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Chemical composition, antioxidant and anti-hemolytic activity of musa (AAB) var. sirumalai banana pulp and its peel

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ABSTRACT

Banana pulp and peel were analysed for their major nutrient contents, phytochemical constituents namely phenol and flavanoid, antioxidant and anti-hemolytic activity. The selected variety was Sirumalai banana variety. The result revealed the presence of nutrient constituent comprising moisture (71.12±0.03% for pulp and 6.03±0.05% for peel); ash (06.57±0.07% for pulp and 08.52±0.01% for peel); Carbohydrate (41.82±0.09% for pulp and 25.31±0.04% for peel); protein (07.62±1.02% for pulp and 03.23±0.015% for peel); fat (11.91±0.28% for pulp and 0.986±0.02% for peel) and fiber (22.78±0.12% for pulp and 23.24±0.01% for peel). Phenol content of pulp and peel were found to be 0.98±0.09mg/g and 0.52±0.11mg/g respectively. Flavanoid content of pulp and peel were found to be 29.92±0.24 mg/g and 22.76±0.07 mg/g respectively. Antioxidant activity of the banana variety was analysed by DPPH and hydroxyl scavenging activity. DPPH scavenging percentage of pulp and peel was found to be 81.72±0.06% and 71.95±0.21%. Hydroxyl scavenging percentage of pulp and peel was found to be 70.04±0.13% and 58.98±0.17%. Percentage anti-hemolytic activity of Sirumalai pulp ranged from 31.18±0.01% to 76.22±0.16; peel ranged from 24.31±0.02% to 64.69±0.04% at a concentration of 100-500 mg/ml. The results revealed that banana pulp and peel consist of essential chemical constituents that have good antioxidant and anti-hemolytic activity.

Introduction

Fruits are important natural sources of antioxidants and dietary fiber. In addition fruits are also the good source of phytochemicals, they are non-nutritive plant chemicals which have disease preventive properties (Kokate et al., 2006). In their natural environment, fruits are exposed to oxygen in the air but also to a good dose of light energy and to a cocktail of environmental pollutants; thus naturally, fruit peels have developed complex integrated extracellular and intracellular defense systems against stresses brought about by reactive oxygen species and related species (Cross et al., 1998). While some studies have been already done on the antioxidative power of fruits (Widyasari, 2002; Di Mauro, 2003), only very few have been done on fruit by-products especially the fruit peels.

Fruit peels, in most cases, are discarded and treated as wastes due to their lack of commercial application. Fruit peels that become wastes consequently add to the current severe pollution problem. Previous studies, however, showed that, in general, fruit peels contain higher concentrations of dietary fiber and antioxidant compounds than the flesh of the fruit (Emaga et al., 2008). It is therefore possible to utilize fruit peels as dietary fiber and antioxidant food additive to produce value-added food products for human consumption and they may play a role in the prevention for risk of chronic diseases e.g., diabetes mellitus, cardiovascular diseases and cancer (Arawande et al., 2010).

Banana is one of the most important commercial fruit and cash crops grown in all continents of the world. In addition to this, now a days, it is also gaining importance as a source of fibers. India is the largest producer of banana in the world with an estimated annual output of 13.5 million tons, of which 80% is generated from six states, namely, Tamilnadu, Maharashtra, Karnataka, Kerala, Andhra Pradesh and Gujarat. *Musa* spp. cultivars 'Virupakshi' and 'Sirumalai' (AAB), is one of the hill banana variety, grown at a height of 2000 to 5000 feet with well distributed annual rainfall of 1250-1500 mm in the lower Palni, Sirumalai and Kolli hills. Hill bananas, unique to the state of Tamil Nadu, are known for their special flavour and long shelf life.

Sirumalai banana fruits are being consumed as fruit and vegetable from time immemorial. They are considered as highly nutritious food for the pregnant, lactating women, growing children and aged. However this indigenous knowledge, passed down from generation to generation in various parts of the hilly regions, mainly in Tamilnadu. However there are no scientific reports on the nutritional, phytochemical and other medicinal properties of the fruit. Thus, the present study was a first attempt aimed to estimate the nutritional and phytochemical composition of the pulp and peel of the fruit, and its role in antioxidant and anti-hemolytic activity.

Materials and Methods

Sample Collection and Processing

The fruits were obtained from the local market, Dindigul, Tamilnadu. The fruits were rinsed under running water for 5 min before peeling manually. Pulp and peel were cut in to pieces aseptically and allowed to dry in a solar dryer at 40°C, which took average of 7 days for drying. Dried pulp and peel were ground into fine powder using mixer grinder. The powder samples were then stored in an air tight container in refrigerator for future use.

Analytical Methods

The samples were analysed for moisture, ash, fat, protein, fiber, carbohydrate (AOAC, 2000), phenols (Singelton and

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Rossi, 1965) and flavanoids (Harborne, 1973). The antioxidant scavenging potential of the pulp and peel extract was analyzed by DPPH assay with slight modification (Blios, 1958) and the hydroxyl radical scavenging assay (Halliwell et al., 1989).

Anti-hemolytic activity

The preparation of erythrocyte membrane ghost and the subsequent determination of the chemically induced lipid peroxidation were performed according to the modified method of Naim et al. (2007). The erythrocytes from adult human blood were separated by centrifugation (2000 rpm for 10 min) and washed with saline phosphate buffer (0.9 g of sodium chloride dissolved in 100 ml of 0.2 M phosphate buffer of pH 7.4) until the supernatant becomes colourless. The erythrocytes were then diluted with saline phosphate buffer to give 4% (v/v) suspension. 500 µg of extract/ ml of saline phosphate buffer were added to 2.0 ml of erythrocyte suspension and the volume was made up to 5.0 ml with saline phosphate buffer. This mixture was pre-incubated for 5 min and then 0.5 ml of H_2O_2 solution of appropriate concentration in saline buffer was added. The concentration of H_2O_2 in the reaction mixture was adjusted so as to bring about 90% hemolysis of blood cells after 240 min. After the incubation time, the reaction mixturewas centrifuged at 1500 rpm for 10 min and the extend of hemolysis was determined by measuring the absorbance at 540 nm corresponding to haemoglobin liberation. Natural and synthetic standards at the same concentration as sample extract were used for comparison. The percent hemolysis inhibition was calculated using the formula:

Inhibition percentage = [A control –A sample / A control] × 100

Statistical analysis

All experiments were conducted in triplicates and the parameters were given as means ± standard error. Both mean and standard deviation were performed where appropriate, using the statistical package within Microsoft® Excel Version 2007.Ink and the graphs were plotted using software Origin 6.0.

Results

Results on nutritional and phytochemical analysis of pulp and peel are given in Table: 1and 2 respectively. Noteworthy is the amount of dietary fiber present, pulp constitutes around 22.78±0.12% and the peel constitutes around 23.24±0.01%. Phenol content of pulp and peel were found to be 0.98±0.09mg/g and 0.52±0.11mg/g respectively. Flavanoid content of pulp and peel were found to be 29.92±0.24 mg/g and 22.76±0.07 mg/g respectively. Results obtained showed that both the pulp and peel of the Sirumalai banana exhibited significant amount of proximate and phytochemical constituents. Keeping these results as a base, the pulp and peel were analysed for their antioxidant activity using two radical scavenging assays namely; DPPH and OH^-, results obtained were specified in Table:3. Both the pulp and peel of the Sirumalai banana exhibited significant radical scavenging activity, proving it's usage as a good antioxidant.

Results obtained for antihemolytic activity of the pulp and peel is represented in Figure:1. Percentage antihemolytic activity of Sirumalai banana pulp ranged from 31.18±0.01% to 76.22±0.16; peel ranged from 24.31±0.02% to 64.69±0.04%, at a concentration of 100-500 mg/ml. The lysis of erythrocytes in the presence of H^2O^2, $FeCl_3$, in the absence of sample extract was considered as 100% hemolytic activity. When pulp and peel is considered, pulp showed higher anti-hemolytic activity than the peel. Percentage hemolytic activity steeped from 100mg/ml to 500mg/ml, thus the activity was concentration dependent.

Discussion

Banana has earned the status as a high nutritive fruit. It has a unique combination of energy value, tissue – building elements, proteins, vitamins and minerals. In some countries, banana fruit and its peel are considered to be the golden fruit of nature because they do help to promote natural beauty by providing the body with essential nutrients and also healthy digestion. Apart from being a nutritious food, banana fruit and its peels are proven as possessing many curative properties because of their various kinds of vitamins, minerals, fibres and carbohydrates.

Results obtained for proximate analysis and phytochemical analysis of pulp and peel falls in the range of earlier reports on Nendran banana (Anhwange et al., 2009). The results of the present study indicate that pulp and peels have different antioxidative components which exhibit antioxidant activities in two different assays. High correlations between free radical scavenging activity with phenols and flavonoids were observed. In addition, phenolic compounds can act synergistically, additively, or antagonistically to inhibit reactive species. Results on antioxidant activity of the banana pulp and peel are found to be in concurrence with the earlier reports of Emaga et al. (2008). Oxygen consumption of cells generates a series of Reactive Oxygen Species (ROS). Thus, aerobic organisms undergo oxidative modification of biomolecules in tissues. Erythrocytes are vulnerable to oxidative stress due to their high content of polyunsaturated lipids and transition metals, especially iron, which is known to catalyze free radicals generation via Fenton reaction (Chiu et al., 1982). In some disorders such as thalassemia, sickle cell anemia and chronic renal disease, ROS production is higher than normal (Nematbakhsh et al., 2013). In addition, iron is involved in etiopathology of these patients (Thephinlap et al., 2011). Iron mediated oxidative modification of membrane lipid and hemoglobin can cause hemolysis and increase the severities of diseases (Zhu et al., 2002). Although there is powerful defense system for prevention of oxidation, erythrocytes of such patients demonstrate an increased ROS and decreased content of antioxidants than their normal counterparts (Fibach et al., 2010). Therefore, much attention has been focused on the use of substances to inhibit the damage of free radicals.

Results obtained for antihemolytic activity of the pulp and peel showed significant activity. In the study, we found that the Sirumalai banana pulp and peel extract decreases the hemolysis of human RBCs and also they did not show any harmful effect on human RBCs. All pulp and peel extracts exhibited satisfactory inhibitory properties against hemolysis at low concentration to high concentration. Results were in accordance with the earlier reports on hemolysis in some fruits and herbs like *Psidium guajava* (Thephinlap et al., 2013),and *Coriandrum sativum* L. (Rajeshwari et al., 2012). This is the first report on antihemolytic activity of pulp and peel of Sirumalai Banana.

Conclusion

Thus, from the study both the pulp and peel of Sirumalai banana exhibited significant antioxidant and anti-hemolytic activity. Banana peels, a waste from banana fruit and they contain high amount of antioxidant, phenolic content and exhibit significant anti-hemolytic activity. Banana peel also can be commercialized because it qualitatively and quantitatively contain more antioxidants and also by gaining some profit and creating waste to wealth. It also will have does not compete with banana pulp in producing end product especially in the food industry. The results obtained in the present study ensure that, banana can continuously act as the natural antioxidant source; in

addition its anti-hemolytic activity can be utilized to treat various erythrocytes linked disorders. Hence both banana peel and pulp can be exploited for their therapeutic potential.

Table 1. Proximate composition of sirumalai banana

Parameters (%)	Sirumalai banana	
	Pulp	Peel
Moisture	71.12±0.03	6.03±0.05
Ash	06.57±0.07	08.52±0.01
Carbohydrate	41.82±0.09	25.31±0.04
Protein	07.62±1.02	03.23±0.015
Fat	11.91±0.28	0.986±0.02
Fiber	22.78±0.12	23.24±0.01

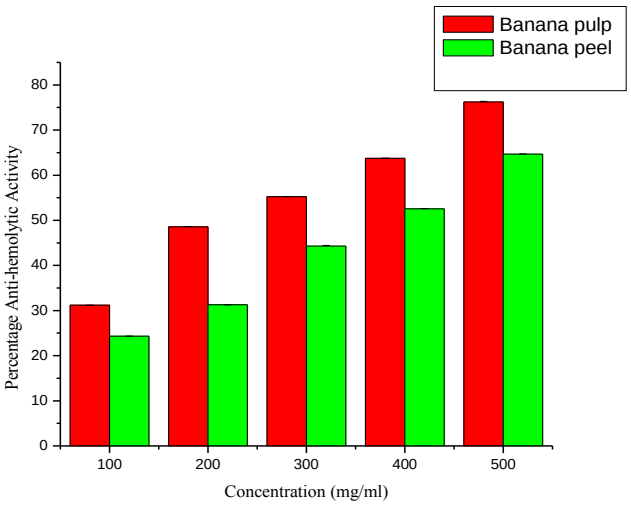
Table 2. Phytochemical composition of sirumalai banana

Parameters (mg/g)	Sirumalai Banana	
	Pulp	Peel
Flavonoid (rutin equivalent)	29.92±0.24	22.76±0.07
Phenol (AAE)	0.98±0.09	0.52±0.11

Table 3. Antioxidant activity of sirumalai banana

RADICALSCAVENGING (%)	Sirumalai Banana	
	Pulp	Peel
DPPH	81.72±0.06	71.95±0.21
OH^-	70.04±0.13	58.98±0.17

Figure 1. Anti-hemolytic activity of sirumalai banana



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