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IMPACT OF SOME TECHNOLOGICAL TREATMENTS ON ANTIOXIDANT CAPACITY OF BANANA AND POTATO PEEL EXTRACTS

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ABSTRACT

Antioxidant properties and total phenolic contents of banana and potato peel extracts were studied. The fresh banana peels were divided into two parts. The first part was treated with or without citric acid (1% *W/W*) and sodium-meta-bi-sulfite (200 ppm) then prepared ethanol 95% and/or methanol extracted. Part from the second part had the same transaction as first part was dried at 45° C and other part, as same transaction as first part, was freeze-dried and extracted with ethanol 95% and/or methanol. Potato peels were dried or freeze-dried without any treatment and prepared extracted as the parts of banana peels. The total phenolic compounds and free radical scavenging assay by DPPH (1,1 diphenyl-2- picrylhydrazyl radical) were measured. Extract capacity to inhibit lipid peroxidation measured by two methods: thiobarbituric acid reactive substances (TBARS) and β -carotene bleaching assay. The obtained results show that freeze-dried banana peels with citric acid (1% *W/W*) processing extracts exhibited the strongest antioxidant capacity in different assays, followed by freeze-dried banana peel with sodium-meta-bi-sulfite (200 ppm) processing and fresh banana peel with citric acid (1% *W/W*) extracts. Freeze-dried potato peel extracts showed slightly higher result than those of dried potato peel extracts. In general, ethanol and methanol extracts showed comparable activity to synthetic antioxidants (BHA). The results suggested that the natural antioxidant and bioactive of banana and potato peels can be used in production of function food.

Key word: Banana peel extracts, potato peel extracts, antioxidant, free radical, lipid oxidation.

INTRODUCTION

The antioxidants are one of the most significant active components that play an important role in reducing oxidation process. It is considered the most important food additives, and plays many roles during food processing as preservatives, prevent formation of harmful and unwanted compounds in food and preserve the colour of a food item (Rubalya and Neelamegam, 2012; Carocho and Ferreira, 2013).

Antioxidants are an inhibitor of the process of oxidation, even at relatively small concentration and thus have diverse physiological role in the body. Antioxidant constituents of the plant materials act as radical scavengers, and helps in converting the radicals to less reactive substance. A variety of free radical scavenging antioxidants is found in dietary sources like fruits, vegetables and tea, *etc* (Mandal *et al.*, 2009).

By-products of food processing, such as peels and pomace, represent an abundant source of bioactive compounds. In many cases these by-products are not used to their potential. In addition, dealing with waste and by-products in a sustainable and environmentally friendly way are becoming a highly important issue in the food industry. Due to the European Landfill Directive, the food industry is forced to reduce a percentage of waste and by-products going to landfill by 2020 (Kosseva, 2009).

Banana peels (*Musa* sp.) (27-30% w.w) is rich in phytochemical compounds, mainly antioxidants. The total amount of phenolic compounds in banana peel ranges from 0.90 to 3.0 g/100 g DW (Nguyen *et al.*, 2003; Someya

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et al., 2002). Someya *et al.* (2002) identified gallocatechin at a concentration of 160 mg/100 g DW. Ripe banana peel also contains other compounds, such as the anthocyanins delphinidin and cyaniding (Seymour, 1993) and catecholamines (Kanazawa and Sakakibara, 2000). Furthermore, carotenoids, such as β-carotene, a-carotene and different xanthophylls, have been identified in banana peel in the range of 0.3–0.4 mg lutein equivalents/ 100 g (Subagio *et al.*, 1996), as well as sterols and triterpenes, such as β-sitosterol, stigmasterol, campesterol, cycloeucalenol, cycloartenol, and 2,4-methylene cycloartanol (Knapp and Nicholas, 1969). Someya *et al.* (2002) have evaluated the antioxidant activity in banana peel, measured as the effect on lipid autoxidation, in relation to its gallocatechin content (Gonzalez-Montelongo *et al.*, 2010).

Potato are a major world crop. Over the last years, the consumption of processed potato has been increased (Schieber and Saldana, 2009). Potato are generally peeled when processed. Potato peel waste has been proposed as dietary fiber for baking products (Arora and Camire, 1994), but also as a source of natural antioxidants. Polyphenols, an important group of antioxidants present in potato, are largely concentrated in the peel, since they have a role in the defiance mechanism against phyto-pathogens (Friedman, 1997). Potato peels have therefore been subject of study in lipid oxidation studies.

The aims of the present study were monitoring of the impact of some treatments and solvents on antioxidant capacity of banana and potato peel extracts compared with synthetic antioxidant (BHA).

MATERIALS AND METHODS

Materials

Plant Materials

Fruits from cultivars of banana (*Musa* sp.) were obtained from a private farm at El-Mahla district, El-Garbia Govarnorate, Egypt, and potato peels were obtained from farm frites factory, 10th of Ramadan city, Egypt.

Chemicals and Reagents

Ethanol (95%), methanol solvents, citric acid, sodium-meta-bi-sulfite, Na_2Co_3, chloroform and hydrochloric acid were purchased from El-Gomhoria Chemical Company, Zagzag, Egypt. Folin-Ciocalteu reagent, Gallic acid, β-carotene, Linoleic acid, Tween 20, TBA (Thiobarbituric acid), phosphatidyyl-choline, potassium chloride, iron chloride, TCA (trichloroacetic acid), DPPH (2,2-diphenyl-1-picrylhdrazyl) and butylted hydroxyl anisole (BHA were purchased from Sigma Chemical Company, Cairo, Egypt.

Methods

Preparation of Samples

Potato peel samples

Potato peels were washed well with tap water to get rid of the remnants of starch sticking out it and stacked it on trays for half hour to get rid of excess water.

Banana peel samples

Banana fruits were peeled after getting rid of the brown outer edge and into contact with the axis of the fruit with fruiting column before conducting technology transactions to keep the yellow colour of the peels. Two transactions technology to keep the colour of banana peels were used: In the first method peels was immersed in (200 ppm) sodium-meta-bi-sulphite solution for 10 min. The second method performed by immersing the banana peels in (1%) citric acid solution for 10 min. The interval between peeling and experimental work was specified to be less than one hour.

Drying (D) and freeze-drying (Fr) of the prepared samples

The samples (banana peel (BP) and potato peels (PP)) were stacked on trays drying oven for 48 hr., at 45°C very well to be sample density suitable for the temperature and the efficiency of the drying oven. The samples should be flipping once every hour in the first four hours. The freeze- dried process was carried out as the follow manually, banana or potato peels were separated then frozen in liquid nitrogen and freeze-dried at 50 mPa and −40°C (Christ alpha 1-4 LSC freeze-dryer, Osterode, Germany). The dried and freeze-dried banana

and potato peels were ground to a fine powder, placed in plastic pags and wrapped with aluminum foil and stored at -20°C until the extractions were carried out.

Sequential extraction of fresh (F) and dried (D) samples

Sequential extractions of fresh (F) and dried (D) samples were conducted using two solvents (ethanol 95% and methanol). For the fresh samples, 50 g fresh weight of each sample was soaked in the first solvent, 500 ml ethanol 95% in a 1000 ml conical flask for 48 hr., on the stirring hotplate at 37°C (Fisher Scientific, Pittsburgh, PA) with magnetic stirrer (1000 rpm). The obtained extract was filtered using filter paper (Whatman No. 1, England) and the filtrate was concentrated using rotary evaporator (EYELA, Japan). The same extraction procedure was applied to the residue of sample. It was successively soaked in 500 mL methanol (second solvent). Using the same type from each sample. Ethanol and methanol extracts were freeze-dried (Thermo-Electron Corporation-Hot power dry LL300 freeze dryer). The dried extracts after evaporation of solvents were weighed to determine the yield and stored frozen until use.

Determination of colour

The colour of banana and potato peel extracts was determined according to the tristimulus colour system described by Francis (1983) using the Hunter-Lab (Hunter Lab Colour Flex EZ, USA).

Determination of total phenolic compounds (TPC)

The concentration of total phenols in all extracts was measured by a UV spectrophotometer (Jenway-UV-VIS spectrophotometer), based on a colorimetric oxidation/reduction reaction, as described by Skerget *et al.* (2005). Total phenolic content of the extracts obtained from banana and potato peel extracts with or without treatments was determined using Folin–Ciocalteu colorim-etric method by manipulating the regression equation of Gallic acid calibration curve ($y=0.015x + 0.0533$, $r2 = 0.9966$). The total phenolic content was expressed as Gallic acid equivalent.

DPPH free radical scavenging assay

The electron donation ability of the obtained extracts was measured by bleaching of the purple coloured solution of DPPH according to the method of Hanato *et al.* (1988). 0.1 ml of each extracts (10 mg extracts/10 ml solvent) was added to 3 mL of 0.1 mM DPPH dissolved in ethanol (95%) and/or methanol according to the solvent used for extraction. After incubation period of zero, 30, 60, 90 and 120 min at room temperature, the absorbance was determind against a control at 517 nm (Gulcin *et al.,* 2004). Percentage of antioxidant activity of free radical DPPH was calculated as follow:

$$\text{Inhibition (\%)} = 100 \times (A\ (\text{cont.}) - A\ (\text{Test}))/A\ (\text{Cont.})$$

Where A (cont.) is the absorbance of the control and A (Test) is the absorbance of the sample at 517 nm.

Extract Capacity to Inhibit Lipid Peroxidation

β-Carotene/Linoleic acid bleaching assay

The ability of extracts and synthetic antioxidants to prevent the bleaching of B-carotene was assessed as described by Kayvan *et al.* (2007). In brief, 0.2 mg of B-carotene in 1 ml chloroform, 20 mg linoleic acid and 200 mg tween 20 were placed in a round- bottom flask. After removal of the chloroform, 50 ml distilled water was added and the resulting mixture was stirred vigorously. Aliquots (3 ml) of the emulsion was transferred to tubes containing extract or synthetic antioxidant. Immediately after mixing 0.5 ml of extract solution (10 mg extract/10 ml solvent), an aliquot from each tube was transferred to a cuvette and the absorbance at 470 nm was recorded (Ab_s^0). The remaining samples were placed in water bath at 50°C for 120 min, then the absorbance at 470 nm was recorded (Ab_s^{120}). A control without added extract was also analyzed. Antioxidant activity was calculated as follow:

$$\text{Antioxidant activity (\%)} = [1 - (Ab_s^0\ \text{sample} - Ab_s^{120}\ \text{sample}) / (Ab_s^0\ \text{control} - Ab_s^{120}\ \text{control})] \times 100$$

Where Ab_s^0 sample is the absorbance of sample at 0-time, Ab_s^{120} sample is the absorbance after 120 min, Ab_s^0 control is absorbance of control at 0-time and Ab_s^{120} control is the absorbance of control after 120 min.

Thiobarbituric acid reactive substances (TBARS) assay

The capacity of the extracts to inhibit lipid peroxidation was also evaluated by using the modified assay of thiobarbituric acid reactive substances (TBARS) (Gonzalez-Paramas *et al.*, 2004). The method is based on the peroxidation of a liposome system (25 ml of 50 mg/ml phosphatidyl-choline in 1.5:1 (*V:V*) chloroform: ethanol) induced by 200 ml of 1 mM iron chloride containing 300 mM potassium chloride in the presence of the extracts (50 ml). Peroxidation was started by adding ascorbate (125 ml at 0.16 mM) and incubating at 37°C for 24 hr. The reaction was stopped by adding 0.75 ml of a mixture 1.5:1 (*V:V*) of 9.4% TCA in 0.47 N hydrochloric acid (pH 1.5) with 1% TBA and 0.05 ml of BHT (760 mg/l in ethanol). The production of TBARS, mainly malonaldehyde, as a secondary product of peroxidation, was measured spectrophotometrically at 535 nm after incubation at 95 ° C for 60 min.

A control without the extracts (with the different solvents used in the extractions) was used to evaluate the phosphatidyl-choline peroxidation as inhibition ratio (IP, %):

$$IP = \left(1 - \frac{A_t}{A_t^0}\right) \times 100$$

Where A_t and A_t^0 are extract and control absorbance after incubation for 60 min. The repeatability standard deviation of the procedure was always <10%.

RESULTS AND DISCUSSION

Effect of Treatments on Colour of Banana Peel Extracts and Colour of Potato Peel Extracts

Data in Table 1 shows the colour value of banana and potato peel extracts. The methanolic extracts of FrBPs have highest value of lightness (7.55 l) followed with ethanolic extracts of FrBPci (7.46 l). However, the treatment of banana peels with 1% citric acid and 200ppm sodium-meta-bi-sulfite lead to slight improve in lightness. The results may be due to impact of treatment with citric acid 1% (*W/W*) and sodium-meta-bi-sulfite 200ppm (*W/W*) on inhibition of enzymatic and non-enzymatic browning reaction. Methanolic extract of FBPc has the highest value of redness (0.88 a) followed with ethanolic extract of FBPc (0.81 *a*). Ethanolic extract of FrBPci has the highest value of yellowness (5.81 *b*) followed with ethanolic extract of FrBPc (3.55 *b*). The results may be due to preservation on pigments from oxidation and/or breakage by heat.

Total Phenolic Content (TPC)

Data in Table 2 shows that the methanolic extract of FrBPci and FrBPs showed the highest total phenolic content (237 mg gallic acid/g extract), followed by the same extract of DBPci and ethanolic extract of FrBPci (233 mg gallic acid/g extract). While, the lowest value was ethanolic extract of FBPc (220 mg gallic acid /g extract) and the same extract of DPP (209 mg gallic acid/g extract). The highest value from the phenolic content in the methanolic extract of FrBPci and FrBPs were attributed to the effectiveness of solvent and treatment before extraction to keep the bioactive compounds. These results are in agreement with the results reported by Capecka *et al.* (2005) how compared the total phenolic contents of fresh and dried samples of lamiaceae (Sulaiman *et al.*, 2011). At cellular level, the phenolic compounds are located in the vacuoles and are separated from oxidative enzymes in an intact fruit (Macheix *et al.*, 1990). This structure collapses during dehydration or drying process leading to a release of more phenolic compounds, together with the oxidative and hydrolytic enzymes that may degrade the phenolic compounds (Toor and Savage, 2006). Nevertheless, drying will denature these enzymes and preserve the phenolic compounds in the dried samples.

Heat treatment applied during extraction also may increase the extraction of phenolic compounds from plant materials. Solvents used for extraction also affected significantly the total phenolic concentration of fresh and dried banana and potato peels. Variations in total phenolic contents among the investigated banana and potato peel extracts observed in this study may be due to the type of extraction technique and / or the type of treatments (Sulaiman *et al.*, 2011).

Table 1. Hunter-lab colour values of banana and potato peel extracts

Sample	Ethanolic extracts			Methanolic extracts		
	l	a	b	l	a	b
FBPc	4.03	0.81	1.03	3.90	0.88	0.91
FBPs	5.15	0.15	1.25	5.03	0.26	1.20
FBPci	5.63	0.62	1.22	5.58	0.55	1.22
DBPc	4.32	0.77	1.17	4.27	0.82	1.10
DBPs	4.74	0.26	1.42	4.90	0.19	1.31
DBPci	4.98	0.25	1.50	4.92	0.23	1.43
FrBPc	5.68	0.53	3.55	7.42	0.55	2.70
FrBPs	5.82	0.60	1.94	7.55	0.49	1.81
FrBPci	7.46	0.64	5.81	6.18	0.38	1.58
DPP	4.60	0.30	1.50	4.83	0.22	1.40
FrPP	6.15	0.27	2.13	5.01	0.21	1.31

l: ranges from 0 (black) to 100 (white) **a**: **a+**= redness and **a-**= greenness **b**: **b+**= yellowness and **b-**= blueness

FBPc is the control fresh banana peel extracts, FBPs is the fresh banana peel extracts with sodium-meta-bi-sulfite, FBPci is the fresh banana peel extracts with citric acid 1%; DBPc is the control dried banana peel extracts, DBPs is the dried banana peel extracts with sodium-meta-bi-sulfite and DBPci is the dried banana peel extract with citric acid; FrBPc is the control freeze-dried banana peel extract, FrBPs is the freeze-dried banana peel extract with sodium-meta-bi-sulfite and FrBPci is the freeze-dried banana peel extract with citric acid 1%; DPP is the dried potatoe peel extracts and FrPP is the freeze-dried potatoe peel extracts.

Table 2. Total phenolic content of banana and potato peel extracts (mg gallic acid /g extract).*

Sample	Concentration (mg gallic acid /g extract)	
	Methanolic extracts	Ethanolic extracts
FBPc	224	220
FBPs	227	225
FBPci	230	227
DBPc	225	219
DBPs	229	221
DBPci	233	225
FrBPc	230	226
FrBPs	237	230
FrBPci	237	233
DPP	213	209
FrPP	217	215

*The results obtained from the assay were expressed as means as standard deviation of triplicate analyses.

FBPc is the control fresh banana peel extracts, FBPs is the fresh banana peel extract with sodium-meta-bi-sulfite, FBPci is the fresh banana peel extracts with citric acid 1%; DBPc is the control dried banana peel extracts, DBPs is the dried banana peel extracts with sodium-meta-bi-sulfite and DBPci is the dried banana peel extract with citric acid; FrBPc is the control freeze-dried banana peel extract, FrBPs is the freeze-dried banana peel extract with sodium-meta-bi-sulfite and FrBPci is the freeze-dried banana peel extract with citric acid 1%; DPP is the dried potatoe peel extracts and FrPP is the freeze-dried potatoe peel extracts.

DPPH Free Radical Scavenging Activity

Data in Figs. 1 and 2 illustrate that banana peel extracts were strong scavenging activity against DPPH radicals than potato peel extracts. The radical-scavenging activity of methanolic FBPci was superior to 88% at 120 min. All over the sample of banana peel extracts have a treatment for both solvents showed resistance of scavenging DPPH radical for all over the time of reaction except ethanolic DBPs and FrBPs (83% - 82.8% at 30 min of dried sample and 83.1% - 82.8% at 120 min of freeze dried sample). In all over the time of reaction for both solvent, methanolic FBPci (87.2%, 87.5%, 87.7%, 87.9% and 88% at zero, 30, 60, 90 and 120 min Sequentially) and for ethanolic extracts, FBPci and FrBPci (83.2%, 83.3%, 83.6%, 83.7% and 83.9% at zero time, 30, 60, 90 and 120 min, respectively of fresh sample and 83.2%, 83.2%, 83.2%, 83.5% and 83.7% at zero, 30, 60, 90 and 120 min, respectively of freez dried sample) had the highest value. In generally, extracts obtained with methanol had the highest antioxidant activity compared with ethanol 95%. These results are in agreement with the results reported by Al-Harrasi *et al.* (2014).

Extract Capacity to Inhibit Lipid Peroxidation

β-Carotene/linoleic acid bleachin (βCB) assay

Data in Table 3 shows the effect of banana and potato peel extracts on oxidation of β-carotene/ linoleic acid at 50°C. All extracts were capable for inhibiting the bleaching of β-carotene by scavenging linoleate-derived free radicals. The highest value was (91.9%) for methanolic FrBPci extract followed by (90.8%) for methanolic FrBPs extract. In addition, ethanolic (95%) and methanolic extracts of banana peel showed bleaching of β-carotene slightly higher than those of potato peel extracts. BHA had bleaching β-carotene more than all banana peel extracts. In generally, extracts obtained with methanol had the highest inhibition of lipid peroxidation compared with ethanol (95%). Inhibition of lipid peroxidation in this assay based on oxidation of linoleic acid produces hydro-peroxide derived free radicals that attack the chromophore of β-carotene, resulting in bleaching of the reaction emulsion. An extract capable of retarding/inhibiting the oxidation of β-carotene may be described as a free radical scavenger and primary antioxidant (Liyana-Pathirana and Shahidi, 2006). These results are in agreement with the results reported by Mariod *et al.* (2006) and Chew *et al.* (2008).

Thiobarbituric acid reactive substances (TBARS) assay

Data in Table 4 shows the effect of banana and potato peel extracts on inhibition of lipid peroxidation by using thiobarbituric acid reactive substances (TBARS) assay. Ethanolic (95%) and methanolic extracts of banana peel showed inhibition of lipid peroxidation slightly higher than those of potato peel extracts. While BHA inhibited lipid peroxidation more than banana peel extracts. Generally, extracts obtained with methanol had the highest inhibition of lipid peroxidation compared with ethanol (95%). The highest value was found of methanolic FrBPci extract followed by methanolic FBPci extract (71.3% and 71.2%, respectively). These results are in agreement with the results reported by Murthy *et al.* (2002), Singh *et al.* (2002) and Gonzalez-Montelongo *et al.* (2010).

Yield of extracts

The yield of banana peel extracts with methanol and ethanol solvents varied from 18.1 to 23.9 g/100 g plant (Fig. 3). Treated banana peel have higher value than control banana peel and potato peel. Methanol gave high value of yield extract compared ethanol solvent. These results agree with the results reported by Gonzalez-Montelongo *et al.* (2010) and Abo El-Maati *et al.* (2012), although comparison is highly difficult because of the different extraction conditions used.

Conclusions

There is a great deal of antioxidant activity in banana and potato peel and it could be a very inexpensive source of extracts rich in bioactive compounds, as previously suggested. Treatment of banana peel and extracting it with methanol was not only very efficient but also produced extracts with high antioxidant capacity, as confirmed by various model systems. This may be due to maintain on bioactive compound and variation in the quality and quantity of phenolic compounds and other bioactive compounds

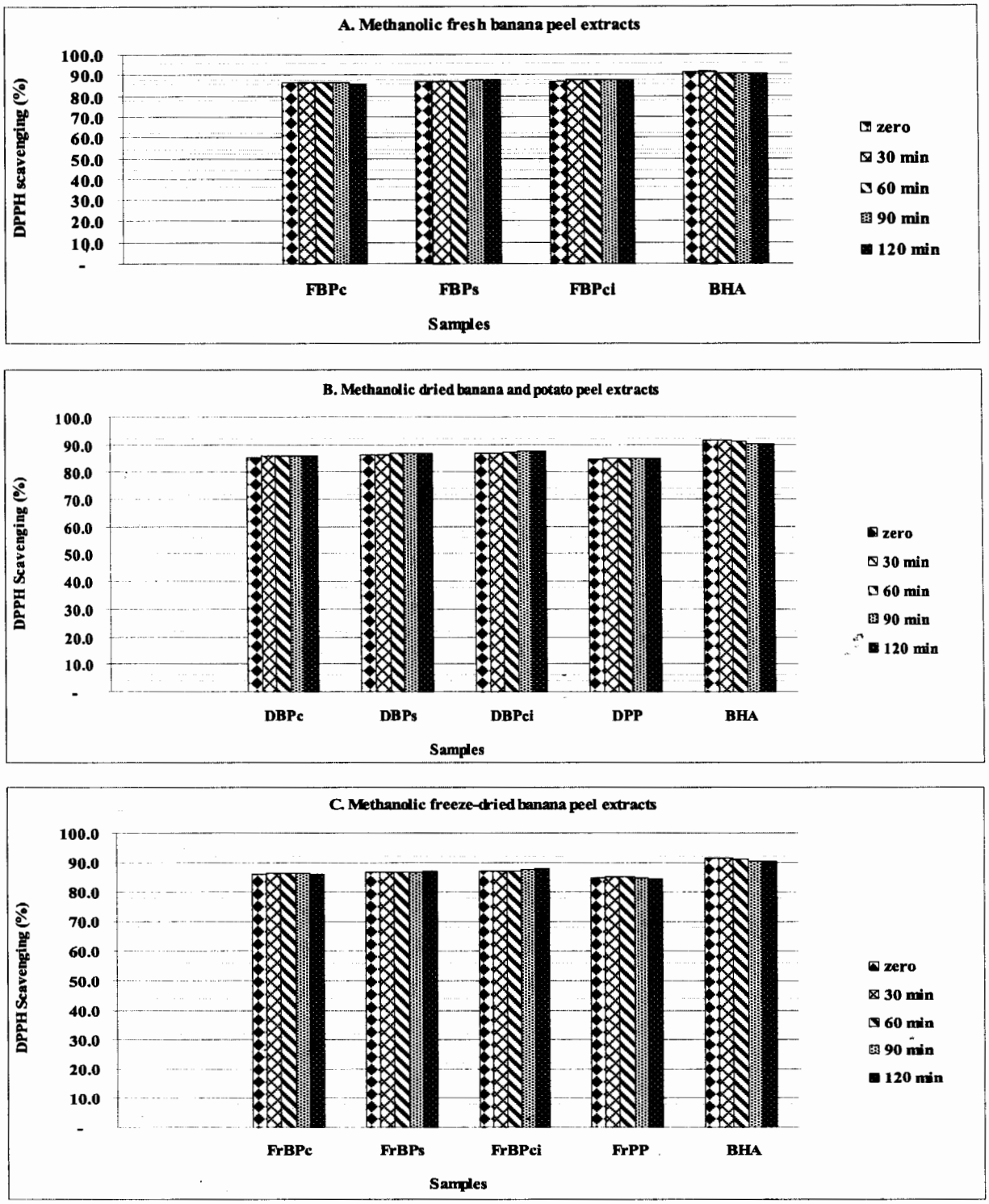

Fig. 1. DPPH free radical scavenging activity of methanolic extracts

FBPc is the control fresh banana peel extracts, FBPs is the fresh banana peel extracts with sodium-meta-bi-sulfite, FBPci is the fresh banana peel extracts with citric acid 1%; DBPc is the control dried banana peel extracts, DBPs is the dried banana peel extracts with sodium-meta-bi-sulfite and DBPci is the dried banana peel extract with citric acid; FrBPc is the control freeze-dried banana peel extract, FrBPs is the freeze-dried banana peel extract with sodium-meta-bi-sulfite and FrBPci is the freeze-dried banana peel extract with citric acid 1%; DPP is the dried potato peel extracts and FrPP is the freeze-dried potato peel extracts.

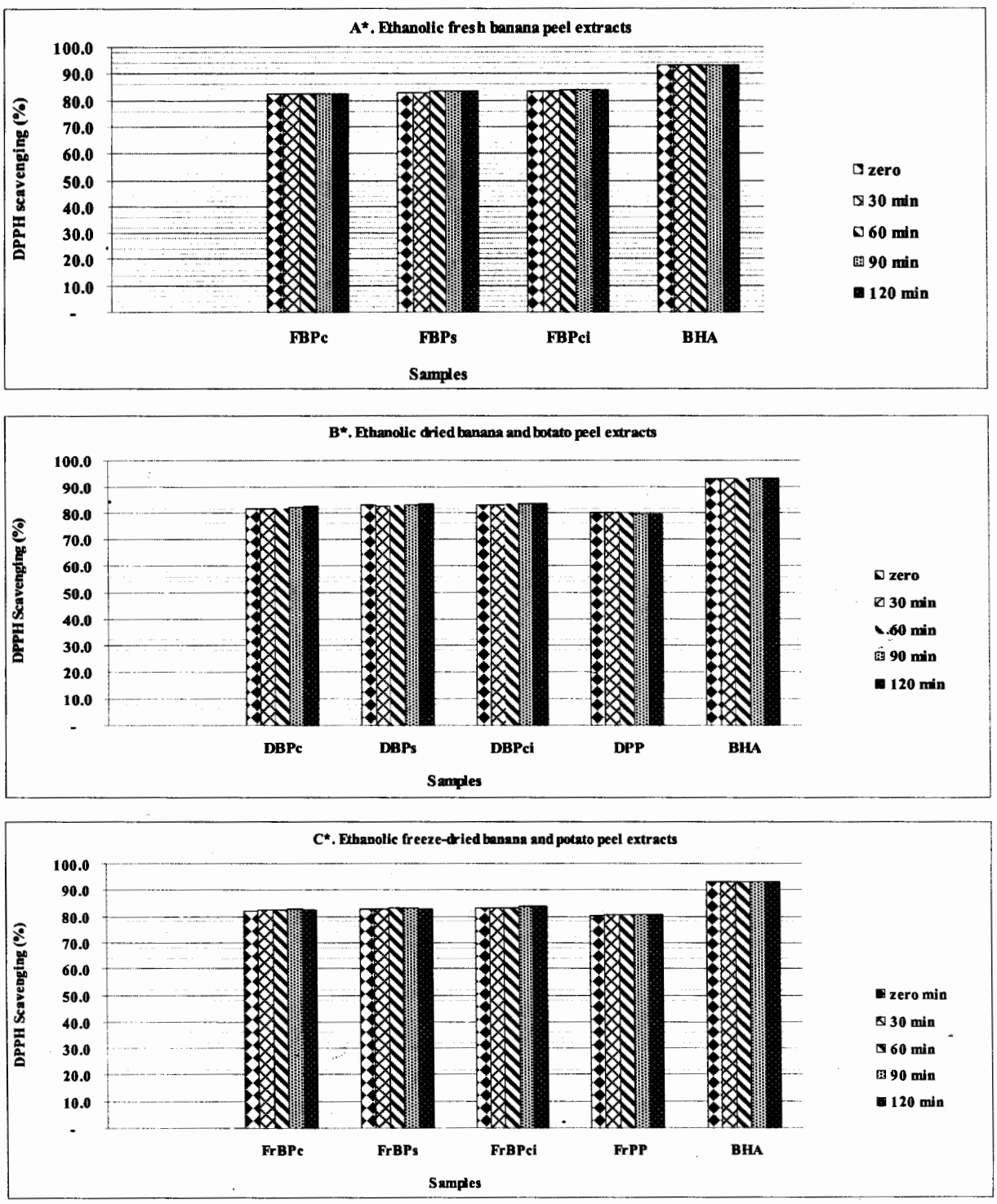

Fig. 2. DPPH Free Radical Scavenging Activity of Ethanolic Extracts

FBPc is the control fresh banana peel extracts, FBPs is the fresh banana peel extracts with sodium-meta-bi-sulfite, FBPci is the fresh banana peel extracts with citric acid 1%; DBPc is the control dried banana peel extracts, DBPs is the dried banana peel extracts with sodium-meta-bi-sulfite and DBPci is the dried banana peel extract with citric acid; FrBPc is the control freeze-dried banana peel extract, FrBPs is the freeze-dried banana peel extract with sodium-meta-bi-sulfite and FrBPci is the freeze-dried banana peel extract with citric acid 1%; DPP is the dried potato peel extracts and FrPP is the freeze-dried potato peel extracts.

Table 3. Extract capacity to inhibit lipid peroxidation by β-carotene bleaching assay

Sample	Inhibition lipid peroxidation (%)	
	Methanolic extracts	Ethanolic extracts
FBPc	89.6	88.9
FBPs	90.1	89.1
FBPci	90.5	89.4
DBPc	89.0	88.4
DBPs	89.7	88.7
DBPci	90.3	88.8
FrBPc	90.3	88.9
FrBPs	90.8	89.5
FrBPci	91.9	90.0
DPP	90.0	88.1
FrPP	90.3	88.6
BHA	95.5	95.5

FBPc is the control fresh banana peel extracts, FBPs is the fresh banana peel extracts with sodium-meta-bi-sulfite, FBPci is the fresh banana peel extracts with citric acid 1%; DBPc is the control dried banana peel extracts, DBPs is the dried banana peel extracts with sodium-meta-bi-sulfite and DBPci is the dried banana peel extract with citric acid; FrBPc is the control freeze-dried banana peel extract, FrBPs is the freeze-dried banana peel extract with sodium-meta-bi-sulfite and FrBPci is the freeze-dried banana peel extract with citric acid 1%; DPP is the dried potato peel extracts and FrPP is the freeze-dried potato peel extracts.

Table 4. Extract capacity to inhibit lipid peroxidation by thiobarbituric acid reactive substances (TBARS) assay

Sample	Inhibition lipid peroxidation (%)	
	Methanolic extracts	Ethanolic extracts
FBPc	70.5	67.1
FBPs	70.9	67.8
FBPci	71.2	68.1
DBPc	70.0	67.2
DBPs	70.2	67.5
DBPci	70.7	68.0
FrBPc	70.3	67.8
FrBPs	70.7	68.0
FrBPci	71.3	68.3
DPP	68.7	66.3
FrPP	69.2	66.9
BHA	89.7	89.0

FBPc is the control fresh banana peel extracts, FBPs is the fresh banana peel extracts with sodium metabisulfite, FBPci is the fresh banana peel extracts with citric acid 1%; DBPc is the control dried banana peel extracts, DBPs is the dried banana peel extracts with sodium-meta-bi-sulfite and DBPci is the dried banana peel extract with citric acid; FrBPc is the control freeze-dried banana peel extract, FrBPs is the freeze-dried banana peel extract with sodium metabisulfite and FrBPci is the freeze-dried banana peel extract with citric acid 1%; DPP is the dried potato peel extracts and FrPP is the freeze-dried potato peel extracts.

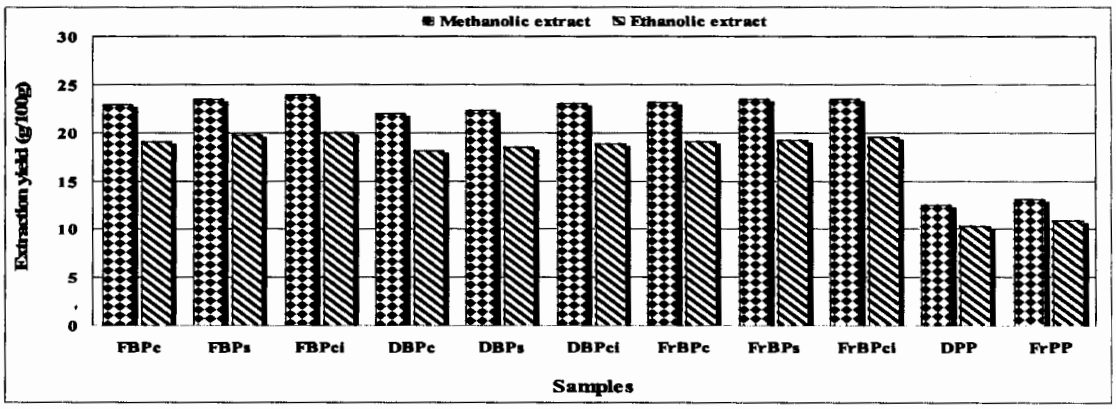

Fig. 3. Yield of extracts

FBPc is the control fresh banana peel extracts, FBPs is the fresh banana peel extracts with sodium-meta-bi-sulfite, FBPci is the fresh banana peel extracts with citric acid 1%; DBPc is the control dried banana peel extracts, DBPs is the dried banana peel extracts with sodium-meta-bi-sulfite and DBPci is the dried banana peel extract with citric acid; FrBPc is the control freeze-dried banana peel extract, FrBPs is the freeze-dried banana peel extract with sodium-meta-bi-sulfite and FrBPci is the freeze-dried banana peel extract with citric acid 1%; DPP is the dried potato peel extracts and FrPP is the freeze-dried potato peel extracts.

present in the different extracts. The antioxidant activities of banana peel extracts obtained from different treatment (citric acid 1% (*W/W*) and sodium-meta-bi-sulfite 200 ppm (*W/W*)) were almost similar. However, the impact of other extraction conditions, such as time or temperature, should be studied in greater depth. Further work is also required for the isolation and characterization of individual phenolic compounds present in various extracts, to determine the mechanisms involved in the antioxidant capacity of these by-product extracts.

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تأثير بعض المعاملات التكنولوجية على المحتوى المضاد للأكسدة لقشور الموز والبطاطس

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فى هذا البحث تم دراسة الخصائص المضادة للأكسدة والمحتوى الكلى للفينولات لكل من قشور الموز والبطاطس. قسمت عينات قشور الموز الى قسمين، استخدم الجزء الأول على حالته الطازجه وقد قسم بدوره الى ثلاثة أقسام أحدهما تم معاملته بالصوديوم ميتا باى سلفيت ٢٠٠ جزء فى المليون والآخر تم معاملته بحامض الستريك (١%) أما القسم الأخير فبقى على حالته دون معاملات (كنترول)، بينما قسم الجزء الثانى إلى قسمين أحدهما أجرى له عملية تجفيف على ٤٥°م والآخر أجريت له عملية تجفيد وكلا القسمين تم معاملة عيناته بنفس معاملات الجزء الطازج مع الإبقاء على عينة فى كل منهما بدون معاملات (كنترول)؛ أما قشور البطاطس فتم تقسيمها إلى جزئين أحدهما أجريت له عملية تجفيف والآخر أجريت له عملية تجفيد وكلا الجزئين لم تجرى عليه أى معاملات. تم حساب المحتوى الكلى للفينولات والقدرة على كسح الشوارد الحرة باستخدام صبغة DPPH (1,1 diphenyl-2- picrylhydrazyl radical) كما تم قياس القدرة على تثبيط البيروكسيدات الدهنية بطريقتين هما: طريقة تبييض البيتا كاروتين وطريقة حمض الثيوباربتيوريك؛ وكانت عينات قشور الموز المعاملة بحامض الستريك (١%) والتى أجرى لها عملية تجفيد هى الافضل من بين العينات تجاه جميع الاختبارات يليها عينات الموز المعاملة بالصوديوم ميتا باى سلفيت والتى أجرى لها عملية تجفيد ثم عينة الموز الطازجة التى عوملت بحامض الستريك (١%) وكانت نتائج إختبارات مستخلصات قشور البطاطس التى أجرى لها عملية تجفيد أفضل قليلا من مستخلصات قشور البطاطس المجففة وقد تم مقارنة المستخلصات الإيثيلية والميثيلية مع مضاد الأكسدة الصناعى بيوتيليتيد هيدروكسى أنيسول (BHA)، ومن النتائج المتحصل عليها يمكننا التوصية بأن مضادات الأكسدة الطبيعية والمركبات النشطه المستخلصة من قشور كلا من الموز والبطاطس من الممكن استخدامها فى تصنيع الغذاء وكذلك تحضير الأغذية الوظيفية.

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