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Antioxidant activity of microwave-assisted extract of longan (*Dimocarpus Longan* Lour.) peel

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Abstract

The longan (*Dimocarpus Longan* Lour.) peel was extracted with 95% ethanol employing microwave-assisted extraction and Soxhlet extraction method, the total phenolic content of microwave-assisted extract of Langan peel (MEL) and Soxhlet extract of Langan peel (SEL) reached 96.78 mg/g and 90.35 mg/g dry weight, respectively, expressed as pyrocatechol equivalents, which were quantified using Folin–Ciocalteu reagent. Subsequently, antioxidant properties of two extracts were investigated employing various established systems *in vitro* including 2,2′-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay, hydroxyl radical scavenging assay using a new resonance scattering (RS) method, reducing power and total antioxidant capacity. MEL and SEL showed excellent antioxidant in all test systems compared to synthetic antioxidant 2,6-di-ter-butyl-4-methylphenol (BHT) and the antioxidant activities of MEL were all superior to those of SEL. Furthermore, the suitability of MEL and SEL as substitute of BHT were determined in peanut oil, and the decrease of lipid oxidation were monitored using thiobarbituric acid-reactive substances (TBARS) assay. MEL and SEL treatment significantly ($P < 0.05$) reduced lipid oxidation in peanut oil compared to the control. No significant differences ($P = 0.05$) in lipid oxidation were detected between MEL, SEL and BHT samples of peanut oil.

Keywords: Longan peel; Microwave-assisted extraction; Total phenolic content; DPPH radical; Hydroxyl radical; Reducing power; Total antioxidant capacity

1. Introduction

Active oxygen and free radicals exist in human body in the form of superoxide anion ($O_2^{-\cdot}$), hydrogen peroxide (H_2O_2) and hydroxyl radical ($^{\cdot}OH$) and so on. As normal metabolic action going on in human body, active oxygen and free radicals are constantly formed. If they reach high levels, oxidative stress in human body would be created, which leads to a variety of biochemical and physiological lesions and often results in metabolic impairment and cell death (Ames, 1998). On the other hand, high levels of active oxygen and free radicals could also cause lipid oxidation which led to a highly deteriorative process and unacceptable properties of foods as well as a loss in nutritional value (Koleva et al., 2003; Pan et al., 2007). However, the action of active oxygen and free radicals is opposed by a balanced system of antioxidant defences, including antioxidant compounds and enzymes (Halliwell & Gutteridge, 1999). Hence the presence of antioxidants is essential for their quality, retention and safety. In the past years, commercial antioxidant used to be a number of synthetic antioxidants, such as 2-3-ter-butyl-4-methoxyphenol (BHA), 2,6-di-ter-butyl-4-methylphenol (BHT) and so on, but they have been suspected of possessing of certain toxicity and being responsible for liver damage and carcinogenesis (Pan, Liang, Wang, & Liang, 2004; Pan et al., 2007; Valentaõ et al., 2002). Therefore, the development and isolation of natural antioxidants from natural

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plant has been become the focus of the research of antioxidant.

The preservative effect of many plant spices and herbs suggests the presence of antioxidative and antimicrobial constituents in all parts of the plants (tree bark, stalks, leaves, fruits, roots, flowers, pods and seeds) (Hirasa & Takemasa, 1998; Kim, Kim, Kim, & Heo, 1997). Actually, plants contain a diverse group of phenolic compounds, including simple phenolics, phenolic acids, anthocyanins, hydroxycinnamic acid derivatives, and flavonoids. All the phenolic classes have the structural requirements of free radical scavengers and have potential as food antioxidants (Bandoniene & Murkovic, 2002), so phenolic compounds are attracting considerable interest in the field of chemistry, food and medicine (Okuda, Valentine, Shapiro, & Downing, 1994).

Longan (*Dimocarpus longan* Lour.) is a member of the Sapindaceae family which is a highly attractive subtropical fruit widely distributed in the south of China, previous study of its biochemical and physiological activities focused on longan seeds mostly. Morton (1987) depicted that longan seeds are traditional used as a folklore medicine, which are administered to counteract heavy sweating and the pulverized kernel serves as a styptic. Specially, longan seeds has previously been shown to possess potent antioxidant activities which could be ascribed to their phenolic contents (Soong & Barlow, 2004). However, there is a little study on longan peel which usually regards as a waste material, especially no previous study on the antioxidant property of longan peel so far as we know.

Different extraction techniques, such as dispersed-solids, percolation, Soxhlet and supercritical fluid extraction have been used to isolate antioxidants from the plants, however none of them can be considered as an optimal method for this purpose (Grigonis, Venskutonis, Sivik, Sandahl, & Eskilsson, 2005). Recently, microwave-assisted method has been used as an alternative laboratory scale extraction method, which proved to be considerably more effective and economical. It provides higher recoveries, requires considerable less time and the smaller solvent consumption compared to conventional extraction (Martino, Ramaiola, Urbano, Bracco, & Collina, 2006). It was also reported that phenolic compounds can be easily extracted with microwave-assisted method (Pan, Niu, & Liu, 2003). So microwave-assisted method should have significant implications for extraction of antioxidant compounds in plants.

In present study, the possibility of using microwave-assisted method as a rapid and effective method for extracting antioxidant compounds from longan peel was investigated for the first time, and the total phenolic content and the antioxidant activities of MEL was compared to those of SEL to confirm the advantage of microwave-assisted method. Subsequently, the suitability of MEL and SEL as substitute antioxidants of BHT were also determined in all test systems *in vitro* as well as their using in peanut oil.

2. Materials and methods

2.1. Materials

Folin–Ciocalteu reagent, 2,2′-diphenyl-1-picrylhydrazyl (DPPH), 2,6-di-ter-butyl-4-methylphenol (BHT), thiobarbituric acid (TBA) and trichloroacetic acid (TCA) were purchased from Sigma Chemicals Co. (St. Louis, MO, USA). Other chemicals were purchased from China National Medicine Group Shanghai Corporation (Shanghai, China). All chemicals and solvents used were of analytical grade.

The peanut oil, which was stripped, was bought from Beijing Chemical Company (Beijing, China). It contained very low α-tocopherol ($2.0\ mg\ kg^{-1}$) and no synthetic antioxidants.

2.2. Equipment and apparatus

The following instruments were used: UV-1100 spectrophotometer (Beijing Rayleigh Analytical Instrument Corporation, China); RE-52AA rotavapour (Shanghai Yarong Biochemistry Instrument Factory, Shanghai, China); DZF-1B vacuum drier (Shanghai Yuejin Medical Instrument CO., Ltd., Shanghai, China); SHB-βA water-circulation multifunction vacuum pump (Zhengzhou Great Wall Scientific Industry and Trade CO., Ltd., Zhengzhou, China); XH-100A microwave extraction and synthesis apparatus (Beijing XiangHu Science and Technology Development Co., Ltd., Beijing, China); Rayleigh scattering and synchronous fluorescence (SF) spectra were recorded with a model RF-540 spectrofluorophotometer (Shimadzu, Japan), using the synchronous scanning technique that the excited wavelength λ_{ex} was equal to the emission wavelength λ_{em} ($\lambda_{ex} = \lambda_{em}$), a model of TU-1901 dual beams spectrophotometer (Puxi Com., China) were used for recording the absorption spectra.

2.3. Preparation of extracts

Longan was obtained from Guilin Pharmaceuticals Group of China (Zhongshan Road, Guilin City, China). The peel of Longan were ground (max particle size 0.4 mm) after dried in oven at 60 ± 0.5 °C, then was extracted with microwave-assisted extraction. Soxhlet extraction was also employed for comparation. Microwave-assisted extraction were performed in a three neck flask with a temperature detector, ground material (5 g) were extracted with 50 mL ethanol (95%) at 80 °C for 30 min, the microwave power was 500 W and the microwave frequency was 2450 MHz. For Soxhlet extraction, ground material (5 g) were placed in a Soxhlet apparatus and extracted with 80 mL of ethanol (95%) for 2 h. Solvent of two extracts were evaporated using a RE-52AA rotavapour at 50 °C and a SHB-βA water-circulation multifunction vacuum pump. Extracts were finally dried in a DZF-1B vacuum drier at 30 °C and 0.07 MPa and were stored

in a freezer until use. The yield of MEL and SEL were 12.8% and 10.9%, respectively.

2.4. Determination of total phenolic compounds

Total soluble phenolics in MEL and SEL were determined using Folin–Ciocalteu reagent according to the method of Slinkard and Singleton (1977) using pyrocatechol as a standard. Briefly, extract solution (1 mL, 1 mg/mL) in a volumetric flask was diluted with glass-distilled water (46 mL). Folin–Ciocalteu reagent (1 mL) was added and the contents of flask were mixed thoroughly. After 3 min, sodium carbonate solution (3 mL, 2%) were added, and then the mixture was allowed to stand for 2 h with intermittent shaking. The absorbance was measured at 760 nm. The concentration of total phenolic compounds in the extract was determined as micrograms of pyrocatechol equivalents by using an equation that was obtained from standard pyrocatechol graph given as: absorbance = 0.22 μg pyrocatechol + 0.0571.

2.5. Scavenging activity on DPPH radical

To evaluate the free radical scavenging activity, MEL was allowed to react with a stable free radical, 2,2′-diphenyl-1-picrylhydrazyl radical (DPPH) (Brand, Cuvelier, & Berset, 1995; Sanchez-Moreno, Larrauri, & Saura-Calixto, 1998; Blois, 1958). Briefly, MEL or SEL solution (0.2 mL) in 95% ethanol at different concentrations (0.2, 0.5, 0.8, 1.2 mg/mL) was added to 8 mL 0.004% (w/v) solution of DPPH in 95% ethanol. The reaction mixture was incubated at 28 °C. The scavenging activity on DPPH radical was determined by measuring the absorbance at 515 nm each 10 min until the reaction reached the steady state. The antioxidant activity was expressed as a percentage of scavenging activity on DPPH radical: SC% = [1 − (absorbance of sample)/(absorbance of control)] × 100%. The control contains all reagents except the extract. The DPPH radical scavenging activity of BHT (0.5 mg/mL) and SEL (0.5 mg/mL) were also assayed for comparison. All tests were performed in triplicate and mean were centred.

2.6. Hydroxyl radical scavenging activity

Hydroxyl radical scavenging activity of MEL, SEL and BHT was estimated through the new method of Liang, Zhou, and Jiang (2006). HCl–NaAc buffer solution (pH = 4.95, 1.0 mL), KI solution (0.020 mol/L, 0.7 mL), Fe(II) solution (4.00×10^{-5} mol/L, 0.1 mL) and H_2O_2 standard solution (6.48 μmol/L, 0.4 mL) were piped in a 10 mL graduated tube, then rhodamine B (RhB, 1.50×10^{-4} mol/L, 1.4 mL) was mixed. The mixed solution was diluted to 5 mL with water and mixed thoroughly. The resonance scattering spectra was obtained by using the synchronous scanning technique in a model RF-540 spectrofluorophotometer. The I_s which presents the RS intensity for the system containing H_2O_2 and scavenger, I presents the RS intensity for the system containing H_2O_2 and I_b the RS intensity in the absence of H_2O_2 were measured at 420 nm. The scavenging percentage (P) could be calculated as $P\ (\%) = [(I - I_s)/(I - I_b)] \times 100\ (\%)$. The IC_{50} (defined as the concentration of sample at which 50% of hydroxyl radical were scavenged) was calculated for each sample.

2.7. Reducing power

The determination of reducing power was performed as described by Oyaizu (1986). One millilitre of various MEL or SEL solution (0.05, 0.08, 0.1 and 0.2 mg/mL) were mixed with phosphate buffer (2.5 mL, 0.2 M, pH 6.6) and potassium ferricyanide (2.5 mL, 1%). After the mixture was incubated at 50 °C for 20 min, trichloroacetic acid (2.5 mL, 10%) was added, and the mixture was centrifuged at 3000 rpm for 10 min. The upper layer of solution (2.5 mL) was mixed with distilled water (2.5 mL) and ferric chloride (0.5 mL, 0.1%), then the absorbance was measured at 700 nm against a blank. Increasing absorbance of the reaction mixture indicates increasing reducing power. The reducing power of BHT (0.5 mg/mL) was also determined for comparation.

2.8. Determination of total antioxidant capacity

The total antioxidant capacity of MEL was determined according to the method of Prieto, Pineda, and Aguilar (1999). MEL or SEL solution (0.1 mL) was combined with 0.3 mL of reagent solution (0.6 M sulphuric acid, 28 mM sodium phosphate and 4 mM ammonium molybdate). The reaction mixture was incubated at 95 °C for 150 min. After the mixture had cooled to room temperature, the absorbance of the mixture was measured at 695 nm against a blank. The readings were taken each 30 min. The antioxidant activity was expressed as the absorbance of the sample. The antioxidant activity of BHT (0.5 mg/mL) and SEL (0.5 mg/mL) were also assayed for comparison.

2.9. Antioxidant potential of MEL and SEL in peanut oil

Calculated amounts of MEL and SEL (0.01, 0.02, 0.05 and 0.08 mg/mL of the oil) were added to 50 mL of peanut oil. The additive was mixed into the oil with a magnetic stirrer. Synthetic antioxidant BHT was used as a reference for comparison. The oxidative deterioration of samples was studied using Schaal oven test method as described by Economou, Oreopoulou, and Thomopoulos (1991). The oil samples (50 mL each) were placed in open 100 mL beakers, and placed in 60 ± 0.5 °C oven for 24 h. A blank sample was prepared under the same conditions, without adding any additives. The rate of antioxidation of peanut oil was estimated according to the increase of 2-thiobarbituric acid-reactive substances (TBARS) using the classical TBA procedure. The TBARS values of untreated and treated samples were used to calculate the

inhibition of lipid oxidation as follows: Inhibition (%) = (control − treatment)/control × 100%.

2.10. Statistical analysis

All experimental results were centred at using three parallel measurements of mean ± SD. Analysis of variance was performed by ANOVA procedure. Duncan's new multiple-range test was used to determine the differences of means. P values < 0.05 were regarded as significant and P values <0.01 as very significant.

3. Results and discussion

3.1. Total phenolic content

It is well known that plant phenolic are highly effective free radical scavengers and antioxidants and antioxidant activity of fruits and tea is derived largely from phenolic and polyphenolic compounds, so there should be a close correlation between the content of phenolic compounds and antioxidant activity. (Bravo, 1998). The Folin–Ciocalteu phenol method is actually not an antioxidant test but an replaceable assay for the quantity of oxidizable substance, i.e. phenolic compounds (Wangensteen, Samuelsen, & Malterud, 2004). Phenolic compounds undergo a complex redox reaction with phosphotungstic and phosphomolybdic acids present in the reagent (Singleton, Orthofer, & Lamuela-Raventós, 1999). In present study, the true antioxidant potential of MEL is revealed by expressing antioxidant activity in terms of phenolic content compared to that of SEL employing Folin–Ciocalteu phenol method. The total phenolic content of MEL and SEL were 96.78 mg/g and 90.35 mg/g dry weight, respectively, expressed as pyrocatechol equivalents ($P < 0.05$).

3.2. Scavenging activity on DPPH radical

Antioxidant properties, especially radical scavenging activities, are very important due to the deleterious role of free radicals in foods and in biological system (Gülçin, 2006). DPPH is a kind of stable free radical and accepts an electron or hydrogen radical to become a stable diamagnetic molecule (Soares, Dins, Cunha, & Ameida, 1997) which was widely used to investigate radical scavenging activity now for its advantage of ease and economical. In DPPH radical scavenging assay, antioxidants are able to reduce the stable DPPH radical to yellow-coloured and the antioxidant power is indicated by the degree of discoloration which could be determined by measuring of a decrease in the absorbance at 515 nm.

A concentration-dependent assay was carried out with MEL and the results are presented in Fig. 1. These results provide a direct comparison of the antioxidant activities of MEL with SEL and BHT. Fig. 1 illustrates that MEL and SEL possessed significant scavenging activities on DPPH radical, their scavenging effect was increased with increasing concentration and reaction time, and their scavenging activities is pretty more higher than BHT. In addition, the scavenging effect of MEL at the concentration of 0.2 mg/mL was closed to that of SEL at the concentration of 0.5 mg/mL, indicated that the scavenging effect of MEL on DPPH radical was superior to SEL. After 30 min, the scavenging activities of MEL at 0.2 mg/mL was 56.48% while that of SEL was 57.99% at 0.5 mg/mL.

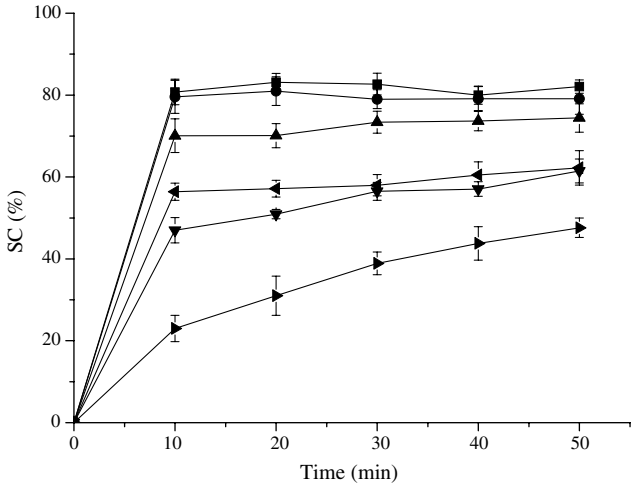

Fig. 1. DPPH free radical scavenging activity of MEL compared to REL and BHT. 0.2 mg/mL MEL (▼), 0.5 mg/mL MEL (▲), 0.8 mg/mL MEL (●), 1.2 mg/mL MEL (■), 0.5 mg/mL SEL (◀), 0.5 mg/mL BHT (▶). SC% (percentage of scavenging activity on DPPH radical) = [1 − (absorbance of sample)/(absorbance of control)] × 100%. Results are mean ± SD of three parallel measurements. $P < 0.01$, when compared to the control.

With regard to other fruit peel extracts, Mexican lime peel extract and Persian lime peel extract exhibit a moderate scavenging ability (11.3% and 35.5%) at 0.2 mg/mL (Ubando-Rivera, Navarro-Ocaña, & Valdivia-López, 2005), whereas that of potato peel was about 90% at the concentration of 2.5 mg/mL (Nandita & Rajini, 2004). Apparently, the scavenging activities of MEL and SEL were more effective than those of two lime peel extracts and potato peel extract.

3.3. Scavenging activity on hydroxyl radicals

Hydroxyl radicals are the most reactive and predominant radicals generated endogenously during aerobic metabolism among the reactive oxygen species (ROS) (Waling, 1975), which could be formed from superoxide anion and hydrogen peroxide, in the presence of metal ions, such as copper or iron and cause the aging of human body and some diseases (Siddhuraju & Becker, 2007), interact with the purine and pyrimidine bases of DNA as well as abstract hydrogen atoms from biological molecules (e.g. thiol compounds), leading to the formation of sulphur radicals able to combine with oxygen to generate oxysulphur radicals, a number of which damage biological molecules (Halliwell, Gutteridge, & Aruoma, 1987). Hydroxyl radical

formation can occur in several ways, by far the most important mechanism *in vitro* is the Fenton reaction where a transition metal is involved as a prooxidant in the catalyzed decomposition of superoxide and hydrogen peroxide (Stohs & Bagchi, 1995). Previous methods to determined hydroxyl radicals include high-performance liquid chromatography (HPLC), the electron spin resonance (ESR)-spin trapping method, chemiluminescence method, fluorescence method, spectrophotometer method, capillary zone electrophoresis method and so on (Liang et al., 2006). In present study, hydroxyl radical scavenging activity of RP was measured by a new resonance scattering spectral method of Liang et al. (2006) from Fenton reaction. In the reaction system of this method, the main reaction processed as,

$$Fe^{2+} + H_2O_2 \rightarrow Fe^{3+} + {}^{\cdot}OH + OH^-$$
$${}^{\cdot}OH + I^- \rightarrow OH^- + I_2$$
$$I_2 + I^- \rightarrow I_3^-$$
$$nRh^+ + nI_3^- \rightarrow (Rh - I_3)_n$$

Based on these reaction and resonance scattering effect of $(Rh - I_3)_n$ at 420 nm, this method could be employed to determined hydroxyl radical scavenging activity.

According to this procedure, the scavenging percentage of MEL and SEL on hydroxyl radical was investigated. Fig. 2 indicates that the MEL and SEL exhibited a quite strong concentration-dependent inhibition of hydroxyl radical at a pretty low concentration compared to BHT, and the scavenging percentage of MEL was better than SEL. The IC_{50} of MEL was only 1.74 μg/mL, and the IC_{50} of SEL was 2.27 μg/mL whereas BHT reached 2.79 μg/mL. So the scavenging ability were in this order: MEL > SEL > BHT.

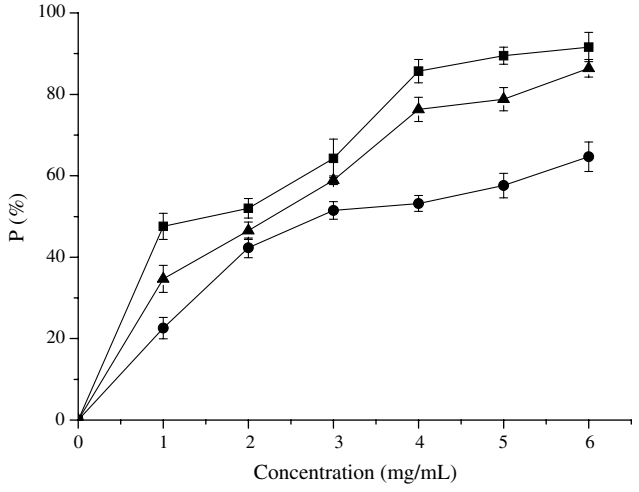

Fig. 2. Hydroxyl radical scavenginig activity of MEL compared to SEL and BHT at pH 4.95, 3.00×10^{-3} mol/L KI, 4.00×10^{-5} mol/L Fe^{2+}, 3.00×10^{-5} mol/L RhS and 6.48 μmol/L H_2O_2(OR = 5 S = 2). MEL (■), SEL (▲), BHT (●). P (%) = $[(I - I_s)/(I - I_b)] \times 100\%$. Results are mean ± SD of three parallel measurements. $P < 0.05$, when compared with the control.

3.4. Reducing power

The reducing capacity of a compound may serve as a significant indicator of its potential antioxidant activity (Yıldırım et al., 2000). The exist of reductones are the keys of the reducing power, which exhibit their antioxidant activities through the action of breaking the free radical chain by donating a hydrogen atom (Xing et al., 2005). In the assay, the presence of reductants in the antioxidant sample causes the reduction of the Fe^{3+}/ferricyanide complex to the Fe^{2+}/ferrous form (Gülçin, 2006), so the reducing power of the sample could be monitored by measuring the formation of Perl's Prussian blue at 700 nm (Chung, Chang, Chao, Lin, & Chou, 2002).

Fig. 3 depicts the reducing properties of MEL and SEL as well as BHT at different concentration. The reducing power of MEL was outstanding at various concentration compared with SEL and BHT and its reducing power was correlated with increasing concentration. At 1.0 mg/mL, the reducing power of MEL and SEL were 1.587 and 1.439, respectively, while that of BHT was 1.166 only. Therefore the reducing power were in this order: MEL > SEL > BHT. It was speculated that excellent reducing power of MEL and SEL presented in this study may be due to the abundant total phenolic compounds and thus was likely to contribute considerably to the observed antioxidant effects.

3.5. Total antioxidant capacity assay

The assay is based on the reduction of Mo (VI) to Mo (V) by extracts and subsequent formation of a green phosphate/Mo (V) complex at acid pH. The high absorbance values indicated that the sample possessed significant antioxidant activity. In this assay, the total antioxidant activities of MEL and SEL were measured and compared with that of BHT and the control, which contained no

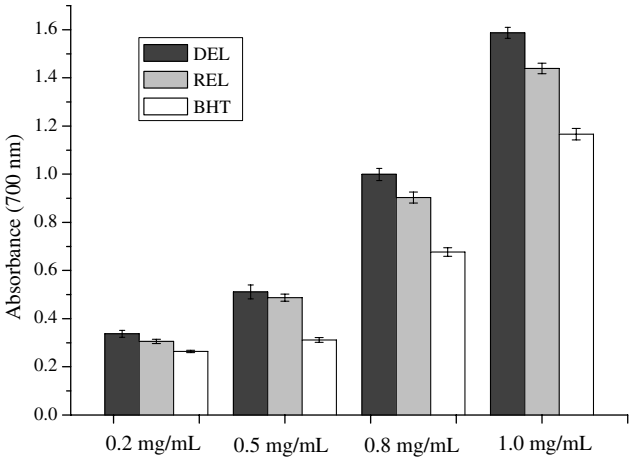

Fig. 3. The reducing power of MEL, SEL and BHT. Results are mean ± SD of three parallel measurements. $P < 0.01$, when compared with control.

antioxidant component. According to the results, MEL and SEL had significant total antioxidant activities and the effects increased with increasing reaction time and increasing concentration. Fig. 4 also depicts that total antioxidant of MEL at the concentration of 0.1 mg/mL was close to BHT at the concentration of 0.5 mg/mL, which indicated that the total antioxidant of MEL was superior to BHT. With regard to SEL, the total antioxidant of MEL at the concentration of 0.2 mg/mL was close to SEL at the concentration of 0.5 mg/mL, so MEL possess better total antioxidant than SEL.

3.6. Lipid peroxidation in peanut oil

The level of 2-thiobarbituric acid-reactive substances (TBARS), products of lipid peroxidation, is often measured in order to assess the extent of oxidation that occurs in biological systems. Lipid oxidation for peanut oil, which was untreated or treated with antioxidants, MEL, SEL and BHT at concentrations of 0.01, 0.02, 0.05 and 0.08 mg/mL is shown in Fig. 5. Oxidation levels were in all peanut oil samples as antioxidant concentration increased. The highest level of lipid oxidation occurred in untreated peanut oil samples compared with those containing the added antioxidants.

Overall differences in the inhibition rate of lipid oxidation between MEL, SEL and BHT in all peanut oil samples examined are also presented in Fig. 5. MEL, SEL and BHT significantly ($P < 0.05$) improved oxidative stability of peanut oil. Addition of BHT at a concentration of 0.01, 0.02, 0.05 and 0.08 mg/mL reduced lipid oxidation by 25.30%, 38.78%, 43.97% and 55.78% for peanut oil samples, respectively. However, addition of MEL at the same concentration inhibited lipid oxidation by 30.70%, 40.82%, 57.37% and 68.05%, and addition of SEL at the same concentration inhibited lipid oxidation by 27.1%, 39.63%, 50.11% and 64.39% for peanut oil samples, respectively. No significant differences ($P = 0.05$) in lipid oxidation were detected between MEL, SEL and BHT samples of peanut oil.

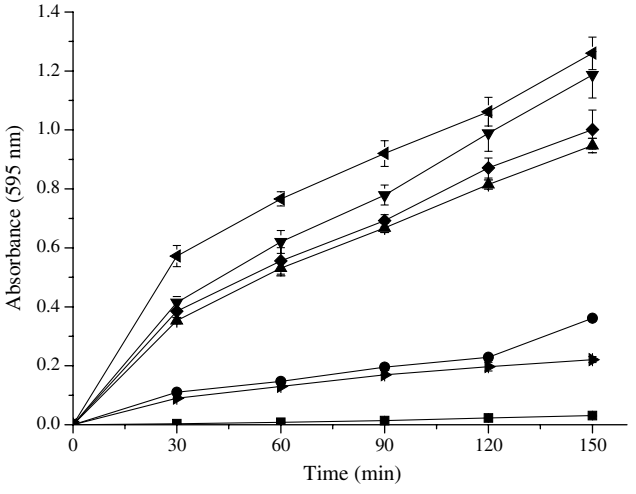

Fig. 4. Total antioxidant activity of MEL and BHT. Control (■), 0.1 mg/mL MEL (●), 0.25 mg/mL MEL (▲), 0.5 mg/mL MEL (▼), 1.0 mg/mL MEL (▼), 0.5 mg/mL BHT (◀), 0.5 mg/mL SEL (▶). Results are mean ± SD of three parallel measurements. $P < 0.01$, when compared to the control.

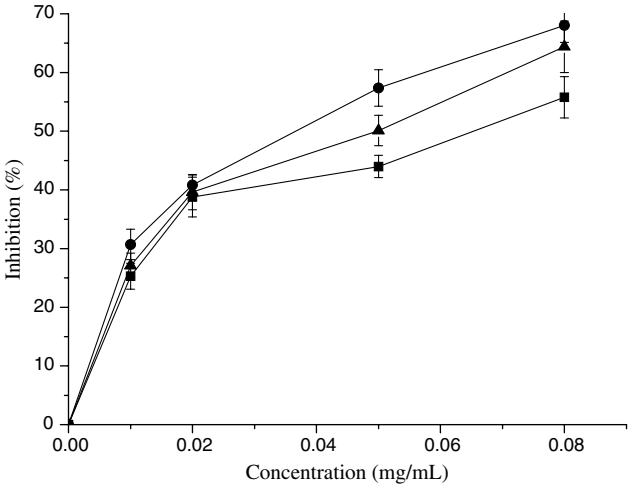

Fig. 5. Lipid oxidation inhibited by MEL, SEL and BHT in peanut oil. MEL (●), SEL (▲), BHT (■). Results are mean ± SD of three parallel measurements. $P < 0.01$, when compared with the control.

4. Conclusions

In this study, we have investigated the possibility of employing microwave-assisted method to extract antioxidant from longan peel. The results indicated that MEL and SEL possess abundant phenolic content and exhibits excellent antioxidant activities comparing to synthetic antioxidant BHT. The main finding of this work is the fact that the antioxidant of MEL was superior to those of SEL which suggested that microwave-assisted method processed advantages compared to Soxhlet extraction method and it could be used as a effective method to extract antioxidant components considering these factors such as extraction time, solvent wastage and so on. This study gives a strong impact for expanding the investigations of antioxidants compounds extracted with microwave-assisted method from longan peel and making the using of MEL as an substitute antioxidant of BHT in the food industry. To study the antioxidant mechanisms of some specific phenolic components in longan peel, further study are in progress. Nevertheless, basis on our results obtained, MEL might be somewhat beneficial to the antioxidant protection system in food industry even in human body against oxidative damage.

Acknowledgements

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