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Chemical Papers 68 (1) 121–129 (2014)
DOI: 10.2478/s11696-013-0417-6

ORIGINAL PAPER

Thermal stability, antioxidant activity, and photo-oxidation of natural polyphenols

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Received 12 January 2013; Revised 25 March 2013; Accepted 5 April 2013

The thermal stability (60 °C, 80 °C, 100 °C), antioxidant activity, and ultraviolet C light (UV-C) stability of standard polyphenols solutions (catechin, gallic acid, and vanillic acid) and of vegetal extracts from spruce bark and grape seeds were investigated. Exposure of the standard solutions and vegetal extracts to high temperatures revealed that phenolic compounds were also relatively stable (degradations ranged from 15 % to 30 % after 4 h of exposure). The highest antioxidant activity was obtained for ascorbic acid and gallic acid followed by catechin and caffeic acid and the grape seeds. The results show that, after 3 h of UV-C exposure, approximately 40 % of vanillic acid, 50 % of gallic acid, and 83 % of catechin were removed. Similar degradation rates were observed for vegetal extracts, with the exception of the degradation of catechin (40 %) from grape seeds. In addition, the photo-oxidation of polyphenols in the presence of food constituents such as citric acid, ascorbic acid, sodium chloride, and sodium nitrate was assessed.
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Keywords: polyphenols, photo-oxidation, thermal stability, radical scavenging activity, food additives

Introduction

There has recently been a considerable increase in interest in finding naturally occurring antioxidants to replace synthetic antioxidants, some of which are being restricted due to their carcinogenicity. The use of natural antioxidants also has great potential as a result of consumers demanding additive-free, fresher, and more natural-tasting food (Muanda et al., 2011; Díaz-García et al., 2013).

Antioxidants are compounds that can delay or inhibit the oxidation of lipids or other molecules by inhibiting the initiation or propagation of oxidising chain reactions. These properties can play an important role in adsorbing and neutralising free radicals, quenching oxygen, or decomposing peroxides (Karou et al., 2005). Phenolic compounds, one of the most widely occurring groups of phytochemicals, are of considerable physiological and morphological importance in plants. Phenolics may act, among others, as phytoalexins, anti-feedants, contributors to plant pigmentation, antioxidants, and protective agents against ultraviolet (UV) light (Ignat et al., 2011a). Polyphenols have many industrial applications in fields such as medicine, cosmetics, and the food industry. These compounds may be used as natural colorants and preservatives for foods, or as additives in the production of paints, paper, cosmetics, and pharmaceutical products (Naczk & Shahidi, 2006; Giusti & Wrolstad, 2003). Most notably, the antioxidant activities of polyphenols are presumed to exert various pharmacological effects such as anti-carcinogenic, anti-mutagenic, and cardio-protective effects, linked to their free radical scavenging (Parr & Bolwell, 2000; Castañeda-Ovando et al., 2009; Díaz-García et al., 2013).

In recent years, special attention has been focused on the isolation of phenolics from different raw materials (medicinal plants, fruits, vegetables, industrial by-products, and beverages) and on exploration of their

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