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Biochemical Composition Analysis of Citrus Fruit (Shaddock) of Assam for Preparation of Beverages

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Abstract—*Shaddock (Citrus maxima) is the second largest citrus fruit cultivated in India. Nutrient retention, appealing flavor, additional medicinal values and other organoleptic qualities of fruits are the main consideration in standardization of different ratios of blend components. So, the present study was carried out to portray the biochemical properties of citrus fruit (Shaddock). The fruits were randomly selected from the tree and after clear visual observation, fresh fruits and completely ripen fruits were selected for the experimental purpose. The Shaddock fruit juices were prepared and analyzed without dilution. The biochemical parameters such as micro and macro nutrients, energy and carbohydrate, vitamin B complex Thiamine and Riboflavin present in the extracts were determined using high performance liquid chromatography (HPLC) equipped with diode array detector (DAD) and inductively coupled plasma optical emission spectrometry (ICP-OES). The study revealed that shaddocks are rich source of potassium and iron with 1439.83 ± 115.358 and 57.80 ± 57.374. The fresh shaddock had on an average 7.00º Brix TSS, 1.09 per cent titratable acidity, 23.39 ± 0.623 percent energy and carbohydrate 5.42 ± 0.109. The study therefore recommends that there is a need to popularize nutritionally superior Shaddock based carbonated and non-carbonated beverages as better substitute for commercial beverages. The study gives an idea of the fruits which are rich in nutrients but are not accepted due to high acidity or slightly bitter taste and can be blended with other fruits to improve their acceptability and make use of available nutrients. The biochemical analysis of the Shaddock fruit juice could be the preliminary clues with respect to pharmaceutical value and nutraceutical values for process standardization and value addition with blending with other nutritious fruits and leaf extract.*

1. INTRODUCTION

The citrus genus has some of the most widely cultivated crops in the world because of their nutritional and potential health benefits. Citrus fruit have numerous therapeutic properties which inhibit the growth of various deadly diseases. Citrus fruits have unique properties which have ability to act as anticancer, antiviral, anti-tumor, anti-inflammatory. The flavor profiles of citrus juices depend on the balance between sugars and organic acids. Their nature and concentrations present significantly contribute to the perception of citrus juices [6]. Furthermore, the interaction of volatile and non-volatile components plays an important role in the organoleptic quality of food [3, 4, 9].

Citrus maxima (Shaddock) belong to the family Rutacea, and are one of the most cultivated crops in Assam. They are also known as pommelo, pomelo or shaddock.The fruit taste sweet and is slightly acidic with a hint of bitterness. The fruit is commonly classified as common (white) or pigmented (pink). The fruit is either round or oblong with white thick spongy pith that encloses the edible portion of the fruit. The fruit is native of Southeast Asia and the Indo-China regions. Since ancient times, the fruit have been practiced and used as an appetizer, anti-toxic, cardiac stimulant and stomach tonic [1]. The fruit also shares tremendous flavonoids such as neohesperidin, hesperidin, naringenin and naringin [4, 5, 11]. Interestingly, it has been reported that phytochemical profile can vary with their geographical location, cultivars and species, thus the fruit can exhibit various biochemical, metals and minerals especially antioxidant activity [2, 7]. Thus, the present study was carried out to portray the biochemical properties of citrus fruit (Shaddock) and assess the scope for ready to serve Juice.

2. MATERIALS AND METHODS

2.1. Sampling of citrus fruit

Locally available shaddock fruits were collected from Dogorpara village, Kokrajhar district, Assam. Mature Shaddock fruits were sorted and selected from the matured fruits (Fig. 1.). The fruit's maturity was determined by its dark yellow appearance. The uniform size, colour and maturity of the fruit was selected by visual observation and used as experimental material. The pinkish red variety colours of the shaddock flesh were only selected for the experimental purpose.

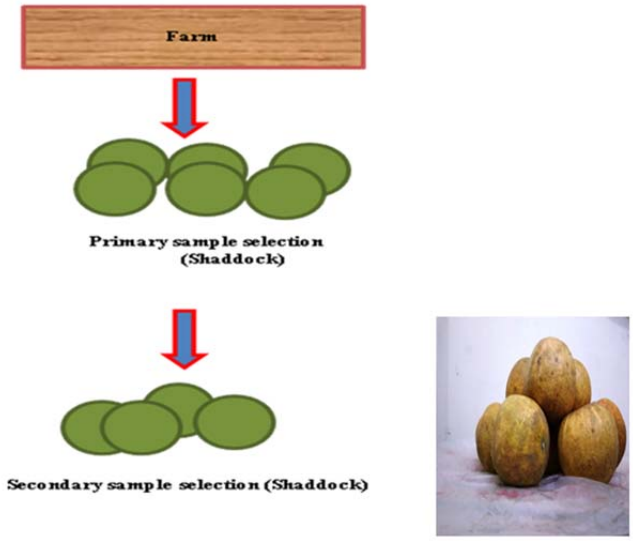

Fig. 1: Flow chart for sampling of shaddock.

2.2. Extraction of shaddock juice

Fully mature and uniform size shaddock fruits were cut nicely with the stainless steel knives and the albedo portion and seed was removed to avoid the bitterness of the juice. The juicy section of the fruits are separated nicely and blended in electric centrifugal fruit juice extractor. The juice was again filtered using whatman no.2 filter paper. The steps involved in the preparation of juice are shown in flow chart (Fig. 2).

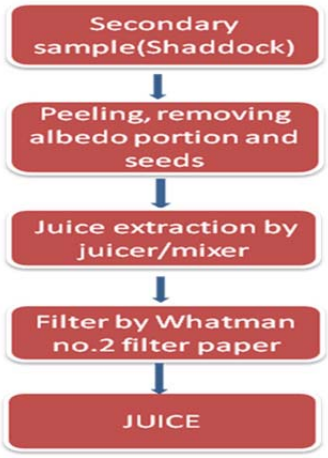

Fig. 2: Flow chart for extraction of shaddock juice.

2.3. Physico and Bio-chemical analysis

The physical properties considered for analysis are fruit weight, vertical diameter, horizontal diameter, peel thickness, peel weight and seeds. The bio-chemical properties considered for analysis are Total Soluble Solids (TSS), pH, acidity, sugar, moisture, fat, protein, carbohydrate, energy, ash, vitamin C, vitamin B complex and trace metals (calcium, zinc, potassium, magnesium, iron sodium). The physico and bio-chemical properties of the citrus fruit shaddock were analysed using standard procedures and shown in Table 1.

TSS were measured by hand refractrometer and the values were expressed in degree brix (Erma, 0-32°Brix), the acidity was determined by titrating unknown quantity of sample against 0.1 N sodium hydroxide solution using phenolphthalein as an indicator and expressed in per cent anhydrous citric acid, Lane-Eynon method was performed to determine the total sugar content of the juice, ascorbic acid content of the juice was titrimetrically estimated by indophenol dye method, The pH was determined by an Electronic pH meter. Ash, protein, fat, moisture was determined as per the procedure described by [8]. Carbohydrate was obtained by deducting total sum of fat, moisture, ash and protein with hundred. The energy of the juice was also obtained by multiply of four times with total sum of protein and carbohydrate plus nine times multiply of fat. The biochemical parameters such as micro and macro nutrients, vitamin B complex, Thiamine and Riboflavin present in the juice were determined using high performance liquid chromatography (HPLC) equipped with diode array detector (DAD) and inductively coupled plasma optical emission spectrometry (ICP-OES).

3. RESULTS AND DISCUSSION

3.1. Physical composition of shaddock

The physical parameters such as weight, vertical diameter, horizontal diameter, peel thickness, peel weight, and seeds of the 20 number of samples were assessed and presented in Table 1. From the citrus fruits (shaddock) samples, it was found that the weight ranges from 500 to 800g; vertical diameter from 355.6 to 381 mm and horizontal diameter from 330.2 to 381 mm; the peel thickness from 50 to 60 ; peel weight from 300 to 400g; number of seeds varies from 35 to 40. The average juicy recovery of shaddock was found 63%.

3.2. Bio-chemical composition of shaddock

The biochemical properties were determined using the standard analysis methods in triplicates. The TSS, pH, acidity, vitamin-C, sugar, protein, fat, moisture, ash, carbohydrate and energy of the citrus fruit shaddock obtained was shown in Table 2.

Table 1: Physical parameters of Shaddock fruit

Shaddock Sample	Weight (Gram)	Vertical diameter (mm)	Horizontal diameter (mm)	Peel thickness (mm)	Peel weight (Gram)	Seeds
S 1	700	356.9	360	55	333.01	38
S 2	755	380.2	370.5	57	350	35
S 3	678	381.0	366.6	55	377.23	39
S 4	500	259.6	354	50	389.27	40

S5	765	359.7	357.2	55	345.01	40
S 6	745	355.6	365.33	51	277.01	35
S 7	576	374.5	330.2	58	355.77	37
S 8	665	377.5	344.12	55	400	40
S 9	548	370.9	367.55	55	356.47	38
S 10	648	367.5	370	52	398.55	37
S 11	769	357.3	360.3	60	356.77	40
S 12	768	370.7	381	54	333.51	38
S 13	577	381	350.33	56	347.7	39
S 14	678	365.8	377.3	58	358.56	40
S 15	588	379.5	374.1	59	300	38
S 16	700	378.2	366.2	53	359.34	37
S 17	577	381	370.55	60	357.6	39
S 18	789	381	361.33	54	370	30
S 19	800	356.4	359.19	59	380.9	40
S20	547	377.5	365.01	50	394.48	40
Average	668.7	365.6	362.54	55.3	357.06	38
Maximum	800	381	381	60	400.00	40
Minimum	500	355.6	330.2	50	277.01	30

Table 2: Biochemical parameters of Shaddock fruit.

Parameters	Unit	Replications			Average
		R1	R2	R3	
TSS	Brix	6	7	8	7
pH	-	3.58	3.56	3.55	3.56
Acidity	mg/100 ml	1.09	1.10	1.09	1.09
Vitamin C	mg/100 ml	80	80	80	80
Sugar	g/100 ml	3.06	3.06	3.06	3.06
Moisture	g/100 ml	93.79	93.20	94.01	93.66
Ash	g/100 ml	0.35	0.35	0.35	0.35
Protein	g/100 ml	0.18	0.19	0.19	0.18
Fat	g/100 ml	0.13	0.10	0.09	0.10
Carbohydrate	g/100 ml	5.55	5.36	5.36	5.42
Energy	Kcal/100 ml	24.10	23.05	23.00	23.38

The analysis revealed that the fruit juice is acidic in nature and contain low fat, protein and with more vitamin C (80 mg/100ml) and energy (24kcal/100ml). Since the average TSS content was found 7, so the juice could be blended with other fruit and or leave extracts to standardize the juice.

The HPLC method was used to analyze the B-vitamin complex thiamine and riboflavin present in the shaddock juice. The present study for the analysis of thiamine and riboflavin was found minimal but could not quantify because the detection unit was less than 0.1 mg/100g. The chromatogram graph of blank and Shaddock fruit sample for identification of vitamin B1 and vitamin B2 complex using HPLC analysis are shown in Fig. 3 and 4, respectively.

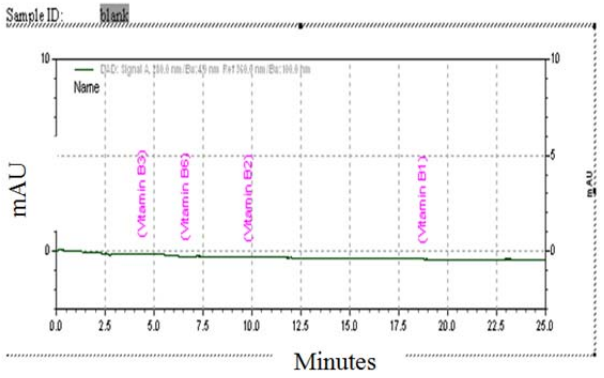

Fig. 3: HPLC chromatogram for blank sample

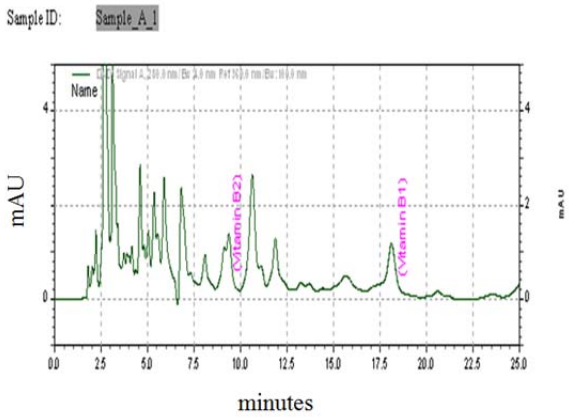

Fig. 4: HPLC chromatogram for Shaddock sample.

In addition, the analysis for the trace elements was determined using inductively coupled plasma optical emission spectrometry (ICP-OES). All analyses were performed on a ICP-OES equipped with standard torch assembly. Microwave digestion has shown to be useful for sample preparation. The trace levels of elements were determined simultaneously with macro levels of nutrient metals and minerals. The results obtained for standard (blank) and shaddock sample using inductively coupled plasma optical emission spectrometry (ICP-OES) is shown in Table 3 and 4.

Table 3: ICP-OES results of blank sample.

Sample Qty: Element	Corr. intensity	Con (calib) (mg/L)	Conc (sample) (mg/L)
Ca 317.933	11,935.9	0.005	0.005
Fe 238.204	-6,785.3	-0.012	-0.012
Na 589.592	-57,334.9	0.028	0.028
K 766.490	809.5	0.066	0.066
Mg 285.213	9,714.9	0.008	0.008
Zn 206.200	-316.1	-0.013	-0.013

Table 4: ICP-OES results of shaddock fruit juice.

Sample Qty: Element	Corr. intensity	Conc (calib.) (mg/L)	Conc (sample) (mg/L)
Ca 317.933	1,426,315.3	1.67	1.67
Fe 238.204	1869,032.3	2.48	2.48
Na 589.592	471,344.9	0.14	0.14
K 766.490	28,754,694.5	28.95	28.95
Mg 285.213	627,844.6	1.30	1.30
Zn 206.200	1,066.1	-0.01	-0.01

The sample of the citrus fruit shaddock was performed in triplicates for accurate results during the process .The observed trace elements in blank and shaddock sample were compared and quantified the available trace element in shaddock as shown in Table 5.

Table 5: Trace elements of shaddock.

Sl.no	Trace Elements	Observation (mg/L)
1	Calcium	77.37
2	Iron	57.80
3	Sodium	6.32
4	Potassium	1439.83
5	Magnesium	64.08
6	Zinc	0

4. CONCLUSION

Nutrient retention, appealing flavor, additional medicinal values and other organoleptic qualities are the main consideration in standardization of different ratios of blend components of fruit juice. So, the present study was undertaken to analyse of physical and bio-chemical, macro and micro nutrients properties of the citrus fruit (shaddock). The analysis revealed that the fruit juice is acidic in nature and contain low fat, sugar, protein and vitamin B complex. But the fruit contains more vitamin C, potassium and energy. It was found that the shaddock fruit has potential bio-chemical, nutrient characteristics which could be beneficial for promoting human health and preventing disease as well as value addition beverages. And further the quality of the shaddock fruit could be improved with blending of two or more fruits and leave extract as ready to serve beverage.

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