ScienceDirect

Food and Chemical Toxicology
Volume 45, Issue 9, September 2007, Pages 1650-1661

A comparison of chemical, antioxidant and antimicrobial studies of cinnamon leaf and bark volatile oils, oleoresins and their constituents ☆

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https://doi.org/10.1016/j.fct.2007.02.031
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Abstract

The antioxidant, antifungal and antibacterial potentials of volatile oils and oleoresin of *Cinnamomum zeylanicum* Blume (leaf and bark) were investigated in the present study. The oleoresins have shown excellent activity for the inhibition of primary and secondary oxidation products in mustard oil added at the concentration of 0.02% which were evaluated using peroxide, thiobarbituric acid, *p*-anisidine and carbonyl values. Moreover, it was further supported by other complementary antioxidant assays such as ferric thiocyanate method in linoleic acid system, reducing power, chelating and scavenging effects on 1,1′-diphenyl-2-picrylhydrazyl (DPPH) and hydroxyl radicals. In antimicrobial investigations, using inverted petriplate and food poison techniques, the leaf and bark volatile oils has been found to be highly effective against all the tested fungi except *Aspergillus ochraceus*. However, leaf oleoresin has shown inhibition only for *Penicillium citrinum* whereas bark oleoresin has caused complete mycelial zone inhibition for *Aspergillus flavus* and *A. ochraceus* along with *Aspergillus niger*, *Aspergillus terreus*, *P. citrinum* and *Penicillium viridicatum* at 6μL. Using agar well diffusion method, leaf volatile oil and oleoresin have shown better results in comparison with bark volatile oil, oleoresin and commercial bactericide, i.e., ampicillin. Gas chromatographic–mass spectroscopy studies on leaf volatile oil and oleoresin resulted in the identification of 19

and 25 components, which accounts for the 99.4% and 97.1%, respectively of the total amount and the major component was eugenol with 87.3% and 87.2%, respectively. The analysis of cinnamon bark volatile oil showed the presence of 13 components accounting for 100% of the total amount. (*E*)-cinnamaldehyde was found as the major component along with δ-cadinene (0.9%), whereas its bark oleoresin showed the presence of 17 components accounting for 92.3% of the total amount. The major components were (*E*)-cinnamaldehyde (49.9%), along with several other components.

Introduction

Free radical reactions occur in human body and food systems. Free radicals, in the form of reactive oxygen and nitrogen species, are an integral part of normal physiology. An over production of these reactive species can occur, due to oxidative stress brought about by the imbalance of bodily antioxidant defence system and free radical formation. These reactive species can react with biomolecules, causing cellular injury and death. This may lead to the development of chronic diseases such as cancers and those that involve the cardio- and cerebrovascular systems. The consumption of fruits and vegetables (Peschel et al., 2006) containing antioxidants has been found to offer protection against these diseases. Dietary antioxidants can augment cellular defences and help to prevent oxidative damage to cellular components (Halliwell, 1989). Besides playing an important role in physiological systems, antioxidants have been used in food industry to prolong the shelf life of foods, especially those rich in polyunsaturated fats. These components in food are readily oxidized by molecular oxygen and are major cause of oxidative deterioration, nutritional losses, off flavour development and discoloration. The addition of synthetic antioxidants, such as propyl gallate, butylated hydroxylanisole (BHA), butylated hydroxyltoluene (BHT) and tertiary butylhydroquinone has been widely used industrially to control lipid oxidation in foods. However, the use of these synthetic antioxidants has been questioned due to their potential health risks and toxicity (Kahl and Kappus, 1993). The search for antioxidants from natural sources has received much attention and efforts have been put in to identify compounds that can act as suitable antioxidants to replace synthetic ones. In addition, these naturally occurring antioxidants can be formulated as functional foods and nutraceuticals that can help to prevent oxidative damage from occurring in the body.

Plants contain a variety of substances called “Phytochemicals” (Pratt, 1992), that owe to naturally occurring components present in plants (Caragay, 1992). The phytochemical preparations with dual functionalities in preventing lipid oxidation and antimicrobial properties have tremendous potential for extending shelf life of food products. Several research groups around the world have succeeded in finding and identifying natural antioxidants from herbs and spices using different model systems. The antioxidant

activity of Labiatae herbs such as rosemary, sage, summer savory and borage are also well documented (Bandoniene et al., 2002, Djarmati et al., 1991, Ho et al., 2000, Aruoma et al., 1996, Cuvelier et al., 1994, Wong et al., 1995, Chang et al., 1997, Madsen et al., 1996, Gordon and Weng, 1992, Takacsova et al., 1995). However, the aromatic spicy and medicinal plants from Laureceae family are less extensively studied. Cinnamon (*Cinnamomum zeylanicum* Blume, syn *C. verum*, family Laureceae) is a widely used spice and have many applications in perfumery, flavoring and pharmaceutical industries. Although, the chemical constituents of leaf and bark essential oils of cinnamon have been studied (Raina et al., 2001, Simić et al., 2004, Jayaprakash et al., 1997), the potential antioxidant properties have yet not been studied and it seems that investigation on oleoresins are scarce. Hence, in the present work, attempt has been made to explore the possible antioxidant and antimicrobial properties by different methods which can give more comprehensive information especially when the effectiveness of multi component natural oleoresins is investigated. The objective of present investigation is to compare the chemical composition of leaf and bark essential oils and oleoresins as well as demonstrate the possibility of protecting the stored food materials against micro-organism and antioxidative behaviour on mustard oil using as additive by various methods.

Section snippets

Chemicals

Thiobarbituric acid, pure components eugenol and cinnamaldehyde were received form Merck, Germany. Diphenylpicrylhydrazyl (DPPH), carbendazim were procured from Sigma (Sigma–Aldrich GmbH, Sternheim, Germany) and linoleic acid from Across (New Jersey, USA). BHT, BHA, and 2,4-dinitrophenylhydrazine were purchased from s. d fine-chem Ltd, Mumbai, India. Ampicillin was purchased from Ranbaxy Fine chemicals Ltd., New Delhi, India. Crude mustard oil was purchased from local oil mill, Gorakhpur,…

Chemical analysis

GC and GC–MS analysis of cinnamon leaf volatile oil showed the presence of 19 components accounting for 99.4% of the total amount (Table 1). The major component was eugenol (87.3%) followed by bicyclogermacrene (3.6%), α-phellanderene (1.9%), β-carryophyllene (1.9%), aromadendrene (1.1%), *p*-cymene (0.7%) and 1,8-cineole (0.7%). Moreover, its oleoresin showed the presence of 25 components accounting for 97.1% of the total amount (Table 1). The major components accounting were eugenol (87.2%),…

Conclusion

The present study provided the potential antimicrobial and antioxidant properties of the volatile oils and oleoresins of cinnamon leaf and bark. The oleoresins have shown better effect on primary and secondary oxidation products in mustard oil. The radical scavenging activity and other complementary assays are also in good correlation. Moreover, the potency of the constituents such as eugenol and cinnamaldehyde could provide a chemical basis for some of the health benefits claimed for cinnamon…

Acknowledgements

We are thankful to Head, Chemistry Department, DDU Gorakhpur University, Gorakhpur for providing laboratory facilities. Prof. K.D.S. Yadav of our department is also thanked for providing spectral facility. Life Sciences Research Board, DRDO, New Delhi and CONICET and Consejo de Investigaciones de la Universidad Nacional de Tucuman (CIUNT) Argentina are also thanked for financial assistance….

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