Journal of Agricultural Engineering and Food Technology
p-ISSN: 2350-0085; e-ISSN: 2350-0263; Volume 3, Issue 1; January-March, 2016 pp. 54-57

http://www.krishisanskriti.org/Publication.html

Study of Physical, Optical and Biochemical Characteristics of Elephant Apple (*Dillenia Indica*) for its Utility Potential in Food Processing Industries

Jeuti Basumatary[1], C.B. Khobragade[2], Sanjib K Paul[3] and Prasanna Kumar G V[4]

[1,2,3,4]Department of Agricultural Engineering, Assam University (A Central University), Silchar-788011, Assam, India
E-mail: [1]jeutibty@gmail.com, [2]khobragadechetan@gmail.com, [3]sankumarpaul@gmail.com, [4]pkumargv@gmail.com

Abstract—*Elephant apple (Dillenia indica) is a tropical tree, distributed in various countries of South Asian region including India. In India, it is not commercially cultivated, but is found wild in its Himalayan and sub-Himalayan region. Now, people have been showing more interest in the beneficial effects of consuming fruits and vegetables. Fruits contribute significant nutritional and commercial value from the ancient time. Indigenously elephant apple is being used in various food products as sole or contributing ingredient, but there is lack of published works in terms of depth scientific investigations about the fruit. So, in this study it is decided to determine various aspects of the fruit to validate the traditional knowledge about its goodness in consumption and processing.*

Mature elephant apple was subjected for various physical, optical and biochemical investigations. Average diameter, density and specific gravity of the fruit were determined as 11.4 ±0.10 cm, 1.001±0.01gm/cm^3 and 0.98±0.01. Hunter colorimetric analysis of the fruit revealed 36.67±0.31,-23.62±0.23 and 18.42±0.13 as its L, a and b. Optical analysis also exposed hue angle (α)
and chroma (C) as -37.94±0.27 and 29.95±0.17. pH and total soluble solid (TSS) of fruit sample were found as 3.4±0.03 and 6±0.05 ^{O}Brix respectively.

Further analysis also revealed that the edible part of fruit contains moisture (wb) of 83.3±0.82%, ash 4.45±0.04%, acidity 1.02±0.01 %, ascorbic acid 5.40±0.05 mg/100g, reducing sugar 2±0.01%, non-reducing sugar 3±0.02%, protein 0.72±0.01%, fat 0.592±0.01%, carbohydrate 9.05±0.09% and crude fibre 2.04±0.02 %. Investigation revealed highly significant antioxidant activity of 45.5±0.45 % in the fresh sample.

From the experimental outcome, it can be concluded that elephant apple possess excellent food value and enormous potential to be used as raw material for various food processing industries. So, this investigation will surely be used as a curtain raiser for future researchers to find out the optimum process and product parameters for industrial production of different value added products.

Keywords*: Dillenia indica, biochemical, optical, antioxidant, hue, chroma*

1. INTRODUCTION

Elephant apple is a 15m tall tree of family: Dilleniaceae and genus Dillenia having 20-30cm long leave, flower of diameter 15cm [11].The fibrous fruit have gelatinous pulp enclosed by five edible imbricate sepals containing numerous seeds. The fruit is harvested from September to February [2]. In India the plant is distributed in the sub-Himalayan tract from Uttarakhand eastwards to Assam and Bengal southwards to central and south India. *D. indica* is an ethno-medicinally important plant used for the treatment of severe diseases like cancer and diarrhea. The fruit extract has shown significant anti-leukemic activity in human leukemic cell lines. The fruit possesses tonic and laxative properties and is used for abdominal pains. The antioxidant effect of a plant is mainly due to phenolic compounds such as flavonoids, phenolic acids, tannins and phenolic diterpenes [12].

The green mature fruit is acidic, sour, bitter, pungent, astringent, but the ripe fruit is sweet, sour, appetizing, and tasty. Fruit decoction used for curing dandruff and checking falling of hairs, eaten to combat weakness; as tonic. Ripe fruits are eaten fresh as well as cooked; juice, mixed with sugar and water, serves as a cooling beverage in fever, and as a cough syrup. Ripe fruit-juice removes flatulence, external application helps suppuration of boil, thickened and fleshy calyx on fruits used as a flavoring agent, or made into different products including jams and jellies [13]. The fruit could be processed to industrial value added products such as clear beverage and ready-to-serve beverage and squash [2]. The fruit is used as a drug for the treatment of type-2 diabetes traditionally in Assam [14].

Elephant apple is a important source of healthy diet and help in physiological process. Though, it has been used by tribal and folk communities of various forest regions of India, information on the health, nutritional, pharmacognostical,

phytopharmacological benefits of this plant is limited due to lack of knowledge, technical study and investigations. Therefore, present work is aimed to determine the physical, optical and biochemical characteristics of elephant apple to quantify its contribution to the diet and it's potentially to use in pharmaceutical and food industry.

2. MATERIAL AND METHODS

2.1 Raw material collection and fruit sampling

Fresh matured ***Dillenia indica*** were collected from Irongmara market, Durgakona (Assam). Raw materials are washed for physical analysis and sliced, deseeded for optical and chemical analysis. All chemical were of analytical grade and glass wares were borosilicate.

2.2 Physical characteristics

2.2.1 Diameter, density and specific gravity

Diameter of fruit was measured by using vernier caliper. Density of fruit was measured by the ratio of weight to volume where fruit volume is determined by water displacement technique [3]. Specific gravity was measured by measuring fruit weight in air and in water [4].

2.3 Optical characteristics

2.3.1 Color indices, hue angle (α) and chroma (C)

Color of fresh elephant apple slices was determined by hunter color lab in terms of the CIE, L (degree of lightness to darkness), a (degree of redness to greenness), b (degree of yellowness to blueness) values [7]. Also, the chroma (C) (Eq-1) and hue angle (α) (Eq-2) were calculated from the values of L, a, b.

$$C = \sqrt{a^2 + b^2} \quad \text{.... (1)}$$

$$\alpha = \tan^{-1}(\frac{b}{a}) \quad \text{.... (2)}$$

2.4 Chemical characteristics

2.4.1 pH

pH of the samples was measured using a pH meter. The pH was standardized by standard buffer solution [1].

2.4.2 Total soluble solid (TSS)

Soluble solids content was measured with a portable refractometer. One drop of fruit juice was placed on the refractometer glass prism and the TSS was obtained as ^{o}Brix [8].

2.4.3 Moisture content

The sliced elephant apple was kept in hot air oven at 105^{O}C±1. The weight loss of elephant apple was recorded after 24 hours [1]. The moisture content was determined by following formula:

$$Moisture\,content\,(\%Wb) = \frac{Weight of\ water}{Weight of\ food\ sample} \times 100$$

…. (3)

Ash content

The fruit was kept in muffle furnace at not more than 525°C for 4-6 hours. The weight of ash was taken and determined [7]. The ash percentage is calculated by using the formula:

$$Ash\ content(\%) = \frac{Weight of\ ash}{Weight of\ sample} \times 100$$

…. (4) 2.4.5 **Acidity**

Ten gram of ground elephant apple was taken in a 250 mL conical flask, and four drops of phenolphthalein indicator was added. This was titrated with the standard 0.1N NaOH to faint pink point. The result was expressed as g citric acid l^{-1} [9].

2.4.6 Ascorbic acid

The ascorbic acid was determined by volumetric method. 0. 5 g sample was extracted in a 4% oxalic acid, made up to 100 ml, and centrifuged. Supernatant (5 mL) was taken, 10% of oxalic acid was added and titrated against the 2, 6-dichlorophenolindophenol dye to a pink end point.

2.4.7 Reducing sugar

Reducing sugar was estimated by Nelson-Somogyi method. In first part, 100 mg fresh ***Dillenia indica*** was extracted with 80% ethanol twice. Alkaline copper tartrate was added to extract and heated to reduce the copper from the cupric to cuprous state. The cuprous oxide thus formed was treated with arsenomolybdic acid and reduce the molybdic acid to molybdenum blue. The blue color developed was measured at 620 nm in a colorimeter [6].

2.4.8 Non reducing sugar

Non reducing sugar was determined by following the method prescribed by Sadasivam and Manickam (1991) [6].

2.4.9. Protein

Protein content was determined by Micro-Kjeldahl method. 100mg of sample was taken for analysis. Nitrogen or any other organic material is converted to ammonium sulphate by H_2SO during digestion. This salt on steam distillation, produce ammonia and collected in boric acid solution. The solution was titrated against the standard acid until the solution become violet colour [6].

$$Total\ \mathrm{Pr}otein = (\%)Nitrogen \times 6.25 \quad \text{.... (5)}$$

2.4.10 Fat content

To determine fat content 3gm of food sample was wrapped by a filter paper and transferred into soxhlet. The fat was

extracted with petroleum ether (150 drops/min) by heating. After 14 hour it was then distilled off completely and dried. After cooling, reweigh dried sample [6]

$$Fat(\%) = \frac{Weight\,of\ fat}{Weight\,of\ sample} \times 100 \quad \ldots. (6)$$

2.4.11 Total carbohydrate

The carbohydrate content was measured by Anthrone method. 100 mg of the sample was kept in a boiling water bath for 3 hours with 5 mL of 2.5 (N) HCl. In hot acidic medium glucose is dehydrated to hydroxymethyl furfural. This compound forms a green colored product with anthrone which was measured at 630 nm [6].

2.4.12 Crude fibre

Two g of ground material was extracted with petroleum ether to remove fat. Then the sample was boiled with 200 mL of sulphuric acid for 30 min. Then the sample was boiled with 200mL of sodium hydroxide solution for 30 min. The sample was washed with 25 mL of boiling 1.25% H_2SO_4, three 50 mL portions of water and 25 mL alcohol. The residue was removed, dried for 2hours at 130 ±2°C and weighed (W_1). The residue was ignited for 30 min at 600 ±15°C and weighed (W_2) [6].

$$Crude\ fibre(\%) = \frac{(W_1) - (W_2)}{Weight\,of\,the\,sample} \times 100 \quad \ldots. (7)$$

2.4.13 Antioxidant activity

Radical scavenging activity of the extracts was determined using DPPH. Trolox solution was used as a standard, and the results were expressed as µmol trolox equivalent (TE)/g. 3.9 mL aliquot of a 0.0634 mM of DPPH solution, in methanol (95%) was added to 0.1 mL of each extract. Change in the absorbance of the sample extract was measured at 515 nm [10].

2.5 Statistical analysis

All analyses were carried out in triplicates. So, data obtained were expressed as the mean of three values ± standard deviation.

3. RESULTS AND DISCUSSION

3.1 Physical characteristics

Physical analysis showed that the diameter, density and specific gravity of fresh elephant apple were 11.4±0.104, 1.001±0.01001 and 0.98±0.0091 respectively as given in Table1.

Table 1 Physical characteristics of fresh matured elephant apple

Parameter (s)	Value
Diameter (cm)	11.4±0.104
Density (gm/cm^3)	1.001±0.01001
Specific gravity	0.98±0.0091

Means ±SD **(n=3)**

3.2 Optical characteristics

The color indices i.e. L, a and b were 36.67±0.31, -23.62±0.23, 18.42±0.13. Hue angle and chroma was obtained as -37.94±0.27, 29.95±0.17 respectively as shown in Table 2.

Table 2 Optical characteristics of fresh mature elephant apple

Parameter	Value
L	36.67±0.31
a	-23.62±0.23
b	18.42±0.13
Hue angle (H^o)	-37.94±0.27
Chroma	29.95±0.17

Means ±SD **(n=3)**

3.3 Biochemical characteristics

The fresh fruit revealed pH 3.4±0.03, total soluble solid 6±0.05 (^{O}Brix), moisture content 83.3±0.82 (wb), ash 4.45±0.04 %, acidity 1.02±0.01%, ascorbic acid 5.40±0.01 mg/100g, reducing sugar 2±0.01%, non-reducing sugar 3±0.02%, protein 0.72±0.01%, fat 0.592±0.01%, carbohydrate 9.05±0.09 %, crude fibre 2.04±0.02 % and antioxidant activity 45.5±0.45 % respectively as shown in Table 3. This investigation further confirmed some of the findings of previous researchers [2]. Biochemical characteristics of the fruit revealed that it is highly acidic in nature with good content of sugar. Fruit also revealed higher content of minerals and sufficient ascorbic acid. High fibre content and antioxidant activity with very less fat content makes the fruit a functional ingredient for food processing industries.

Table 3 Biochemical characteristics of fresh mature elephant apple

Parameter	Value
pH	3.4±0.03
Total soluble solid (^{O}Brix)	6±0.05
Moisture content (wb, %)	83.3±0.82
Ash (%)	4.45±0.04
Acidity (%)	1.02±0.01
Ascorbic acid(mg/100g)	5.40±0.01
Reducing sugar (%)	2±0.01
Non-reducing sugar (%)	3±0.02
Protein (%)	0.72±0.01
Fat (%)	0.592±0.01
Carbohydrate (%)	9.05±0.09
Crude fibre (%)	2.04±0.02
Antioxidant activity (%)	45.5±0.45

Means ±SD **(n=3)**

4. CONCLUSION

The study revealed that there is a great potentially to use the fruit in food and pharmaceutical industry. The fruit have high amount of soluble solid, fibre, ascorbic acid, reducing sugar, non-reducing sugar, carbohydrate, antioxidant activity but fat content is low as compared to other. High fibre content and antioxidant activity with very less fat content makes the fruit a functional ingredient for food processing industries.

REFERENCES

[1] A. R. Hande, Shrikant Baslingappa Swami and N.J. Thakor, " Effect of drying methods and packaging materials on quality parameters of stored kokum rind" *Int J Agric & Biol Eng*,7. August 2014, pp. 114-126.

[2] Abdille M.H. , Singh R.P. , Jayaprakasha G.K. and Jena B.S., "Antioxidant activity of the extracts from *Dillenia indica* fruits", *Food Chemistry*, 90, September (2005), pp. 891–896.

[3] Vahid Akbarpour, Khodayar Hemmati and Mehdi Sharifani, "Physical and Chemical Properties of Pomegranate (*Punica granatum* L.) Fruit in Maturation Stage", *American-Eurasian J. Agric. & Environ. Sci*., 6 (4), 2009, pp. 411-416.

[4] Edmundo Mercado-Silva, Pedro Benito-Bautista, Ma.de los Angeles Garcia-Velasco, "Fruit development, harvest index and ripening changes of guavas produced in central Mexico", *Postharvest Biology and Technology*, 13, 1998, pp.,143–150.

[5] Ilknur Alibas, "Microwave, vacuum and air drying characteristics of collard leaves", *Drying Technology*, 27, October 2009, pp. 1266– 1273.

[6] S Sadasivam, A Manickam, "Biochemical methods", New age international, 1991.

[7] Satwase A N1, Pandhre G R, Sirsat PGand Wade YR2, "Studies on drying characteristic and nutritional composition of drumstick leaves by using sun, shadow, cabinet and oven drying methods", The open access scientific report, 2, 2013, pp. 1-4.

[8] Harsha Hirdyani**, "**Development and quality evaluation of RTS (ready to serve) beverages made from Traditional Indian medicinal Plants", *Nutrition & Food Sciences*, 2015, pp. 1-4.

[9] Lakshmi. E. Unni, O.P. Chauhan, P.S. Raju, "Quality changes in high pressure processed ginger paste under refrigerated storage", *Food Bioscience*, 2015, pp. 18-25.

[10] Tanmay Kumar Koley, Charanjit Kaur, Shweta Nagal, Shweta Walia, Seema Jaggi, Sarika, "Antioxidant activity and phenolic content in genotypes of Indian jujube (*Zizyphus mauritiana* Lamk.)", *Arabian Journal Of Chemistry*, 2011.

[11] Apurba Talukdar, Nayan Talukdar, Satyendra Deka and Bhargab Jyoti Sahariah, "*Dillenia indica* (outenga) as anti-diabetic herb found in Assam: a review", *International Journal of Pharmaceutical Sciences and Research*, 3(8), July 2012, pp. 2482-2486.

[12] Baikuntha Jyoti Gogoi, Jambey Tsering and Bhabesh Chandra Goswami, "Antioxidant activity and phytochemical analysis of *Dillenia indica* L. fruit of Sonitpur, Assam, India", *International Journal Of Pharmaceutical Sciences And Research,* 3(12), November, 2012, pp.4909-4912.

[13] Dipal Gandhi and Priti Mehta, "*Dillenia indica* Linn. and *Dillenia pentagyna* Roxb.: pharmacognostic, phytochemical and therapeutic aspects", *Applied Pharmaceutical Science,* 3 (11), November, 2013, pp. 134-142.

[14] Das Munmee and Sharma Bishnu Prasad, "Evaluation of hypoglycemic effect of an Indian fruit", *Int. J. Res. Ayurveda Pharma.,* 4(4), July-August 2013.