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TOTAL PHENOLS AND ANTIOXIDANT ACTIVITIES OF LEAF AND STEM EXTRACTS FROM CORIANDER, MINT AND PARSLEY GROWN IN SAUDI ARABIA

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Abstract

Leaves and stems of three different herbs from two different families were used to extract phenolic compounds and the bioactivity of the extracts was evaluated by using 1, 1-diphenyl-2-picrylhydrazyl or DPPH scavenging ability or their antioxidant activities. Extract from leaves of mint, which belongs to *Lamiaceae* family contained 1.24 mgGAE/100 mL of total phenolic compounds and 34.21% antioxidant activity which were significantly higher than those in extracts from coriander and parsley, both of which belong to *Apiaceae* family. Extracts of leaves from these herbs showed more quantity of total phenols and higher antioxidant activities than extracts from stem parts, however both leaves and stems of these three herbs grown in Saudi Arabia contained good quantities of total phenols (>1.02 mgGAE/100 mL) and showed more than 18.3% free radical scavenging activity.

Introduction

The phenolic compounds or polyphenols, secondary vegetal metabolites, constitute a wide and complex array of phytochemicals that exhibit antioxidant action and consequently a beneficial physiological effect (Martinez-Valverde *et al*., 2000). Their ability to delay lipid oxidation in foodstuffs and biological membranes, in addition to their propensity to act as a prophylactic agent has motivated research into food science and biomedicine (Farombi *et al*., 2000). Phenolic phytochemicals are known to exhibit several health beneficial activities such as antioxidant, anti-inflammatory, antihepatotoxic, antitumor and antimicrobial (Hertog, 1995; Rice-Evans *et al*., 1996; Middleton *et al*., 2000). Considering their bioactivity and presence in a wide range of vegetables, these substances are considered natural antioxidants and the vegetable source that it contains as functional food (McDonald *et al*., 2001). Phenolic substances with an antioxidant activity, including phenolic acids and flavonoids, have been isolated from a variety of sources such as rosemary, sage (Lu & Foo, 2001) oregano, thyme and pepper (Nakatani, 1992). Briefly, these compounds are ubiquitously distributed throughout the plant kingdom (Naczk & Shahidi, 2004).

Melo (2002) noted, in the aqueous extract of coriander (*Coriandrum sativum*), 2.7 mg of total phenolics (catechin equivalents) per 100 g of dry sample, exhibiting considerable antioxidant activity. Runnie *et al*., (2004) reported the presence of phenolic compounds in mint (*Mentha arvensis*) leaves and their beneficial effects on vasorelaxation in rats. Antioxidant activity was also noted in the extracts of parsley (*Petroselinum crispum*) using linoleic acid peroxidation assay (Hinneburg *et al*., 2006). Coriander and parsley belong to family *Apiaceae* whereas mint is included in family *Lamiaceae*. Different parts of these herbs may differ in their phenolic composition and in turn their antioxidant activities. Besides this geographical distribution may also have effect biochemical properties of these plants.

The objective of our study was to evaluate the phenolic compounds and the antioxidant activities (radical scavenging ability) of extracts obtained from leaves and stems of coriander, mint and parsley grown in Saudi Arabia.

Materials and Methods

Raw materials: Fresh coriander, mint and parsley were obtained from the local market in Riyadh, Saudi Arabia. Each plant was segregated into leaf and stem fractions and these were dried in an oven at 55°C until the moisture content was constant (8.5%). Samples were ground to a powder form using electrical grinder and passed through mesh (40). All of the chemicals used were of analytical grade, and were purchased from Sigma Chemical Co. (St. Louis, MO, USA).

Extraction from plant material: Each powdered sample (10 g) was submitted to extraction using diethyl ether (50 mL), for 30 min, under agitation at room temperature (25°C), and then the mixture was filtered through Whatman filter paper # 1. The residues were extracted again in diethyl ether (50 mL) and filtered. The filtrates were combined and the total volume of the extract was made 100 mL and stored in a freezer at -18°C until used for further analysis.

Analysis for total phenolic compounds: The total phenolic compounds were analyzed using the Folin Ciocalteu method with some modification (Ghafoor & Choi, 2009). This method depends on the reduction of Folin's reagent by phenols to a mixture of blue oxides which have a maximal absorption in the region of 765 nm. A 200 µL properly diluted sample or a standard solution of varying concentrations were mixed with 400 µL Folin Ciocalteu reagent. The deionized water was used for dilution and control. The solution was diluted to a total volume of 4.6 mL using deionized water then thoroughly mixed. After incubation for 10 minutes at room temperature, 1 mL of 20% Na_2CO_3 solution was added then immediately mixed and incubated for 2 h. The absorbance was read at 765 nm on a spectrophotometer (Ultrospec II 4050; LKB Biochrom, Cambridge, England). Measurements were recorded in triplicates. Gallic acid of 1 mg/mL was used as the standard and the

total phenolic compounds of the samples were expressed in milligram gallic acid equivalent (GAE) per 100 mL (mg GAE/100 mL).

Measurement of antioxidant activity: The free radical scavenging activity of these extracts was determined by using 1, 1-diphenyl-2-picrylhydrazyl or DPPH (Lee *et al*., 1998). Briefly, 1 mL solution of the date flesh extract at a proper concentration was mixed with 2 mL of 10 mg/L methanolic solution DPPH (Sigma Chemical Co., St. Louis, MO, USA). The mixture was shaken vigorously and allowed to stand at room temperature for 5 min and absorbance (ΔA) was recorded at 517 nm by using a spectrophotometer. Lower absorbance of the sample indicated the higher free radical scavenging activity. The control consisting of methanol and reagent solution without extracts was prepared as described before. The scavenging ability (*SA*) was calculated as follows:

$$SA\ (\%) = \frac{(\Delta A_{517\ control} - \Delta A_{517\ sample})}{\Delta A_{517\ control}} \times 100$$

Statistical analysis: All the analysis was carried out in triplicates and the experimental results obtained were expressed as means ± SD. Data was analyzed by Duncan's Multiple Range Test using Statistical Analysis System (SAS, version 9.1) and the mean values were considered significantly different when $p<0.05$.

Results and Discussions

Total phenolic compounds: The total phenolic contents in extracts obtained from the stems and leaves of coriander, mint and parsley are shown in Fig. 1. The highest contents (1.24 mgGAE/100mL) were observed in extract of mint (*Mentha arvensis*) leaves followed by parsley (*Petroselinum crispum*) leaves (1.22 mgGAE/100mL) and coriander (*Coriandrum sativum*) leaves (1.12 mgGAE/100mL). However, there were non-significant differences in the phenolic contents of extracts obtained from stems of these herbs. Triantaphyllou *et al*., (2001) reported that the extracts of *Mentha* species contained bound phenolic acids and flavonoids. The major phenolic acids reported in water-soluble *Mentha spicata* extract are eriocitrin, luteolin glucoside, rosmarinic acid and caffeic acid (Dorman *et al*., 2003). Phenolic compounds present in these extracts are reported to have beneficial effects on other chronic diseases such as coronary heart disease (Forester & Waterhouse, 2009). These health effects are reported to be due to antiradical and antioxidant properties of phenolics in plants and plant derivatives (Lurton, 2003).

Antioxidant activities by DPPH scavenging method: The antiradical activities of herbal extracts were assessed using DPPH (1, 1-diphenyl-2-picrylhydrazyl) radical scavenging assay. It is quick, reliable and reproducible method to search *In vitro* general antiradical activities of pure compounds as well as plant extracts. This method depends on the reduction of purple DPPH to a yellow colored diphenyl picrylhydrazine and the remaining DPPH (Ghafoor *et al*., 2010; Katalinic *et al*., 2006). The results of the assay for antioxidant activity are shown in Fig. 2. The highest free radical scavenging activity (34.21%) was observed for the extract of mint leaves followed by that of parsley leaves extract (30.35%). The free radical scavenging activity of coriander leaves extract was 26.82%. The extracts of these herbs' stems also showed significant free radical scavenging abilities which were more than 18%.

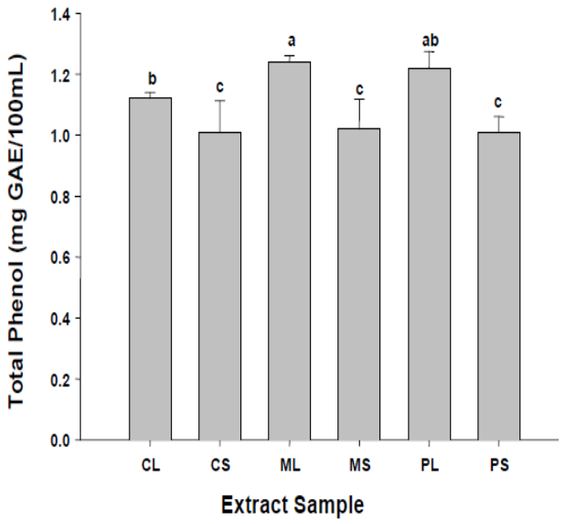

Fig. 1. Total phenolic compounds in extracts obtained from coriander leaves and stems (CL and CS); mint leaves and stems (ML and MS) and parsley leaves and stems (PL and PS). Bars represent standard error of means (n = 3). Bars with different alphabetical letters are significantly ($p<0.05$) different.

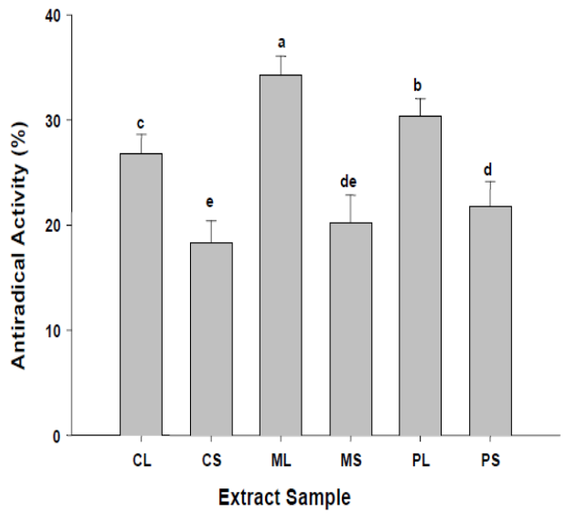

Fig. 2. Antioxidant (DPPH radical scavenging) activities of extracts obtained from coriander leaves and stems (CL and CS); mint leaves and stems (ML and MS) and parsley leaves and stems (PL and PS). Bars represent standard error of means (n = 3). Bars with different alphabetical letters are significantly ($p<0.05$) different.

In general, the total phenols and antioxidant activity of mint leaves were higher than coriander and parsley. This may also be due to the difference of families of these herbs as coriander and parsley belong to *Apiaceae* whereas mint is included in *Lamiaceae*. Albano &Miguel (2011) found that the total phenols and antioxidant activities, especially DPPH scavenging activities of herbs from *Lamiaceae* were higher than those from *Apiaceae*. They also observed that the extracts of these herbs showed good anti-inflammatory activities such that they were able to inhibit 5-lipoxygenase. Similar differences in total phenols among these two families were also documented by Hinneburg *et al*., (2006). There was a correlation in the antioxidant activities and total phenolics, more evident in case of herbal leaves' extract. Such correlations have also been observed in other studies (Ghafoor & Choi, 2009; Lim *et al*., 2010). Experimental and epidemiological evidences have demonstrated the important role of free radicals in the majority of degenerative diseases and the ageing process. As a result, research in the last two decades has been directed towards the search for bioactive phytochemicals (Guerra *et al*., 2005). Oxidation by free radicals is an important event causing aging and human diseases, including cancer, multiple sclerosis, Parkinson's disease, autoimmune disease and senile dementia. After the absorption of food ingredients through intestinal and lung barriers and hepatic detoxification, the peroxidation of membrane lipids appears to be the starting point for cellular modifications (Caillet *et al*., 2007). Screening of plant antioxidants, and comparing their antioxidant potential with that of commercial antioxidants and synthetic products, will help find new sources of natural antioxidants (Wu *et al*., 1982). Our study shows the significance of different herbs grown in Saudi Arabia due to their phenolic contents and antioxidant potential.

Conclusions

The extracts of different parts of three different herbs were evaluated for their phenolic and antioxidant activities. Mint leaves showed maximum total phenols and antioxidant activity. The phenolic contents and antioxidant activities of extracts from leaves of coriander, mint and parsley were higher than those of their stems. Besides this the study shows that these herbs grown in Saudi Arabia are good sources of phenolic compounds and effective against fighting free radicals which are detrimental to human health.

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