Antioxidant and antibacterial properties of some fresh and dried Labiatae herbs

Eric Wei Chiang Chan, Lei Quan Kong, Kar Yen Yee, Wen Yee Chua, Tze Ying Loo

Faculty of Applied Sciences, UCSI University, 56000 Cheras, Kuala Lumpur, Malaysia

Submission Date: 22-3-2012; Accepted Date: 6-8-2012

ABSTRACT

Introduction: Although the antioxidant and antibacterial properties of Labiatae herbs are well known, the effects of different drying methods are yet to be determined. In this study, the antioxidant and antibacterial properties of fresh and oven-dried herbs of oregano, marjoram, rosemary, sage, basil, thyme, peppermint, and spearmint were investigated, in comparison with commercial brands of dried herbs. **Methods:** Antioxidant properties of total phenolic content, total flavonoid content, caffeoylquinic acid content, free radical scavenging activity, and ferric reducing power were assessed using the Folin-Ciocalteu, aluminium chloride, molybdate, DPPH radical scavenging, and potassium ferricyanide assays, respectively. Antibacterial properties were assessed using the disc-diffusion assay based on minimum inhibitory dose (MID). Bacteria tested were Gram-negative *Escherichia coli*, *Pseudomonas aeruginosa*, and *Salmonella typhi*, and Gram-positive *Bacillus cereus*, *Micrococcus luteus*, and *Staphylococcus aureus*. The three drying treatments were oven drying at 50°C (OD_{50}), oven drying at 80°C (OD_{80}), and oven drying at 50°C with microwave pre-treatment (MOD_{50}). **Results:** Fresh and commercial rosemary, and oven-dried oregano had the strongest antioxidant properties. Generally, MOD_{50} herbs had the strongest antioxidant properties followed by OD_{50} and OD_{80} herbs. Oven-dried rosemary had lower phenolic content and antioxidant activity than commercial rosemary, while oven-dried oregano, spearmint, thyme, peppermint, and basil had higher values. All herbs showed no antibacterial activity against Gram-negative *E. coli*, *P. aeruginosa*, and *S. typhi*. Rosemary, sage, peppermint, and spearmint inhibited the growth of Gram-positive *B. cereus*, *M. luteus*, and *S. aureus*. Compared to green and black teas of *Camellia sinensis*, rosemary and sage have stronger antibacterial properties. **Conclusion:** Labiatae herbs can have enhanced antioxidant and antibacterial effects when used in combination. Further research is needed to study the synergistic behaviour of these herbs.

Keywords: oregano, marjoram, rosemary, sage, basil, thyme, peppermint, spearmint.

INTRODUCTION

Herbs and spices are commonly used for flavouring food and as traditional medicines as traditional medicines for generations. There is no clear distinction between them.[1] Herbs are herbaceous plants grown in sub-tropical or temperate climate. They are green leafy material with a pleasant taste. Spices are grown in the tropics and are dried material produced from seed, bark, root, fruit, or flower of shrubs and trees. They are usually brown, black or red in colour with a pungent smell.

Plants of the family Labiatae are annual or perennial herbs that are densely glandular and aromatic.[2] Leaves are simple and opposite, and stems are four-angled. Flowers are hermaphrodite and form whorls that are arranged in spikes, heads, racemes, or cymes. They are widely used for flavouring and as teas or traditional medicines. Some species are also used as sources of essential oils.

Among the common species used for flavouring, oregano is a favourite seasoning for pizza and other Italian dishes.[3] Rosemary is used for flavouring meat and poultry dishes. Thyme adds a pungent taste to meat and vegetables, and is

***Corresponding address:**
Dr. Eric W. C. Chan,
Faculty of Applied Sciences, UCSI University, 56000 Cheras,
Kuala Lumpur, Malaysia
E-mail: chanwc@ucsi.edu.my

DOI: 10.5530/ax.2012.3.3

the most main ingredient for garnishing soups and stews. Basil is a classic complement to tomatoes, and is used to flavour salads, sauces, and vegetables. Sage is widely used for flavouring meat dishes, soups, sausages, and canned food.[2] Marjoram, with a sharp and spicy taste, is used for flavouring eggs, vegetables, soups, stews, etc. Peppermint has a characteristic, sweetish, strong aroma with a cooling after-taste and is widely used in flavouring chewing gums, sugar confectionery, ice creams, desserts, baked goods, tobacco, and alcoholic beverages. It is also used in flavouring pharmaceutical and oral preparations e.g. mouth rinse and toothpaste. Spearmint is often used to flavour vegetables, soups, meat and fish sauces, and salads. It is also used in the flavouring of chewing gums, toothpastes, and other oral products.

Although the antioxidant and antibacterial properties of Labiatae herbs are well known, the effects of different drying methods are poorly studied. In this study, the antioxidant and antibacterial properties of fresh herbs of eight Labiatae herbs were analysed and evaluated. The effects of different drying methods were assessed with comparison to commercial brands of dried herbs.

MATERIALS AND METHODS

Herb samples

Fresh herbs produced by Genting Garden in Genting Highlands were purchased from the Jusco and Cold Storage Supermarkets in the Mid-Valley Megamall in Kuala Lumpur, Malaysia. They were oregano (*Origanum vulgare* L.), marjoram (*Origanum majorana* L.), rosemary (*Rosmarinus officinalis* L.), sage (*Salvia officinalis* L.), basil (*Ocimum basilicum* L.), thyme (*Thymus vulgaris* L.), peppermint (*Mentha piperita* L.), and spearmint (*Mentha spicata* L.). Commercial herbs (COM) of oregano, rosemary, basil, thyme, peppermint, and spearmint were used as standards for comparison.

Drying protocols

The drying protocol used was oven drying. In oven drying, 15 g of herb was dried in an universal oven (Memmert, Germany, Model UFB500) for 5.5 h at 50°C (OD_{50}) and for 3.5 h at 80°C (OD_{80}). The effects of microwave pre-treatment prior to oven drying were also assessed. To assess the effects of microwave pre-treatment, 15 g of herb was heated in a microwave oven (Sharp, Malaysia, Model R-397J(S), 230–240 V, 50 Hz) for 30 sec followed by oven drying for 5.5 h at 50°C (MOD_{50}).

Extraction

For antioxidant properties, fresh herbs (1 g) and oven-dried herbs (0.3 g) were powdered with liquid nitrogen in a mortar and extracted with 50 ml of methanol with continuous shaking (150 rpm) for 1 h at room temperature. Extracts were filtered under suction and stored at 4°C for further analysis.

For antibacterial activity, fresh herbs (10 g) and oven-dried herbs (3 g) were powdered with liquid nitrogen in a mortar and extracted with 100 ml of methanol, three times for 1 h each time. The mixture was swirled continuously at 120 rpm in an orbital shaker. Extracts were filtered under suction and stored at 4°C for further analysis.

Antioxidant properties

Fresh and oven-dried herbs were analysed for phenolic content (total phenolic content, total flavonoid content, and caffeoylquinic acid content), and antioxidant activity (radical scavenging activity and ferric reducing power).

Total phenolic content (TPC) was assessed using the Folin-Ciocalteu (FC) assay.[4] Extracts (300 µl) were introduced into test tubes wrapped with aluminium foil, followed by 1.5 ml of FC reagent (10 times dilution) and 1.2 ml of sodium carbonate (7.5%, w/v). After incubating for 30 min in the dark, absorbance was measured at 765 nm. TPC was expressed as gallic acid equivalent (GAE) in mg per 100 g of sample.

Total flavonoid content (TFC) was evaluated using the aluminium chloride assay.[5] Extract (1 ml) is added into test tubes containing 4 ml of water. Subsequently, 0.3 ml of 5% sodium nitrite was added, followed by 0.3 ml of 10% aluminium chloride. Sodium hydroxide solution (2 ml, 1 M) was then added, followed by 2.4 ml of water to make up to 10 ml. The mixtures were mixed well and incubated at room temperature for 10 min. Absorbance was determined at 415 nm against a sample blank of 1 ml of the respective extracts with 9 ml of water. TFC was expressed as quercetin equivalent (QE) in mg/100 g of sample.

Caffeoylquinic acid content (CQAC) was quantified using the molybdate assay.[6] Molybdate reagent was prepared by dissolving 16.5 g sodium molybdate, 8.0 g dipotassium hydrogen phosphate, and 7.9 g potassium dihydrogen phosphate in 1 litre of water. The reagent (2.7 ml) was added to the plant extract (0.3 ml), mixed and incubated at room temperature for 10 min. Absorbance was measured at 370 nm against a sample blank of 0.3 ml of