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Nutritional and Antioxidant Properties of Some Edible Mangrove Fruits Used by Rural Communities

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ABSTRACT

Edible fruits of mangrove play a significant role in the dietary requirements of the tribal and local communities of Odisha coast. The present study was attempted to evaluate the nutritional parameters viz. moisture, protein, total sugar, reducing sugar, non-reducing sugar and antioxidant potential viz. carotenoid and ascorbic acid and elements viz. sodium, potassium, calcium, iron, manganese, copper and zinc in mangrove fruits of *Bruguiera parviflora, B. cylindrica* and *Heritiera fomes.* Out of five nutritional parameters, *H. fomes* registered highest in four parameters among all studied species. To the contrary, *B. cylindrica* covered lowest in three parameters i.e Total sugar, Non-reducing sugar and Moisture. Amount of carotenoid was maximum in *H. fomes* whereas minimal content was recorded in *B. cylindrica. B. cylindrica* exhibited highest ascorbic acid content and lowest was noted in *H. fomes.* Likewise fruit of *B. parviflora* was found rich in macro element as well as microelement among all the studied species. On the other hand lowest level of macro element was recorded both in *H. fomes* and *B. cylindrica*. Least amount of microelement was recorded in *H. fomes* among all studied fruits. Fruits of *H. fomes* and *B. parviflora* may be act as a good source of nutritional and elemental factors respectively.

KEYWORDS-: antioxidant, mangroves, nutritional, wild fruits

INTRODUCTION

Presently there is a considerable interest in the commonly used edible fruits for search of nutraceuticals and natural antioxidant for their potential use in edibility and medicinal purpose. Mangrove fruits may provide an important source of nutrition and novel drugs. They provide innumerable direct and indirect benefits to human beings. However, very scarce information on edible properties of mangrove fruits is available. Their nutritional as well as antioxidant properties have not yet been extensively and scientifically evaluated. Keeping this in mind, we have attempted to study nutritional, antioxidant potential and elemental properties of three edible mangrove fruits of Odisha coast to find out a potent source of nutraceuticals.

Several studies have already been carried out on the nutritive values and presence of potent micronutrient in the fruits of different plant species (Halder *et al*., 2015) but less study have been documented with fruits of mangrove species (Halder *et al*., 2013). During recent years, there has been a growing interest to evaluate various mangrove fruits for their nutritional value (Rout *et al*., 2015; Sudirman *et al*., 2014; Patil and Chavan 2013; Jacoeb *et al*., 2013). Natural ascorbic acid is most vital for the performance of the body and lack of ascorbic acid in the body impairs the normal formation of intercellular substances throughout the body including collagen, bone matrix and toothdentine (Patra and Thatoi., 2011). Recently the nutritional and antioxidant properties of edible mangrove fruits have been reported (Rout *et al*., 2015).

However, report on scientific validation of nutritional as well as antioxidant potential of mangrove fruits is still not available. Present study is aimed to make a comparative evaluation of the nutritional and antioxidant potential of three edible mangrove fruits along Odisha coast, India.

MATERIALS AND METHODS

Materials

The mangrove fruits (viviparous hypocotyls) viz. *Bruguiera parviflora* (Roxb.) Wight & Arn.ex Griff. (Local name- Kalia chua), *Bruguiera cylindrica* L. (Blume) (Local name-Dot) (Fam.-Rhizophoraceae), *Heritiera fomes* Buch.-Ham (Local name-Sundari) (Fam.- Sterculiaceae) were collected from mangrove forest of Bhitarkanika of the

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Odisha coast (Buffer zone), India. Fruits of each species were collected from different individual trees (at least 10 randomly selected individuals).

Methods

Preparation of fruit samples for elemental analysis

All fruit samples were washed thoroughly and blotted dried. The fruits were dried in Hot air oven at 50^0 C and grounded to a fine powder. Powdered samples were stored in air-tight containers for further use.

Nutrient analysis of mangroves edible fruits

Extraction and estimation of total protein

The fresh fruit samples (500 mg each) were homogenized with pre-chilled mortar and pestle in ice-cold protein extraction buffer (5ml, pH 7.9). The crude homogenate was centrifuged at 10,000 rpm at 4°C for 30 mins and pellets were washed with 10% TCA and were incubated overnight at 4^0 C. Pellets were suspended in 2 ml of 0.1N NaOH. Estimation of total protein was made according to Lowery, (1951). Proteins in the test samples were estimated at 750 nm using bovine serum albumin (fraction V) as standard and calculated using standard curve and expressed mg per gm fresh weight basis.

Extraction and estimation of total sugar content

Total sugar was estimated by using the method of Rangana, (1979). 0.5 gm of fresh fruit samples were taken and homogenized with 80% alcohol and centrifuged the sample for three times at 5000 rpm for 20 mins. The supernatant were collected in fresh beaker and added small quantity of distilled water into the beaker. Heated the content of the beaker at hot plate till the smell of alcohol disappears (for about 3-4 hrs). The volume was made up to 100ml with distilled water and stored for further analysis. 1 ml of alcoholic extract was taken in a test tube and chilled. After a while 4 ml of anthrone's reagent was carefully run down the walls of the test tube. The test tubes were thereafter immersed in ice water. The tubes were brought to ambient temperature and boiled in water bath for 10 min. After proper cooling, the absorbance was measured at 625 nm. Total sugar content was calculated using standard curve (D-Glucose used as standard) and expressed as mg per gm fresh wt.

Extraction and estimation of reducing sugar content

Reducing sugar was estimated using Dinitrosalicylic acid (DNS) reagent (Miller, 1972). 100mg of the fruits sample were homogenized with 80% ethanol by centrifuging three times at 5000rpm for 20 minutes (5ml each time). The supernatant was collected and evaporated by keeping it on a water bath at 80°C. The sugars were dissolved by adding 10ml of distilled water. 3 ml of DNS reagent was added to 3 ml of sample in a lightly capped test tube. The mixture was heated at 90^0 C for 5-15 minutes to attain a red brown color. Then 1 ml of Rochelle's salt solution was added to stabilize the colour. After cooling to room temperature, absorbance was recorded at 575 nm. Reducing sugar content was calculated using standard curve (D-Glucose used as standard) and expressed as mg per gm fresh wt.

Extraction and estimation of non-reducing sugar content

Non-reducing was calculated by subtracting the amount of reducing sugar from that of total sugars.

Moisture content

The percentage of moisture content was determined using the method of AOAC, (2000). The empty dish was dried in the hot air oven at 105°C for 3 hours and then transferred to room temp to cool. The empty dish was then weighed. 3gms of fresh sample was weighed to the dish. The sample was spread to uniformity. The dish was placed with the sample in the hot air oven. It was dried for 3 hours at 105°C. After dried, the dish with the partially covered lid was transferred to room temp to cool. The dish and its dried sample were re-weighed. Percent of moisture content was calculated following method and expressed as percentage.

Moisture (%) = $W_1 - W_2 / W_1 \times 100$

Where, W_1 = Weight (g) of sample before drying.

W_2 = Weight (g) of sample after drying.

Antioxidant analysis of mangrove edible fruits

Extraction and estimation of ascorbic acid content

Ascorbic acid was estimated following the method of Harris and Ray (1935). Sample extraction was done by grinding 0.5g of sample material in 6% oxalic acid solution followed by centrifugation at 3000 rpm for 10 mins.

Transferred the aliquot and made up the volume to 100ml. 5ml of supernatant was added to 10ml of 0.6% oxalic acid solution and it was titrated against dye solution (standard indophenols solution) till pale pink colour was seen. Standardization of dye was done with standard ascorbic acid (1mg/ml). Total ascorbic content(mg/100g) of fruits were calculated by (0.5mg/volume 1) × (volume 2/5ml) × (100ml/ wt. of the sample) × 100, where, volume 1 is burette reading of titration of dye against standard ascorbic acid and volume 2 is burette reading of titration of dye against sample.

Extraction and estimation of carotenoid content

Carotenoid was evaluated following standard method of Arnon (1949). 0.5 gm of the sample was weighed and homogenized in 5 ml of 80% acetone. The volume was then made up to 50ml. The sample was centrifuged at 5000 rpm for 20 minutes till the supernatant became transparent. The supernatant was taken and absorbance was measured at 480, 645 and 663 nm. The quantity of pigments were calculated by the formula and expressed as mg per gm fwt.

Carotenoid (mg/g fwt.) = [O.D 480+0.11(O.D 663) - 0.638(O.D 645)] x 400

Elemental analysis

Some 0.5 g of fine powdered sample of each fruit was digested following wet digestion procedures using conc. HNO_3 and 30% H_2O_2. The digested samples were used for elemental analysis. Iron (Fe), Copper (Cu), Manganese (Mn) and Zinc (Zn) was determined using Atomic Absorption Spectrophotometer and Sodium (Na), Potassium (K), Calcium (Ca) using Flame photometer.

RESULTS AND DISCUSSION

Nutritional analysis

The comparative evaluation of nutritional potential of three selected edible mangrove fruits viz. *Bruguiera parviflora*, *Bruguiera cylindrica* and *Heritiera fomes* was carried out with various parameters such as protein, moisture, total sugar, reducing sugar and non reducing sugar. The highest protein content was exhibited in *H. fomes* (12±0.34 mg/gm fwt.) whereas the lowest was recorded in *B. parviflora* (9.13±1.47 mg/gm fwt.). Protein content of fruits of *H. fomes* was up by 1.31 times as compared to *B. parviflora.* Total protein content of the fruits recorded in this study was higher than those values obtained in *B. gymnorrhiza* fruits as reported by Rout *et al*., (2015); Patil and Chavan., (2013); Quadri and Jamil., (1993) reported protein content relatively higher in *Ceriops tagal* belonging to the species family Rhizophoraceae. Amount of moisture content ranged from 52.61±2.73 % in *B.cylindrica* to 64.44±2.67 % in *B. parviflora* (Table-1). Moisture content of *B. parviflora* was increased by 1.22 fold higher than in fruits of *B.cylindrica.* Moisture (71%) content obtained in *B. gymnorrhiza* were found higher as compared to an earlier report with moisture (66%) by Patil and Chavan., (2013). On the contrary, protein and moisture content were comparatively lower than values obtained in fruits of *B. gymnorrhiza* by Jacoeb *et al*., (2013). Among three edible fruits, *B. cylindrica* showed minimal total sugar content (42±2.82 mg/gm) whereas the fruits of *H. fomes* possessed maximum content (457.33±4.61 mg/g fwt.). Fruits of *H. fomes* exhibited 10.88 fold higher total sugar content than in fruits of *B. cylindrica*. However, non reducing sugar content was found highest in *H. fomes* (448.8±4.52 mg/gm fwt.) followed by *B. parviflora* (84.6±2.07 mg/gm fwt.) and *B. cylindrica* (40±2.8 mg/gm fwt.). It was found that *H. fomes* registered 11.22 fold higher than *B. cylindrica*. Reducing sugar content of *H. fomes* (8.53±0.41 mg/g fwt.) exhibited 11.68 fold higher than *B. parviflora* (0.73±0.23 mg/gm fwt.). This amount of reducing sugar in *H. fomes* was appreciable higher than the *B. parviflora.*

Table-1:- Nutritive value of three edible mangrove fruits

Fruit Species	Nutritional Parameters				
	Protein (mg/g fwt.)	Total sugar (mg/g fwt.)	Reducing sugar (mg/g fwt.)	Non reducing sugar (mg/g fwt.)	Moisture (%)
Bruguiera cylindrica	11±1.11	42±2.82	2.06±0.11	40±2.8	52.61±2.73
Bruguiera parviflora	9.13±1.47	85.33±2.3	0.73±0.23	84.6±2.07	64.44±2.67
Heritiera fomes	12±0.34	457.33±4.61	8.53±0.41	448.8±4.52	57.63±0.99

Values expressed as mean±standard deviation (from 3 determinants)

Elemental analysis

Maximum sodium content was found in *B. parviflora* (1090±1 mg/100g dry wt.) and minimum in *B.cylindrica* (700±1 mg/100g dry wt.). Likewise, *H. fomes* (800±7.81 mg/100g dry wt.) exhibited highest potassium content whereas the minimal in *B. cylindrica* (250±3.60 mg/100g dry wt.). It was observed that calcium content was

found to be highest in *B.cylindrica* (280±1.73 mg/100g dry wt.) and lowest in *H. fomes* (120±3.60 mg/100 g dry wt.). *B. parviflora* showed highest iron, manganese and zinc content (2.93±0.05 mg/100g dry wt., 3±0.1 mg/100g dry wt., and 1.04±0.005 mg/100g dry wt. respectively) while *H. fomes* showed the lowest (0.015±0.0005 mg/100g dry wt., 0.013±0.001 mg/100g dry wt. and 0.006±0.001 mg/100g dry wt. respectively) (Table-2 and Figure-1 & 2). Among studied mangrove fruits, maximum cupper was noted in *B.cylindrica (*1.4±0.1 mg/100g dry wt. Halder *et al*., (2015) reported higher value for Ca, Na and K in *H. fomes* as compared to the present estimation. However, estimated values for iron, Cupper, manganese and Zinc were corroborated with the value reported by Halder *et al*., (2015). Fruits of *Sonneratia apetala* had lower amount of Ca, Fe, Na, K, Zn as compared to the values reported by Halder *et al*., (2015). The values obtained for micro and macro elements were found at par with our previous report (Rout *et al*., 2015).

Table-2:- Elemental analysis of three edible mangrove fruits

Fruit Species	Elemental Parameters						
	Sodium (Na) (mg/100g dry wt.)	Potassium (K) (mg/100g dry wt.)	Calcium (Ca) (mg/100g dry wt.)	Iron (Fe) (mg/100g dry wt.)	Manganese (Mn) (mg/100g dry wt.)	Cupper (Cu) (mg/100g dry wt.)	Zinc (Zn) (mg/100g dry wt.)
Bruguiera cylindrica	700±1	250±3.60	280±1.73	2±0.1	2.63±0.05	1.4±0.1	0.35±0.005
Bruguiera parviflora	1090±1	480±3	240±5	2.93±0.05	3±0.1	1.1±0.1	1.04±0.005
Heritiera fomes	1060±2.64	800±7.81	120±3.60	0.015±0.0005	0.013±0.001	0.025±0.0005	0.006±0.001

Values expressed as mean±standard deviation (from 3 determinants)

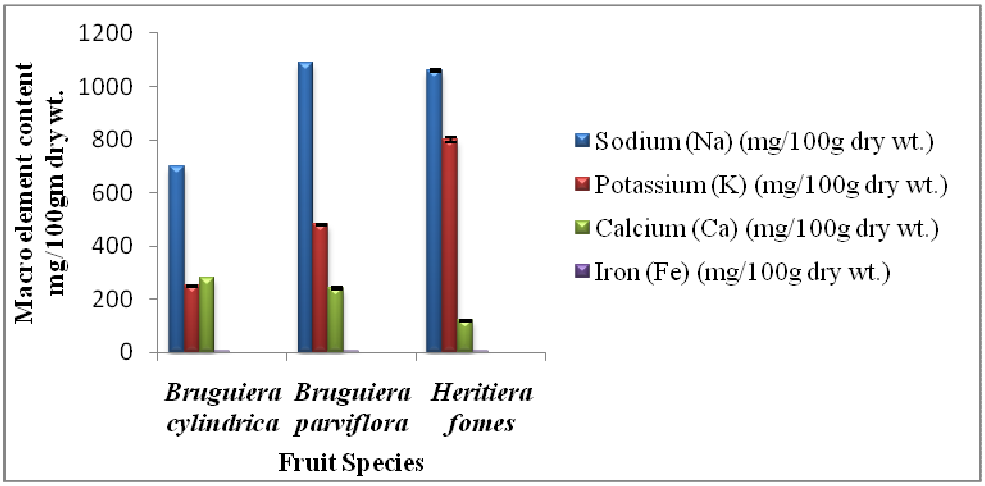

Figure-1:- Macro element analysis of three edible mangrove edible fruits

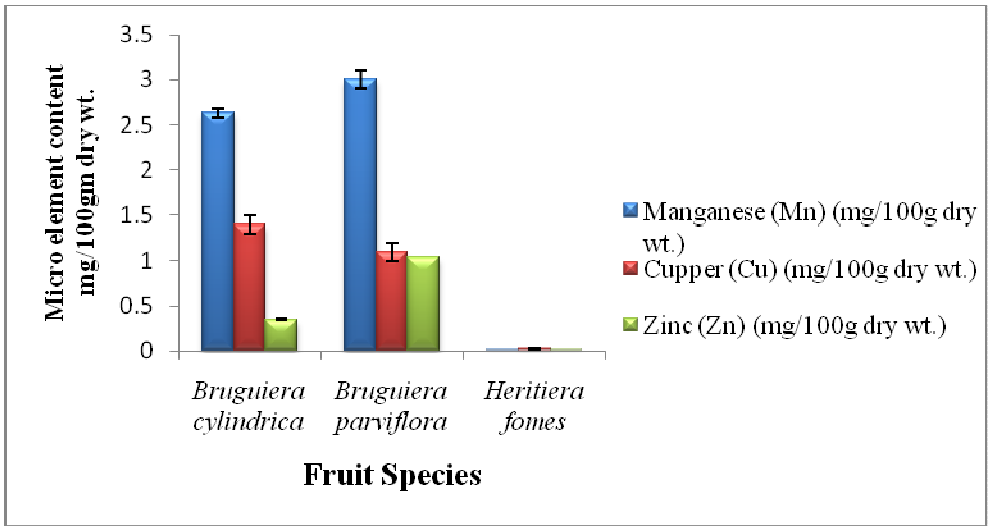

Figure-2:- Micro element analysis of three edible mangrove edible fruits

Antioxidant analysis

Mangrove fruits are used as folklore medicine to treat diseases Bandaranayake., (1998). The present study also analyzed the three mangrove fruits for their ascorbic acid and carotenoid content to evaluate their nutritional adequacy. The study showed that all the mangrove edible fruits under investigation were good sources of ascorbic acid or vitamin C. Vitamin C is a water soluble antioxidant and has a great role to prevent cough and cold. Deficiency of vitamin C can lead to anemia, scurvy, infections and bleeding gums, delayed wound healing and neurotic disturbances (Iqbal *et al*., 2004). Highest ascorbic acid content was obtained in *B. cylindrica* (101.86±4.40 mg/gm) followed by *B. parviflora* (63.73±3.02 mg/gm), *H. fomes* (49.06±1.84 mg/gm) (Table-3). Fruits of *B. cylindrica* exhibited 2.07 fold higher ascorbic acid content than fruits of *H. fomes*. The content of ascorbic acid (49.06 to 1.1.86 mg/100g fwt.) and carotenoid (5.681 to 16.44 mg/g fwt.) were comparatively higher than the value reported earlier by Rout *et al*., (2015). Moreover, the ascorbic acid content was also found higher than the values reported in *A. ilicifolius* fruits by Kumari *et al*., (2014). The lowest amount of carotenoid was noted in *B.cylindrica* (5.681±5.62 mg/g fwt.) and highest in *H. fomes* (16.44±1.82 mg/g fwt.). It was found that fruits of *H. fomes* showed 2.89 fold higher carotenoid content than the fruits of *B. cylindrica*.

Table-3:-Ascorbic acid and carotenoid content of three edible mangrove fruits

Fruit Species	Antioxidant analysis	
	Ascorbic acid content (mg/100g fwt.)	Carotenoid content (mg/g fwt.)
Bruguiera cylindrica	101.86±4.40	5.681±5.62
Bruguiera parviflora	63.73±3.02	8.88±6.53
Heritiera fomes	49.06±1.84	16.44±1.82

Values expressed as mean ± standard deviation (from 3 determinants)

CONCLUSION

High nutritional and antioxidant potential of three mangrove fruits may open new avenue to mitigate many nutritional disorder and useful for food industry to produce a variety of value added products and as an alternative source of bio-nutrition. The nutritive value of *Heritiera fomes* was also high as compared to other studied edible fruits. Thus, the above mentioned promising species deserved to be accepted as non-conventional bio-nutritional sources based primarily on their nutritional and antioxidant properties.

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