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Antioxidants and antioxidant activity common eight banana varieties in Kerala

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Abstract— *The objective of this research were to study antioxidants and antioxidant compounds from selected eight varieties of banana and the antioxidant activity were analysed using two methods such as total antioxidant activity and DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging activity using different solvents such as petroleum ether, methanol and water. In the present study revealed that variety Red banana showed highest β carotene and (8.53 µg/100g). Ascorbic acid content of banana varieties ranged between 1.52 - 5.35 mg/100g. Highest ascorbic acid content was noticed in Red banana (5.35 mg). Highest dopamine content was exhibited in variety Robusta (13.3 mg/100g) and lowest was found in variety Rasakadali (3.2mg/100g). The total antioxidant activity revealed that variety Robusta had the highest DPPH activity with an IC_{50} value of 43.6 µg/ ml in petroleum ether solvent. With regard to total antioxidant activity, variety Padatti exhibited highest activity with an IC_{50} value of 41.2 µg/ ml in petroleum ether while variety Rasakadali (48.4) and Poovan (48.4) showed maximum activity in methanol followed by variety Red banana with an IC_{50} value of 44.4 µg/ ml in methanol.*

Keywords— Antioxidants, Antioxidant activity, β carotene, Ascorbic acid, Dopamine, Total Antioxidant Activity, DPPH Radical Scavenging Activity.

I. INTRODUCTION

Kaur and Kapoor (2002) are of the opinion that diets rich in fruits and vegetables are associated with lower incidence of disease risks, including cardiovascular and cancer. They also argue that processing or cooking can enhance the health promoting effects of fruits and vegetables.

Now a day's consumption of fruits has been increased due to its nutritional and therapeutic effects on the human health due to the presence of phytochemicals and antioxidants. Studies evidence revealed that a healthy eating habit with increased consumption of fruits plays an important role in the prevention of chronic diseases, such as heart diseases, cancer, stroke, diabetes, Alzheimer's diseases and cataract (Willett, 2002; Wright *et al*., 2008).

Free radicals are involved in both the process of aging and the development of cancer. To deal with the free radicals, the body equipped with an effective defense system which includes various enzymes and high and low molecular weight antioxidants. The best sources of antioxidants are fruits and vegetables. The consumption of fruits and vegetables has been inversely associated with morbidity and mortality from degenerative diseases (Terry *et al*., 2001).

Aurore *et al*. (2009) reported that banana, an herbaceous climacteric fruit, represents one of the most significant fruit crop in world export trade after coffee, cereals, sugar and cocoa and is one of the most important fruit crops grown throughout Kerala (Shanmughavelu *et al*., 1992).

Bananas are one of the most popular food in the world contain various antioxidant compounds such as gallocatechin and dopamine which protects the body against the ill effects of free radicals. Since banana fruits are widely available, they have been used as food without apparent toxic effect. Hence, the present study is an evaluation of antioxidants and antioxidant activity present in eight selected banana varieties available in Kerala.

II. MATERIALS AND METHODS

Eight ripe banana varieties used for table purpose were selected for the study. The varieties selected were Palayankodan (AAB), Rasakadali (AB), Robusta (AAA), Poovan (AAB), Nendran (AAB), Kadali (AA), Red banana (AAA), Padatti (AAB). The banana varieties were procured at the time when the characteristic fruit colour developed for each type. They were collected from Instructional Farm, Vellayani and local markets of Trivandrum. To assess the antioxidants and antioxidant activity of banana varieties such asβ carotene,ascorbic acid, dopamine, total antioxidant activity, DPPH radical scavenging activity wereanalysed.

β carotene

Method suggested by Sadasivam and Manickam (2008) was used for the estimation of β carotene.

Ascorbic acid

Ascorbic acid was estimated titrimetrically using 2, 6 dichloro indophenol dye (Ranganna, 2001).

Dopamine

Dopamine was estimated spectrophotometrically using the method suggested by (Li *et al*., 2009) using dopamine hydrochloride as standard.

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Total Antioxidant Activity

The total antioxidant activity was determined through phosphomolybdate method (Buratti *et al.*, 2001). The banana extract was dissolved in phosphomolybdate reagent and incubated in water bath for 90 min. It was allowed to cool and absorbance was measured at 765 nm against the blank.

DPPH Radical ScavengingActivity

Determination of 1,1-diphenyl-2-picrylhydtazyl was carried out using the method described by Ribeiro *et al.* (2008).

The percentage inhibition of DPPH radical was calculated by comparing the result of the test with control (methanol and 1ml DPPH) using the formula (Schlesier *et al*., 2002).

$$\text{Percentage inhibition} = \frac{(\text{Absorbance of control} - \text{Absorbance of test})}{Absorbance\ of\ control} + 100$$

In the present study, antioxidant activity of banana varieties was studied by the total antioxidant activity and DPPH assay in different solvents such as petroleum ether, methanol and water.

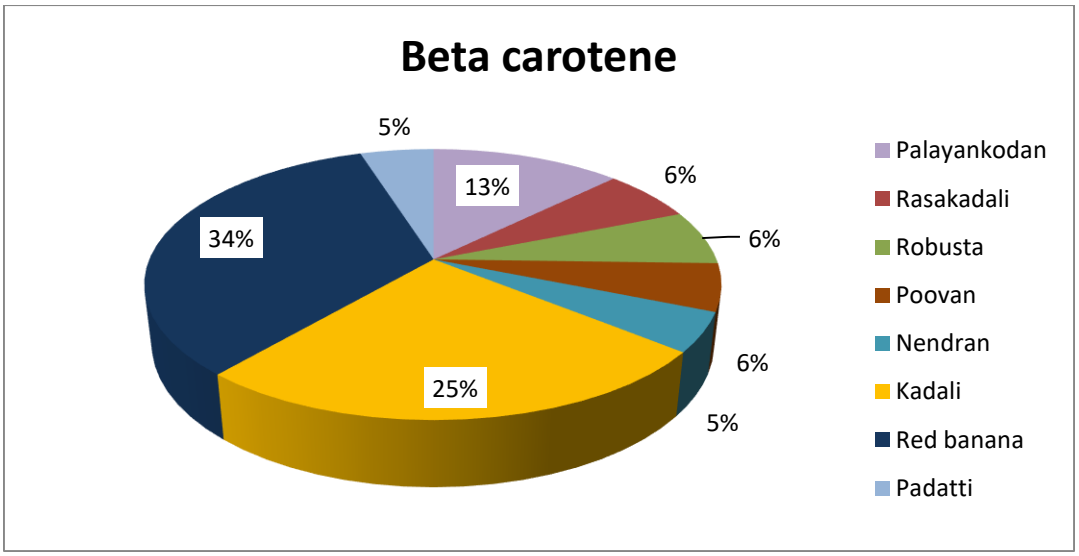
STATISTICAL ANALYSIS

All the analyses were done in triplicates. In order to obtain suitable interpretation the generated data was subjected to statistical analysis like One-way Analysis of Variance (ANOVA) at 0.05% significant level and graphical interpretation of analyzed data was also adopted.

III. RESULTS AND DISCUSSION

Beta carotene, a strong antioxidant can neutralize free radicals and reactive oxygen molecules which may lead to the development of cardiovascular disease and cancer. The data on beta carotene is presented in the Fig 1.

Significant differences ($p < 0.05$) were seen among the banana varieties in terms of the β carotene content. Beta carotene is an important antioxidant present in fruits in different concentration. In the present study, highest beta carotene was found in variety Red banana (21.19 µg/100g) and was significantly different from other varieties. The lowest beta carotene content was noticed in variety Nendran (2.19 µg/100g). The results of the present study showed a wide variation in β carotene levels among the bananas studied. The findings are in close agreement with other studies (Arora *et al*., 2008; Amorim *et al*., 2009) who had reported wide variability in β carotene content in bananas.



Ascorbic acid, a water soluble vitamin protects the body from ill effects of free radicals (Elekofehinti and Kade, 2012). Fresh fruits, vegetables and synthetic tablets supplement the ascorbic acid requirement of the body (Frei and Traber, 2004). However, stress, smoking, infections and burns deplete the ascorbic acid reserves in the body.

The ascorbic acid content of the banana varieties was observed to range between 1.52 - 5.35 mg/100g. The highest ascorbic acid was observed in variety Red banana (5.35 mg) and the lowest for variety Robusta (1.52 mg) (Table 1).

A study conducted by Poongodi (2012) on locally available banana in Tamil Nadu revealed that vitamin C

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content varied from 0.71-4.69 mg g^{-1} fresh tissues. The highest vitamin C content was present in Poovan and on the other hand, least content was found in Robusta. Sreedevi (2013) conducted a study on organically cultivated banana varieties like Nendran, Palayankodan and Rasakadali and found that vitamin C level was high in Rasakadali (6.46mg) followed by Nendran (6.4mg) and Palayankodan (3.33 mg).

Dopamine, 4-(2-aminoethyl) - benzene-1, 2-diol control movement, emotional response, and ability to experience pleasure and pain (Liu *et al*, 2004) and also important for cardiovascular, hormonal, renal and central nervous system functions in the body (Hussain and Lokhandwala, 2003; Zare *et al*., 2006).

Variations in the yield of extracts, extracting compounds, type of soil and agro- climatic condition also affect dopamine content of banana (Hsu *et al*., 2006).

The dopamine content of the different banana varieties was observed to range between 3.2- 13.3 mg/100g. The highest dopamine content was observed in variety Robusta (13.3 mg) and the lowest for variety the Rasakadali (3.2g) (Table 1).

According to Pereira and Marcelo (2014), the dopamine content in the banana pulp at 4-6 stages is 9.1±3.1 mg/100g.

Table.1: Ascorbic acid and dopamine content of banana varieties

Treatments	Name	Ascorbic acid (mg/100g)	Dopamine (mg/100g)
T_1	Palayankodan (AAB)	2.19	8.4
T_2	Rasakadali (AB)	2.18	3.2
T_3	Robusta (AAA)	1.52	13.3
T_4	Poovan (AAB)	4.26	5.3
T_5	Nendran (AAB)	3.36	6.1
T_6	Kadali (AA)	3.50	7.2
T_7	Red banana (AAA)	5.35	11.0
T_8	Padatti (AAB)	1.73	7.2
	CD(0.05)	**0.382**	**0.051**

The banana varieties analyzed for antioxidant capacity are presented in Table 2. It was revealed that antioxidant activity was higher for petroleum ether extract followed by methanol extracts when compared to aqueous extract.

The antioxidant activity of the banana varieties ranged between 41.2-49.2 µg/ml, 44.4-51.6 µg/ml and 46.4-54.8 µg/ml in petroleum ether, methanol and aqueous medium respectively. Highest antioxidant activity was reported in variety Padatti with an IC_{50} value of 41.2 µg/ml and 46.4 µg/ml in petroleum ether and aqueous medium respectively. Where as in methanol solvent, highest activity was exhibited by variety Red banana with an IC_{50} value of 44.4 µg/ml.

Table.2: Total antioxidant activity of banana varieties

Treatments	Name	IC_{50} values (µg/ml)		
		Petroleum ether	Methanol	Water
T_1	Palayankodan (AAB)	48.0	49.2	53.6
T_2	Rasakadali (AB)	43.6	51.6	54.0
T_3	Robusta (AAA)	49.2	50.0	52.2
T_4	Poovan (AAB)	44.0	49.2	49.2
T_5	Nendran (AAB)	44.0	46.0	48.4
T_6	Kadali (AA)	44.6	46.4	54.8
T_7	Red banana(AAA)	43.6	44.4	51.2
T_8	Padatti (AAB)	41.2	46.0	46.4

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The concentration of sample that could scavenge 50% free radical (IC_{50}) was used to determine antioxidant capacity of sample compared to standard. The varieties having lowest IC_{50} had the highest antioxidant capacity. According to Blois (1992), "sample that had IC_{50}<50 ppm, was consider as very strong antioxidant, 50-100 ppm strong antioxidant, 101-150 ppm medium antioxidant, while weak antioxidant with IC_{50}>150 ppm".

Poongodi *et al*. (2012) conducted a study on the antioxidant activity of the pulp extracts of nine varieties of banana, via Kadali, Karpooravalli, Monthan, Pachainadan, Poovan, Rasthali, Robusta and Sevvazhai. The total antioxidant capacity of banana pulp extracts was expressed as number of equivalents of ascorbic acid. According to the results, different pulp extracts exhibited various degrees of antioxidant capacity. The ethanol extracts of variety Rasathali banana showed highest µmol g^{-1} antioxidant activity in the range of 6.60 µmol g^{-1}compared to other varieties of banana pulp, whereas ethanolic extract of poovan banana showed least activity in the range of 3.80 µmol g^{-1}.

The variations in the antioxidant potential reported by various authors can be attributed to differences in cultivars, extraction procedures, geographical location and prevailing conditions such as soil, temperature, sunlight, horticulture practices and so on (Kim *et al*., 2001).

In the present study, free radical scavenging capacity of banana varieties were studied by the DPPH assay in different solvents such as petroleum ether, methanol and water. Table 3 illustrates the results of DPPH activity of the banana varieties. The IC_{50} value was calculated from the graph (it was noted as the concentration of sample needed to scavenge the free radicals at 50 per cent inhibition).

Table .3: DPPH radical scavenging activity of banana varieties

Treatments	**Name**	**IC_{50} values (µg/ml)**		
		Petroleum ether	**Methanol**	**Water**
T_1	Palayankodan (AAB)	50.8	52.4	54.4
T_2	Rasakadali (AB)	45.6	48.4	53.8
T_3	Robusta (AAA)	43.6	50.4	50.8
T_4	Poovan (AAB)	50.0	48.4	52.0
T_5	Nendran (AAB)	51.2	55.2	55.6
T_6	Kadali (AA)	46.8	53.6	58.0
T_7	Red banana (AAA)	48.0	56.8	57.6
T_8	Padatti (AAB)	46.0	51.3	58.8

The results of present study revealed that antioxidant activity ranged from IC_{50} values of 41.2µg/ml to 54.8 µg/ml in the banana varieties studied. Maximum antioxidant capacity was observed in variety Padatti (41.2µg/ml) and minimum antioxidant capacity observed in variety Kadali (54.8 µg/ml).

A study conducted by Pongoodi *et al*. (2012) reported that Karpooravalli banana showed least DPPH radical scavenging activity. Similar findings were also reported by Rungnapa *et al*. (2007) on Thai bananas.

Qusti *et al*. (2010) and Miller *et al*. (2000) conducted a study on antioxidant activity of fresh fruits using DPPH assay and found that plant variety, growing condition, maturity, season, geographic location, fertilizer application, soil type, storage conditions and amount of sunlight received are some of the factors which affect the DPPH assay.

IV. CONCLUSION

The present study highlighted that selected banana varieties serves as a natural store of various health beneficial antioxidant compounds. Antioxidant activity and antioxidant capacity of different selected banana varieties determined by different methods its indicated that banana is rich in various health beneficial various bioactive compounds such as ascorbic acid, beta carotene, dopamine, having potent antioxidant activities and free radical scavenging activity. Banana is cheaper in prize and easily available so that everyone can include their daily diet. This antioxidant compounds and antioxidant activity synergistically act to reduce the risk of degenerative

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diseases like cardiovascular diseases, cancer etc. We can say confidently banana is a "poor man's apple".

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