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Free Radical Scavenging Activities of the Extracts from Banana

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Under ultrasound, banana flesh (BF) and banana peel (BP) were extracted with acetone, ethanol, water and ethyl acetate solvents at 70 ºC to offer acetone extract (BFAE), ethanol extract (BFEE), water extract (BFWE), acetone extract (BPAE), ethanol extract (BPEE), water extract (BPWE) and ethyl acetate extract (BPEA), respectively. Their free radical scavenging activities were evaluated and compared with the common antioxidant butylated hydroxytoluene (BHT), employing DPPH$^{\bullet}$ assay, $ABTS^{+\bullet}$ assay, $O_2^{\bullet-}$ assay and $OH^{\bullet}$ assay. The results showed that all the extracts displayed good radical scavenging activities, with IC_{50} less than standard value 10 mg/mL. It is important to point out that all these seven extracts demonstrated better scavenging activity than the commercial antioxidant butylated hydroxytoluene in $OH^{\bullet}$ assay. The extract solvents were found to have important effect on their radical scavenging activities.

Key Words: Banana, Free radical Scavenging activity, Ultrasound-assisted extract.

INTRODUCTION

The significance of free radicals and reactive oxygen species in the pathogenicity of various kinds of diseases, such as some chronic and age-related diseases has attracted considerable attention[1-5]. Scientific evidence indicates that the antioxidants can reduce the risk for chronic diseases and the consumption of fruit and vegetable have been thought to be associated with a reduced risk of many diseases including cancer and atherosclerosis, which are related to elevated levels of oxidant stress[6]. Antioxidant compounds in food are considered to play an important role as a health-protecting factor. Therefore, more and more studies have been devoted in efforts to explore new and efficient antioxidants from fruit and vegetable.

Banana is the common name for herbaceous plants of the genus *Musa* and for the fruit they produce. It is one such fruit yielding tropical plant that may protect itself from the oxidant stress caused by strong sunshine and high temperature through producing large amounts of antioxidants[7]. It is thus to expect that banana may have potent antioxidant activities. Recently, extracts of banana were found to show good radical scavenging activity against DPPH radical in the initial test and it aroused our interest. Therefore, in this present study, antioxidant activities of the extracts from *Evodia rutaecarpa*, were investigated. Banana peel is a major by-product in pulp industry and it contains various bioactive compounds like polyphenols, carotenoids and others[8]. The present study was undertaken to observe the free radical scavenging property and antioxidant potential of flesh and peel of banana.

EXPERIMENTAL

Bananas were collected from Guilin city of Guangxi Province in May, 2012 and they were separated as banana flesh (BF) and banana peel (BP). Under ultrasound, banana flesh (20 g) were extracted with acetone, ethanol, water and ethyl acetate solvents at 70 ºC for 1 h and filtered through Whatman No. 4 filter paper, respectively. Then the four extract solutions were vacuum evaporated at 50 ºC to dryness to offer only three extracts: acetone extract (BFAE), ethanol extract (BFEE) and water extract (BFWE) with 13.3, 12.4 and 13.5 % yields, respectively. Banana peel was then treated with the same procedure to offer acetone extract (BPAE), ethanol extract (BPEE), water extract (BPWE) and ethyl acetate extract (BPEA) with 8.7, 7.9, 7.6 and 3.5 % yields, respectively. All these seven extracts have sweet smell and taste.

All the seven extracts were dissolved in dimethyl formamide to the concentrations 6×10^{-6} mg/mL, respectively and then their UV/visible spectrums were determined by TU-1901 ultraviolet spectrophotometer.

RESULTS AND DISCUSSION

As showed in Fig. 1, it can be found that in the UV/visible spectra of BFAE, BFEE, BFWE, BPAE, BPEE, BPWE and BPEA there was only a main peak, which may ascribed

TABLE-1
IC_{50} OF THE EXTRACTS FROM BANANA

Entry	IC_{50} BFAE	IC_{50} BFEE	IC_{50} BFWE	IC_{50} BPAE	IC_{50} BPEE	IC_{50} BPWE	IC_{50} BPEA	IC_{50} BHT
$DPPH^{\bullet}$ (μg/mL)	598.11	768.32	825.22	115.11	155.04	415.21	518.68	14.50
$ABTS^{\bullet}$ (μg/mL)	312.31	325.86	496.75	107.40	133.21	104.38	52.71	8.15
$O_2^{-\bullet}$ (μg/mL)	2940.89	5042.90	2640.76	312.04	283.09	263.56	333.40	55.85
$OH^{\bullet}$ (μg/mL)	4.11	1.85	1.40	3.42	2.50	1.29	2.43	5438.69

to be polysaccharides, implying that polysaccharides may the main components of these seven extracts.

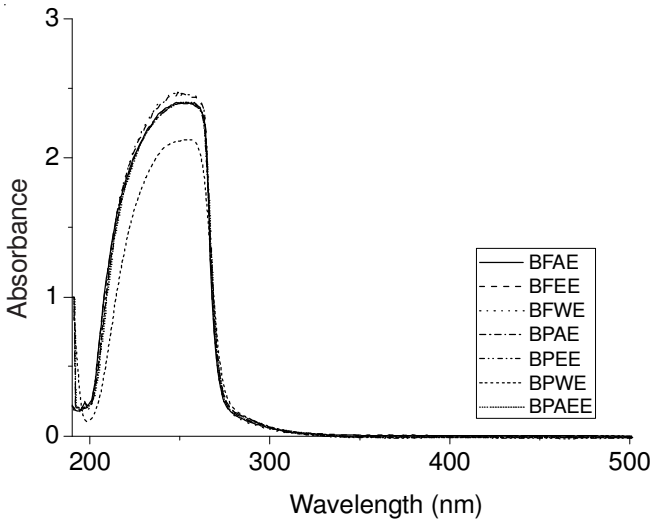

Fig. 1. UV/visible spectra of the extracts from banana

According the literatures[5-8], their free radical scavenging activities were determined as shown in Figs. 2- 5. Significant free radical scavenging activities were clear at all the tested extracts. The values of IC_{50}, the effective concentration at which 50 % of the radicals were scavenged, were calculated to evaluate the radical scavenging activities (Table-1). A lower IC_{50} value implied greater radical scavenging activity and IC_{50} values of less than 10 mg/mL usually indicated effective activities in antioxidant properties[9].

It can be seen in Fig. 2 that BFAE, BFEE, BFWE, BPAE, BPEE, BPWE and BPEA showed evident radical scavenging activities in $DPPH^{\bullet}$ assay. As shown in Table-1, IC_{50} values of BFAE, BFEE, BFWE, BPAE, BPEE, BPWE and BPEA were found to be 598.11, 768.32, 825.22, 115.11, 155.04, 415.21 and 518.68 μg/mL, respectively. Since that their IC_{50} values were further lower than the standard value 10 mg/mL[9], it could concluded that all these above extracts exhibited potent inhibition of DPPH radical. It is clear that the DPPH radical scavenging activities of banana peel were stronger than that of banana flesh. The order of scavenging activity of tested in this assay was: BPAE > BPEE > BPWE > BPEA > BAE > BFEE > BFWE. In addition, extract solvents were found to have important effects on the DPPH radical scavenging activities. The order for banana flesh was: acetone > ethanol > water, while that for banana peel was: acetone > ethanol > water > ethyl acetate.

Fig. 3 showed that BFAE, BFEE, BFWE, BPAE, BPEE, BPWE and BPEA exhibited clear radical scavenging activities in $ABTS^{+\bullet}$ assay. Table-1 displayed that IC_{50} values of BFAE, BFEE, BFWE, BPAE, BPEE, BPWE and BPEA were found to be 312.31, 325.86, 496.75, 107.40, 133.21, 104.38 and 52.71 μg/mL, respectively. Obviously, their IC_{50} values were lower than the standard value 10 mg/mL[9], it was thus to conclude that these seven extracts showed good inhibition of $ABTS^{+}$ radical. Banana peel showed higher $ABTS^{+}$ radical scavenging activities than banana flesh. The order of scavenging activity of these extracts in this assay was listed as follow: BPEA > BPWE > BPAE > BPEE > BFAE > BFEE > BFWE. In addition, extract solvents also showed important influence on the $ABTS^{+}$ radical scavenging activities. The order for banana flesh was: acetone > ethanol > water, while that for banana peel was: ethyl acetate > water > acetone > ethanol.

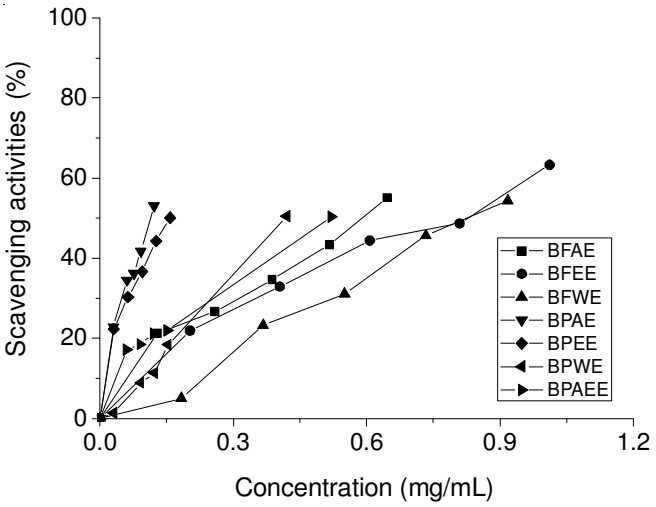

Fig. 2. DPPH radical-scavenging activities of the extracts of banana

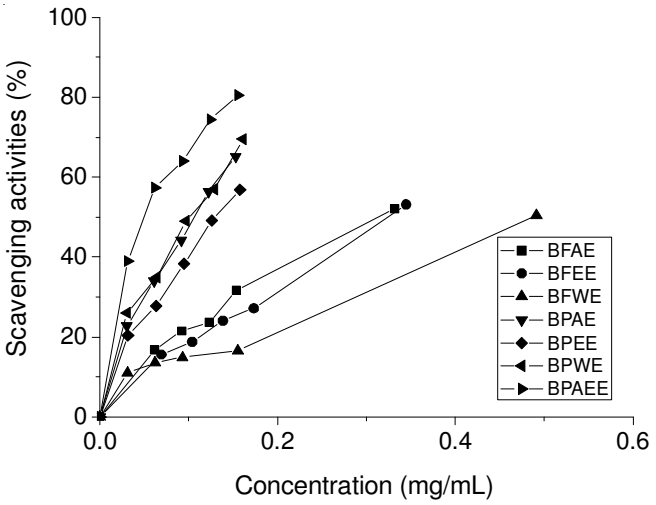

Fig. 3. $ABTS^{+}$ radical-scavenging activities of the extracts of banana

As showed in Fig. 4, BFAE, BFEE, BFWE, BPAE, BPEE, BPWE and BPEA exhibited marked radical scavenging activities in superoxide anion assay. Table-1 showed that IC_{50} values of BFAE, BFEE, BFWE, BPAE, BPEE, BPWE and

BPEA were 2940.89, 5042.90, 2640.76, 312.04, 283.09, 263.56 and 333.40 μg/mL, respectively and were less than the standard value 10 mg/mL[9], showing that their good inhibition of superoxide anion radical. Banana peel also exhibited higher superoxide anion radical scavenging activities than banana flesh. The order in this assay was listed as follow: BPWE > BPEE > BPAE > BPEA > BFWE > BFAE > BFEE. Based on the above observation, extract solvents were found to display important effect on the superoxide anion radical scavenging activities. The order for banana flesh was: water > acetone > ethanol, while that for banana peel was: water > ethanol > acetone > ethyl acetate.

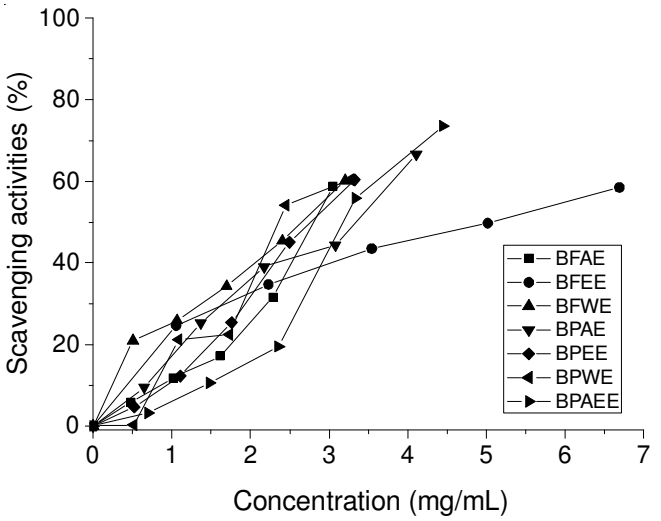

Fig. 4. Superoxide anion radical-scavenging activities of the extracts of banana

The radical scavenging effects were also evaluated in the present study using hydroxyl radicals generated by Fenton reagent[10]. As shown in Fig. 5, all the extracts displayed moderate activity in an amount dependent manner. It can be seen from Table-1, BPWE showed the best hydroxyl radical scavenging activity in this assay with IC_{50} of 1.29 mg/mL, while IC_{50} values of BFAE, BFEE, BFAEE, BPAE, BPEE and BPEA were found to be 4.11, 1.85, 1.40, 3.42, 2.50 and 2.43 mg/mL, respectively. It was important to point out that all these seven extracts showed better hydroxyl radical scavenging activity than the common antioxidant butylated hydroxytoluene. Scavenging activities of these seven extracts decreased in the order of BPWE, BFWE, BFEE, BPEA, BPEE, BPAE and BFAE. The results indicated that extract solvents had the important effect on hydroxyl radical scavenging activities and water should be the best extract solvent in this assay.

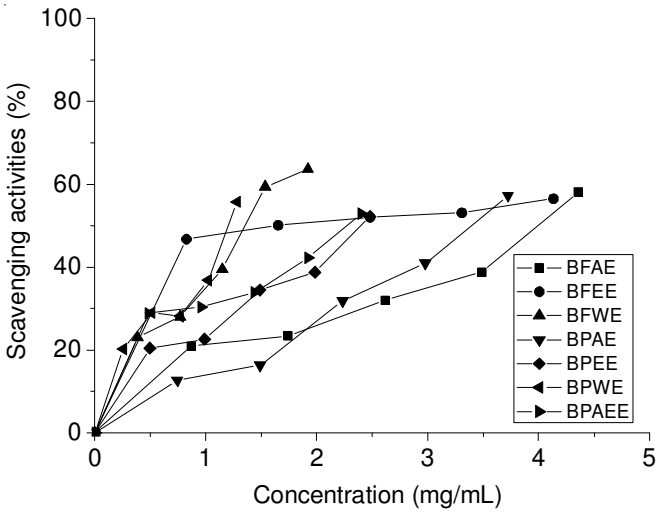

Fig. 5. Hydroxyl radical-scavenging activities of the extracts of banana

On the basis of the above observation, it could be concluded that the key components of the extracts from banana flesh and banana peel may be polysaccharide compounds, which may contribute to their good radical scavenging activities. In addition, the extract solvents had important effect on their radical scavenging activities.

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