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UNDER UTILIZED FRUITS DERIVED NUTRACEUTICALS: A REJUNUVATOR

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ABSTRACT

The nutritional factors of the three different edible fruits were investigated. They were significant differences between the species in the percent of total carbohydrates, proteins, total fat and crude fiber. The mineral composition of the fruit sample is sodium, potassium, calcium, iron, phosphorus, magnesium, zinc, copper, boron, sulphur, chloride, manganese and selenium were determined. Low levels of lipid profile were analyzed in the selected samples. Some of the metals were analyzed they are in below detectable level. Vitamin C and Vitamin A were also determined in three selected fruit samples. Among all the mineral, Potassium, Calcium and Iron were found in major elements in all fruits. Potassium were analyzed as the major constituent found in large quantity in all fruits. *Trema orientalis* fruits rich in vitamin –A. while, vitamin-C rich in *Syzygium jambos* fruits.

KEYWORDS: Nutritional Factors, Edible Fruits, Minerals, Vitamins, Lipid Profile, *Syzygium jambos, Trema orientalis, Rubus ellipticus*.

Phyto-nutritional therapy have emerged as new concepts of health aid in recent years. Strong recommendations for consumption of nutraceuticals from plant origin have become progressively popular to improve health, and to prevent and treat diseases. Nutraceuticals are naturally derived bioactive compounds that are found in foods, dietary supplements and herbal products, and have health promoting, disease preventing and medicinal properties. Plant derived nutraceuticals/functional foods have received considerable attention because of their presumed safety and potential nutritional and therapeutic effects (Shashi Pandey *et al.,* 2011). A nutraceutical is the opposite of junk food and according to the world Health Organization, over 80 % of the world's population (4.3 billion people) rely upon such traditional plant-based systems of medicine as phytochemicals, nutritional constituents or as functional foods (Allen, 1997; Kasbia, 2005). Functional foods are ordinary foods that have components, ingredients, incorporated in them to give them a specific medicinal or physiological benefit other than a purely nutritional effects (Brower, 1998; Elizabeth, 2002; Whitman, 2001; Adom and Liu, 2002).

In many tropical countries, rural people traditionally harvest wide range of leafy vegetables, roots, tubers and fruits from wild because of its taste, cultural uses, as food supplements or to tide over food shortage. Wild plants have been recognized to have potential to meet household food and income security (Guinand and Dechassa, 2000; Kebu and Fassil, 2006). Many wild fruits notably, Amla, Harida, Bel, Eleplant apple have been exploited from wild for centuries across Indian subcontinent on account of its food and medicinal properties. In India, the indigenous fruits collected from wild play significant role in the food and nutrient security of rural poor and tribal. Some wild fruits have been identified to have better nutritional value than cultivated fruits (Eromosele *et al.,* 1991; Maikhuri *et al.,* 1994). As a result, in recent years, a growing interest has emerged to evaluate various wild edible plants for their nutritional features (Nazarudeen, 2010; Nkafamiya *et al.,* 2007; Glew *et al.,* 2005).

FRUITS WITH NUTRIENTS

Aknowledge of the bio-chemical composition and potential biological properties of plant extracts is essential for their further use in the food industry (Katalinic *et al.,* 2013. The herbal plants are also known to have high amounts of essential nutrients, vitamins, minerals, fatty acids, and fiber (Gafar and Itodo, 2011). Minerals are required for growth, activities of muscles,

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skeletal development (such as calcium), cellular activity, oxygen transport (copper and iron), chemical reactions in the body, intestinal absorption (magnesium), fluid balance, and nerve transmission (sodium and potassium), as well as the regulation of the acid- base balance (phosphorus) (Ozcan, 2003).

Many studies are demonstrating the properties of the polyphenolic flavonoid plant –derived constituents of the human diet. Fruits and vegetables have plenty of natural antioxidants, especially vitamin C and E contained in fruits are beta-carotene, phenolic compounds, such as anthocyanin and other flavonoids, which showcase a wide range of biological benefits including antioxidant (Elliot, 1992), anti-inflammatory (Bertuglia *et al.,* 1995 and Borissora *et al.,* 1994) and anticarcinogenic properties (Hou, 2003, Hou *et al.,* 2004, Kang *et al.,* 2003 and Bomser *et al.,*1996). Flavonoids, are important constituents of fruit, vegetables and beverages which contain a wide variety of phenolics in differing amounts (Macheix, 1990; Hertog *et al.,* 1992; Clifford,1999; Tomas-Barberan, 2000; Clifford, 2000; Hollman, 2000). These naturally occurring phenolic compounds can be categorized into five major groups: viz.. Flavonols, Anthocyanins, Hydroxycinnamates, Flavanones, Flavan-3-ols and the related oligomeric procyanidins (Harborne and Mabry, 1982).

An increasing number of studies suggest that consumption of fruit and vegetables can reduce the risk of both cancer and cardiovascular disease, in which components such as vitamin C and E, flavonoids and carotenoids may play a protective role (Gey *et al.,*1991; Ziegler, 1991; Gaziano *et al.,* 1992; Gaziano and Hennikens, 1996; Gandini *et al.,* 2000). Therefore, much attention is currently being paid to the possible health benefits of dietary flavonoids (Joseph *et al.,* 1998; Cao,Y and Cao, R, 1999; Fuhrman *et al.,* 1995; Gaziano, 1996; Hertog *et al.,*1995; Middleton *et al.,* 2000). Flavonoids, as well as flavonoid-rich foods and beverages, show a wide range of antioxidant activities *in-vitro* (Rice-Evans *et al.,* 1996; Visioli *et al.,* 1998; Jovanovic *et al.,* 1998; Paganga *et al.,* 1999; Cao *et al.,* 1996; Wang *et al.,* 1996). The flavonones are mainly found in citrus fruits. Little is known about the bioavailability and absorption and metabolism in man and it is likely that different groups of flavonoids have different pharmacokinetic properties.

MATERIALS AND METHODS

Collection of Plant Samples

Fresh fruits of *Syzygium jambos* (Alston) L., *Trema orientalis* Blume and *Rubus ellipticus* were collected from the natural strands of The Nilgiris district, Tamil Nadu India. (Plate 1,2 &3). The botanical identity of the collected specimens were properly authenticated by Botanical Survey of India (Southern Circle), Coimbatore. The voucher specimens were deposited at the library of BSI –TNAU campus, Coimbatore. Tamil Nadu, India. Fresh plant materials were washed under running tap water, air dried and then homogenized to fine powder and stored in airtight bottles.

Physicochemical Analysis

The sensory nature of dry powder of selected plant materials were observed by keeping a small quantity in a petridish and placed on a white background and the organoleptic characters were observed and tabulated. The physicochemical characters like foreign matter, loss on drying, contents of total ash, acid insoluble ash, water soluble ash, sulphated ash and extractive values were determined according to the method adopted by the Ayurvedic Pharmacopoea (1989).

Nutritional Parameters

Extraction and Estimation of total Carbohydrate

The total carbohydrates content of leaves were extracted and estimated by following the method of Hedge and Hofreiter (1962). 100mg of the leaf extract was hydrolyzed with 5ml of 2.5% N HCl in a boiling water bath for 3h. The contents were neutralized with sodium carbonate and made up to 100ml with distilled water. The contents were centrifuged at 5000 rpm for 10 min and the supernatant was collected. Suitable volume of this extract was added with 4ml of anthrone reagent and kept in a boiling water bath for 8min. Then the content was cooled and the optical density was measured at 630 nm. From the standard curve prepared with glucose, the amount of total carbohydrates present in the leaf was calculated and the results were expressed as g/100g leaf sample on dry weight basis.

Extraction and Estimation of Proteins (True Proteins)

Extraction (Rajaram and Janardhanan, 1990**)**

One g of the air dried leaf sample was defatted by macerating with petroleum ether, after (1:10w/v) for 6h. The petroleum ether was removed by centrifugation at 5000xg for 10min. The pellet was washed with 100ml of cold 10 % (w/v) Trichloro acetic acid (TCA) and centrifuged at 20,000xg for 15min. The procedure was repeated, the

resulting TCA-washed pellet was suspended in 50ml of 1N NaOH solution and incubated at 45 ^{0}C for 16h. The resulting hydrolysate was centrifuged at 20,000xg for 20min. The pellet was re-extracted with 20ml of 1N NaOH solution and centrifuged the supernatants were pooled together.

Protein Determination

The protein from 1ml of the pooled supernatants was precipitated with equal volume of cold 20 % (w/v) TCA for 30min at 4^{0}C. After centrifugation, the protein pellet was dissolved in 0.1N NaOH and from suitable aliquots, the protein content was measured by the method of Lowry *et. al*.,(1951) using bovine serum albumin faction V (sigma chemical) as a standard in a UV-Visible spectrophotometer (Merck) at 750 nm. Average value of triplicate estimations was calculated and the content of true protein was expressed on dry weight basis.

Determination of Ether Extract (or) Crude Fat Content (AOAC, 1970)

Two g of air dried leaf powder was extracted with ether in a Soxhlet apparatus for 16 h. according to the AOAC (1970). The ether was evaporated and the residue was weighed. The average value of triplicate experiments was expressed as percentage of ether extract or total lipid content on dry weight basis.

Determination of Crude Fiber

Crude fiber content in different accessions of leaf sample was estimated according to the method of AOAC (1970). After extraction of crude lipids, One gram of the residue (W1) was taken in a beaker and boiled with 0.225 N H_2So_4 for 30 min in a water bath. Then the contents were filter through a muslin cloth. The residue in the muslin cloth was washed with 30ml of boiling water. The residues were transferred to a beaker and add 100ml of 0.313N NaOH. Boil the contents for 30 min in a boiling water bath and filter through the muslin cloth. The collected residue was washed with hot 1.25% H_2So_4 and subsequently washed with the 350 ml of water and 25 ml of ethanol. The contents were dried in an hot air oven for one hour. Then the contents were cooled in desicator and weighed (W2). The contents were transferred to a crucible and ignited in a muffle furnace at 600^{0}C for 30 min then the contents were cooled in a desicator and weighed (W3). The crude fiber content of the sample was calculated.

$$\text{Crude fiber} = \frac{(W2 - W1) - (W3 - W1) \times 100}{\text{Weight of the Sample}}$$

Mineral Composition

Estimation of Potassium

0.3 g of dry sample was weighed in a conical flask. Then 5 ml of double acid was added. Mixture was put digested until the solution become clear. Residue was washed by water and filtered through ordinary filter paper and made to 100 ml. This solution was taken as A.-5 ml of above solution was taken and made to 50 ml using distilled water. This solution is B and used for potassium estimation by using *Flame Photometer Modal-EEL*.

Calculation

$$K\ \% = GR \times F \times 100/wt \times 50/5 \times (\text{dilution factor}) \times 100/10^6$$

Where, F = factor (100 = how much ppm) ppm = GR × F × 100/wt × 50/5

Estimation of Calcium and Magnesium (Jackson, 1967).

5 ml of sample solution was pipetted out into a beaker. Then 5 ml of KCN solution and 10 ml of Ammonium chloride-ammonium hydroxide buffer was added followed by 2 drops Solochrome black 1 indicator and titrated against EDTA. At end point the wine red color of the solution changes to pure blue color. 5 ml blank solution was also titrated as above.

Calculation

The first three values is a direct measure of calcium present in 5 ml aliquot. The amount of Mg present is obtained from the difference between the first and second titrate values.

$$Ca\ \% = V \times N \times 100/wt \times 100/5 \times 20/1000$$

$$Mg\ \% = V \times N \times 100/wt \times 100/5 \times 12/1000$$

Estimation of Phosphorous (Dickman and Bray, 1940).

One ml of triple acid digested extract was pipette into 100 ml volumetric flask. To this 50ml glass distilled water was added, followed by 5ml ammonium malybdatesulphuric acid reagent (solution A: 25g of ammonium malybdate was dissolved in 100 ml of distilled water. Solution B: 280ml of Conc. H_2So_4 was diluted to 800 ml. Solution A was added slowly with constant stirring to solution B and the volume was made up to 1000ml with glass distilled water). Blue color was

developed by adding six drops of p^H5 % (w/v) stannous chloride solution. The total volume was made up to 100 ml. the intensity of the blue color was measured at 650nm in a Spectrophotometer. The phosphorus content present in the sample was calculated by referring to a standard graph of phosphorus using potassium dihydrogen phosphate (KH_2PO_4) as standard and expressed as $mg100^{-1}g$ of fruit sample.

Estimation of Iron (Fe), and Zinc (Zn) using Atomic Absorption Spectroscopy

After performing either a dry ash or wet acid digestion on a known dry weight (usually about 1 g) of tissue, the obtained ash or digest is wetted with a small amount of deionized water and then brought into solution using 2 ml concentrated HC1. The final dilution with deionized water should be based on the predicted concentration of the element to be determined, ensuring that the final concentration is neither at or below the method detection limits nor above the normal operation range. For determination of the elements Fe, and Zn, final volumes between 10 to 50 ml are required.The wavelength setting for the elements are as follows:

Estimation of Sulphur

2 g of selected fruit powder was weighed in a 250 mL conical flask. Then, 100 mL of the monocalcium phosphate extracting solution (500 mg /L) was added and shaked for 1 hour. The content was filtered through No. 42 filter paper. The 10 ml of the clear filtrate was put in a 25 ml volumetric flask and 2.5 ml of 25% HNO_3 and 2 ml of acetic-phosphoric acid were added. The solution was diluted to about 22 ml and the flask was stoppered well. The $BaSO_4$ suspension was shaked and then 0.5 ml of it and 0.2 g of $BaCl_2$ crystals were added. The flask was inverted several times at intervals for 15-20 minutes. Finally the flask was allowed to stand for 15 minutes and 1 ml of gum acacia-acetic acid was added. The volume was made up to 25 ml, inverted 3 times and set aside for 90 minutes. Then the flask was inverted 10 times and the turbidity intensity was measured at 440 nm using spectrophotometer.

Calculation

S (mg/kg) = (W x 100) / (10 x 2) = W/0.2.

Quantification of vitamin-C

Extraction and Estimation of Ascorbic acid

The vitamin ascorbic acid (Vitamin- C) concentration in the leaf sample was extracted and estimated by following the method of Hawks (1954). 500mg of the sample was grinded with 25ml of 4% oxalic acid in a mortar and pestle and the contents were centrifuged at 8000 rpm for 10min. The supernatant was collected and 10ml of the aliquot was transferred into a conical flask and few drops of bromine water were added drop wise with constant mixing, the enolic hydrogen atoms in ascorbic acid were removed by bromine and when the extract turned to orange yellow in color due to excess of bromine, it was expelled by blowing in the air.

RESULTS AND DISCUSSION

Physicochemical Properties

In the present study, selected fruit samples of *S. jambos, T. orientalis* and *R. ellipticus* were subjected to quantitative analyses of physiochemical properties (Table-1). Solvent/ aqueous extract of the selected samples shows the presence of physiochemical characters, the results were expressed in the table.

Table 1: Physicochemical properties of ethanolic extract of selected wild edible fruits

S. No.	Parameters	*Syzygium jambos*	*Trema orientalis*	*Rubus ellipticus*
1	Taste	Slightly bitter	Astringent	Sweetish sour
2	Color	Dark yellow	Dark brown	Light red
3	Odour	Fruity odour	No odour	Pleasant odour
4	Foreign matter (%)	0.15 ± 0.01	0.09 ± 0.06	0.26 ± 0.04
5	Loss on drying (%)	5.28 ± 0.18	6.24 ± 1.04	8.69 ± 1.03
6	Total ash (%)	2.46 ± 0.06	3.18 ± 0.52	4.02 ± 0.16
7	Acid insoluble ash (%)	0.37 ± 0.02	0.46 ± 0.05	0.14 ± 0.01
8	Water soluble ash (%)	1.52 ± 0.21	1.35 ± 0.08	1.21 ± 0.24
9	Sulphated ash (%)	0.17 ± 0.01	1.17 ± 0.02	1.63 ± 0.08
10	Solubility in alcohol (%)	85.62 ± 1.24	76.12 ± 2.16	88.34 ± 1.72
11	Solubility in water (%)	53.04 ± 1.63	63.27 ± 1.42	62.81 ± 2.36
12	Extract yield (%)	1.74 ± 0.12	0.86 ± 0.02	1.29 ± 0.14

Nutritional Studies

The data on the nutritional parameters of the selected fruit samples were investigated and the results were presented in Table- 2. Among the selected fruit samples the *T. orientalis* has registered the high levels of nutritional parameters. In addition vitamin C (19.1mg/100g) was highly presented in *S. jambos* fruits. This results compared to the earlier report on *T. cardifolia* and *P. americana* fruits has very low levels of nutritional parameters (Rajalakshmi *et al.,* 2015).

Table 2: Nutritional parameters of selected wild edible fruit samples

S. No	Nutritional parameters	Fruit samples		
		S. jambos	***T. orientalis***	***R. ellipticus***
1	Total carbohydrates (g/100 g)	32.00	32.18	20.80
2	Total protein (g/100 g)	24.40	22.47	21.06
3	Fat (g/100 g)	0.026	2.39	0.031
4	Fiber (g/100 g)	3.88	13.57	2.98
5	Vitamin-A (mg/100 g)	0.017	87.18	0.012
6	Vitamin-C (mg/100 g)	19.1	12.35	1.02

Mineral Composition

The data on mineral composition of fruit samples were presented in Table 3, which revealed that calcium (1100mg/100g) occurred as the major element which registered highest in *T. orientalis* fruits. The potassium (410mg/100g) content was found in high level in *R. ellipticus* fruits when compare to the other samples. Among the three different fruit samples, the *T. orientalis* fruits has registered highest value of phosphorus (210mg/100g) content. These values were compared to earlier reports on Banana, *Carissa spinarum*, Guava, Pomegranate, *Eugenia rothii*, *Mimusops elengi*, *Mulas domestica*, Papaya, Grapes (Ajai kumar *et al.,* 2012). The highest iron content was recorded in *P. americana* fruit (40mg/100g) Rajalakshmi *et al.,* 2015.

Table 3: Mineral composition of selected wild edible fruit samples

S. No	Mineral composition	Samples-fruits		
		S. jambos	***T. orientalis***	***R. ellipticus***
1	Sodium (mg/100 g)	23.8	23.0	120
2	Potassium (mg/100 g)	110	180	410
3	Calcium (mg/100 g)	5.1	1100	30.06
4	Iron (mg/100 g)	0.0024	22	0.004
5	Phosphorus (mg/100 g)	6	210	0.95
6	Magnesium (mg/100 g)	2.43	380	6.08
7	Zinc (mg/100 g)	0.04	BDL	11.32
8	Copper (mg/100 g)	0.012	-	0.018
9	Boron (mg/100 g)	0.041	-	0.05
10	Sulphur (mg/100 g)	25.54	60	60.38
11	Chloride (mg/100 g)	14.18	-	8.86
12	Manganese (mg/100 g)	0.023	-	1.37
13	Selenium (mg/100 g)	ND	BDL	BDL
14	Lead (mg/Kg)	0.0017	BDL	0.0083
15	Cadmium (mg/Kg)	0.0023	BDL	0.0013
16	Palladium (mg/Kg)	ND	BDL	ND

Lipid Profile

In the present study showed significant variation in lipid profile of the selected fruit samples. The results presented in table-4.

Table 4: Lipid profile of selected wild edible fruit samples

S. No	Lipid parameters	Fruit samples		
		S. jambos	***T. orientalis***	***R. ellipticus***
1	Total fat (g / 100 g)	0.026	6.1	0.031
2	Saturated fat (g / 100 g)	0.002	0.00	0.001
3	Mono un saturated fat (g / 100 g)	0.006	3.1	0.01
4	Poly un saturated fat (g / 100 g)	0.018	3.4	0.02
5	Trans fat (g / 100 g)	-	-	-

CONCLUSION

Nutraceuticals are of great importance in present system of Medicine and healthcare. Future demand of nutraceutical depends upon consumer perception of mankind and the relationship between diet and disease. Although nutraceuticals and function food have significant role in the promotion and care of human health to prevent diseases, the health professionals, nutritionists, biotechnologists, regulatory toxicologist and nutraceutical industrialist should strategically work together to plan appropriate regulation to provide the ultimate health and therapeutic benefits to mankind with purity, efficacy, and safety.

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