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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.
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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

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