March 2015 Vol. 22 No. 1 50-57
Journal of Northeast Agricultural University (English Edition)

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Antioxidant Activities of Nine Selected Culinary Spices from China

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Abstract: The antioxidant activities and the total phenolic contents of the water and/or ethanol extracts of the nine selected culinary spices from China were systematically investigated. Both ethanol extracts and water extracts had high ability of 1, 1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging, 2, 2'-azinobis (3-ethylbenzthiazoline-6-sulphonic acid) (ABTS) radical scavenging and ferric reducing antioxidant power (FRAP). The ethanol extract of Sichuan pepper showed the highest ability of DPPH radical scavenging. The extract with the highest ABTS radical scavenging effect was that of ethanol extract of cinnamon. Both ethanol and water extracts of cinnamon possessed the high ferric reducing antioxidant power (FRAP) with the values of 4 541.87 and 1 134.52 μmol of Fe (Ⅱ)/g. The extracts with high hydroxyl radical-mediated deoxyribose degradation were all the ethanol extracts as follows: cinnamon, bay leaf, Sichuan pepper, star anise and fennel. The extracts with high antioxidant activities also had the high contents of the phenols. The study indicated that these spices might be potentially be used as natural antioxidants in food.

Key words: antioxidant activity, total phenolic content, spice, antioxidant

CLC number: TS202.3 **Document code:** A **Article ID:** 1006-8104(2015)-01-0050-08

Introduction

Deterioration of food quality occurs during processing and storage and is related to oxidative processes. Degradation affects lipids, carbohydrates and proteins (Halliwell, 1997). Usually synthetic antioxidants, such as, butylhydroxyanisole (BHA) or butylhydroxytoluene (BHT) are used to decelerate these processes. Yet, these antioxidants suffer from the drawback which they are volatile easily and decompose at high temperature. Additionally, it is still unclear whether chronic consumption can lead to health risks (Martinez-Tome *et al*., 2001).

Many antioxidant compounds, naturally occurring in plant sources, have been identified as free radical or active oxygen scavengers. Recently, considerable interest has increased in naturally-occurring antioxidants that can be used to protect human beings and food from oxidative stress damage (Scalbert *et al*., 2005). Spices are natural plant products, which have been used not only as flavoring and coloring agents, but also as food preservatives and folk medicines throughout the world for thousands of years. Many spices have been recognized as having digestive stimulant action, carminative action, antimicrobial, anti-inflammatory, anti-mutagenic, and anti-carcinogenic potential, etc (Ceylan and Fung, 2004; Srinivasan *et al*., 2005). Besides, many spices also are an excellent source of phenolic compounds that have been reported to show superior antioxidant activity (Carlsen *et al*., 2010; Wojdyło *et al*., 2007; Mata *et al*., 2007; Konczak *et al*., 2010). However, the knowledge about the antioxidant capacity and phenolic compounds of

Received 11 December 2014
Supported by the National Natural Science Foundation (31201356); Agricultural Science and Technology Innovation in Jiangsu Province (cx (13)3087); the Natural Science Foundation in Jiangsu Province (BK 20130701)
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spices commonly consumed in China is limited (Lu *et al*., 2011).

More than 400 native spices have been used for a long time in "Chinese cuisine", not only to improve or modify the flavour of foods, but also to avoid its deterioration. Some common spices, such as cinnamon, star anise, Sichuan pepper and dried ginger, are widely used in daily Chinese household cooking (Tapsell *et al*., 2006). The purpose of this study was to evaluate the antioxidant activity and total phenolic contents of selected culinary spices to find out potential sources of natural antioxidants for food application. Nine spices growing in China and commonly used in food preparations were collected, water and/or ethanol extracts were prepared to screen for antioxidant activity and total phenolic content.

Materials and Methods

Plant materials and chemicals

Star anise (*Illicium verum*), Sichuan pepper (*Pericarpium zanthoxyli*), cinnamon (*Cinnamomum aromaticum*), bay leaf (*Laurus nobilis*), fennel (*Foeniculum vulgare*), amomum tsaoko fruit (*Fructus tsaoko*), galangal (*Alpinia officinarum* Hance), dried ginger (*Rhizoma zingiberis*) and dried tangerine peel (*Pericarpium Citri Reticulatae*) were collected from local supermarkets (Nanjing, Jiangsu, China). The collected samples were ground to fine powder by a universal high-speed smashing machine and pass though a 50 mesh screen. The ground samples were stored at −20℃ until analyzed.

1, 1-diphenyl-2-picrylhydrazyl (DPPH), 2, 2'-azino-bis (3-ethylbenzthiazoline-6-sulphonic acid) (ABTS), 2, 4, 6-tri (2-pyridyl)-1, 3, 5-triazine (TPTZ) and 2-deoxy-D-ribose were purchased from Sigma Chemical Co (St. Louis, MO, USA). Ethylenediaminetetraacetic acid (EDTA), thiobarbituric acid (TBA), trichloroacetic acid (TCA), gallic acid, Folin-Ciocalteu reagent, butylated hydroxytoluene (BHT), ascorbic acid, and 6-hydroxy-2, 5, 7, 8-tetramethyl-2-chromanecarboxylic acid (trolox) were from Sinopharm Group Chemical Reagent Co., Ltd (Shanghai, China). All other chemicals used were of analytical grades.

Spices extraction

Ethanol extraction: 20 g of ground sample was extracted with 150 mL ethanol under refluxing for 30 min. The mixture was cooled to room temperature and filtered to get the clear supernatant. The solvent was removed by vacuum distillation to obtain the equivalent dry weight. The dried extract was stored at −20℃ until use.

Water extraction: the water extraction was carried out as described in the ethanol extraction procedure, except that ethanol was replaced by water. The solvent was removed by vacuum distillation to obtain the equivalent dry weight. The dried extract was stored at −20℃ until using. The amomum tsaoko fruit, galangal, dried ginger and dried tangerine peel had no water extract, for a kind of jelly was observed during the water extraction process.

Free radical scavenging by using DPPH radical

DPPH radical scavenging activity of spice extracts was determined using the method described by Borneo *et al*. (2009) with slight modifications. One mL of various concentrations of the extracts was mixed with 3 mL of 0.003% ethanol solution of DPPH. After 30 min of incubation in dark, at room temperature, the absorbance at 517 nm was measured against blank. IC_{50} (half-maximal inhibitory concentration, $\mu g \cdot mL^{-1}$) was calculated as the concentration of the sample necessary to decrease by 50% the initial absorbance of DPPH. BHT, ascorbic acid and trolox were tested as references. The values were presented as the mean of the triplicate analyses.

Free radical scavenging by using ABTS radical

Total antioxidant activity assay was carried out by ABTS method modified by Re *et al* (1999). ABTS was dissolved in water to a concentration of 7 $mmol \cdot L^{-1}$. ABTS radical cation was produced by reacting ABTS stock solution with 2.45 $mmol \cdot L^{-1}$ potassium persulfate (final concentration) and allowing the mixture to stand in the dark room for 16 h before use. ABTS radical cation solution was diluted with 80% ethanol to an absorbance of 0.700±0.02 at 734 nm. The extract was

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