml of aliquot and titrated with 0.01 N EDTA solutions till the color changed from pink to purple. Similarly, a blank was also prepared. Both the minerals were calculated by the following formula and expressed as following,

For Ca + Mg,

Meq of (Ca+Mg)/100 g of plant material = $(0.01 \times V_3) \times (V/V_1) \times (100/1)$

Meq of Ca/100 g of plant material= $(0.01 \times V_2) \times (V/V_1) \times (100/1)$

Where,

V = Volume of the plant digest made

V_1 = Volume of the aliquot taken for analysis

V_2 = Volume of EDTA solution in titration (titre value)

V_3 =Volume of EDTA solution in titration (titre value)

RESULTS AND DISCUSSION

Moisture content : A significant variation in the quality characters of the custard apple fruits collected from the different locations of Brahmaputra valley of Assam were observed in the study. The moisture content of the custard apple fruits collected from different locations of Assam ranges from 52.06% to 75.92% (Table 1). Similar results were also reported

Table 3. Calcium and magnesium.

Treatments	Calcium (mg/100 g)	Magnesium (mg/100 g)
CA-1: Bokajan	27.00	17.00
CA-2: Guwahati	23.67	21.00
CA-3: Titabor	26.67	15.00
CA-4: North Lakhimpur	30.33	23.67
CA-5: Biswanath Chariali	25.67	18.33
CA-6:Narayanpur	24.53	24.00
CA-7:Sadiya	27.00	18.33
CA-8:Sivasagar	26.00	19.00
CA-9:Nagaon	21.67	13.67
CA-10:Tezpur	24.33	24.67
SEd±	1.38	2.04
CD (P=0.05)	2.91	4.29

by Pareek *et al.* (2011) in edible pulp of cherimoya (77.3 ± 3%), custard apple (75.8 ± 2.8%), soursop (81.0 ± 2.5%) and in sugar apple (72.6 ± 2.4 %).

TSS : The present experiment reveals that total soluble solid content ranges from 20.33 °Brix to 25.33 °Brix (Table 1). Higher content of TSS in custard apple fruits might be due to the accumulation of sugars and other soluble components from hydrolysis of protein and oxidation of ascorbic acid. Girwani *et al.* (2011) also reported that total soluble solid ranges from 20 to 28.2 °Brix. The present results of the study got support from the findings of Sudhakar (2013).

Titratable acidity : The titratable acidity content differed significantly in custard apple fruits collected from different places in the present investigation. The lower content of titratable acidity might be due to the conversion of acid into sugar during ripening of the custard apple fruits. Study of Othman *et al.* (2014) also reveals that titratable acidity ranges from 0.10-1.25% (Table 1) in freshly mature fruit. The present findings of the study were in conformity with the results of Mathakar (2005) and Jyolsna (2016).

TSS : Acidity ratio : TSS : Acidity ratio showed a large variation among the custard apple fruits collected from different localities in the present study.

It was observed that TSS : acidity ratio ranged from 73.94 to 191.22 (Table 1). Similar results were also reported by Sousa *et al.* (2006).

Ascorbic acid : The ascorbic acid acts as antioxidant and it has the potential for free radical scavenging activity. In the present experiment, the results showed that the ascorbic acid content of custard apple varied from 24.82 mg/100 g to 31.67 mg/100 g of fruit pulp (Table 1). Pareek *et al.* (2011) also recorded similar results of ascorbic acid content in custard apple which varies from 9.22 to 60 mg/100 g of fruit pulp. The increase in ascorbic acid content might be due to rapid increase in total sugar as the fruit synthesizes ascorbic acid from hexose sugar precursor in custard apple, as also reported by Jana *et al.* (2010) in guava. The results of the present study got supports from Sousa *et al.* (2006).

Sugars : Sugars include total sugars, reducing sugars and non-reducing sugars in fruits. They are important components of custard apple fruits to determine the quality of the fruits. In the present study, there was significant variation in contents of all the three sugars in custard apple fruits of different locations collected for the study (Table 2). The different rates of hydrolysis of starch into sugars such as glucose, sucrose and fructose might be responsible for variation in sugar contents of fruits. The results of the present investigation were in conformity with Sudhakar (2013) and Jyolsna (2016).

Calcium and magnesium : The calcium and magnesium contents of the fruits varied from 21.67 mg/100 g - 30.33 mg/100 g and 13.67 mg/100 g - 24.67 mg/100 g, respectively (Table 3). The variation in calcium and magnesium contents of the fruits might be due to variation in rainfall in custard apple growing locations selected for the study. Poor management practices particularly poor nutrient management practices in each custard apple plants of all locations might have resulted differences in the contents of calcium and magnesium contents in fruits pulp. Similar observations were also reported by Santos *et al.* (2016) and Abdualrahman *et al.* (2016).

CONCLUSION

There is a large variation in the biochemical characters of the custard apple collected from different locations of Assam. The custard apple fruits collected from North Lakhimpur recorded the largest fruit

in terms of size and weight with better qualitative characters. This variation in the different biochemical characters of the fruits might be influenced by the climatic conditions prevailing in those respective locations and also influenced by some other factors namely, soil conditions, management practices particularly pruning and nutrient management. Again all the plants selected for the study were seedling origin which might be one of the reasons for variation in morphological and biochemical characteristics of the custard apple fruits. Further study of custard apple fruits in future on the molecular level would give the accurate characterization of custard apple fruits of different locations of Assam.

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REFERENCES

AOAC (1975) Official Methods of Analysis. 2nd ed. Association of Official Agricultural Chemists, Washington D. C.

Abdualrahman MAY, Ma H, Zhou C, Yagoub AEC, Ali OA, Tahir HE, Wali A (2016) Postharvest physico chemical properties of the pulp and seed oil from *Annona squamosa* L. (Gishta) fruit grown in Darfur region, Sudan. *Arabian J Chem* pp 1—8.

Brown BI, Wong LS, George AP, Nissen RJ (1988) Comparative studies on the postharvest physiology of fruit from different species of *Annona* (custard apple). *J Hortic Sci* 63 (3) : 521—528.

Freed M (1966) Methods of Vitamin Assay. Inter science Publ Inc New York.

Ghosh SN, Mathew B, Manna S (2001) Studies on physico-chemical characteristics of fruits of Custard apples grown under rainfed semi-arid region of West Bengal. *Orissa J Hortic* 29 (1) : 66—68.

Girwani A, Madhavi A, Kumar TS, Reddy GS (2011) Evaluation of custard apple hybrids for fruit yield and quality attributing characters. *Acta Hortic* 890 : 251—254.

Jana BR, Munsi PS, Manna DC, Das B (2010) Evaluation of Guava (*Psidium guajava* L.) genotypes based on fruit morphology, physico-chemical properties and yield under eastern plateau condition. *Ind J Pl Genet Res* 23 (1) : 25—29.

Jyolsna M (2016) Assessment of variability in *Annona* species. Master of Science thesis submitted to Kerala Agricultural University, Vellanikkara, Thrissur.

Marriot J, Robinson M, Karikari SK (1981) Starch and sugar transformation during the ripening of plantains and bananas. *J Sci Food Agric,* pp 1021—1026.

Mathakar TD (2005) Assessment of Custard apple (*Annona squamosa* L.) hybrids. Master of science thesis submitted to Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra), India.

Othman OC, Fabian C, Lugwisha EH (2014) Post harvest physico-chemical properties of soursop (*Annona muricata*) fruits of Coast region. Tanzania. *J Food Nutr Sci* 2 (5) : 220—226.

Pareek S, Yahia EM, Pareek OP, Kaushik RA (2011) Postharvest physiology and technology of *Annona* fruits. *Food Res Int* 44 : 1741—1751.

Saini RS, Sharma KD, Dhankhar OP, Kaushik RA (2012) Laboratory manual of analytical techniques in horticulture. Agrobios, pp 33.

Santos WNLD, Sauthier MCS, Cavalcante DD, Benevides CMJ, Dias FS, Santos DCMB (2016) Mineral composition, nutritional properties, total phenolics and flavonoids compounds of the atemoya fruit (*Annona squamosa* × *Annona cherimola* Mill) and evaluation using multivariate analysis techniques. *Ann Brazilian Acad Sci* 88 (3) : 1243—1252.

Sousa SA, Dantas ACVL, Silva SA, Fonseca AAO, Machado MS, Almeida VO (2006) Fruit characterization of sugar apple genotypes in President Datura. *J Crop Breed Appl Biotechnol* 6 (4) : 295—302.

Sudhakar YS (2013) Morphological and molecular characterization in Custard apple. Doctors of Philosophy thesis submitted to Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India.