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A SUPERIOR ANTIOXIDANT MATERIAL FROM SPENT COFFEE GROUNDS FOR APPLICATION IN ACTIVE PACKAGING, FOOD SUPPLEMENTATION AND ANTIBACTERIAL DEVICES

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PURPOSE OF THE ABSTRACT

Phenolic polymers endowed with antioxidant and free radical scavenging properties occupy an increasing segment in the current panorama of sustainable functional materials because of their potential applications in a broad variety of sectors, such as biocompatible materials for biomedical devices. Another major field of application of antioxidant materials is the incorporation into polymers for stabilization and functionalization. The photo- and thermooxidative degradation of polyethylene and other polymers is indeed an issue of considerable concern, which has spurred intense research aimed to increase stability of the material without undesirable effects associated with the release of toxic additives; functionalization with natural phenol-based antioxidant polymers is likewise an important focus for research especially for active food packaging, a crucial part of the food sector aimed to delay or prevent oxidative deterioration of packaged food [1]. In this context, an attractive source of natural antioxidant materials is provided by phenol-rich waste products of the agricultural and food industry [2, 3]. One noticeable example is represented by spent coffee grounds (SCG), which represent the main by-products of the coffee industry as they are obtained both during instant coffee production and as a result of coffee beverage consumption in restaurants and coffee shops. SCG contain mainly polysaccharides (ca. 40%), lignins (ca. 25%), proteins (8%), and small phenolic compounds, first of all chlorogenic acids (4%) [4]. We report herein the up to 30 times enhancement of the intrinsic antioxidant potency of SCG following overnight treatment with 6 M HCl, at 100 °C [5], leading to a versatile multifunctional material (hydrolyzed spent coffee grounds, HSCG). Spectral and morphological analysis suggested that the remarkable potentiation of the antioxidant activity is due to efficient removal of the hydrolyzable components, mainly carbohydrates, making the polyphenol-rich component available for interaction with free radicals and oxidizing species. Based on these results, the possible exploitation of HSCG as an active component in functional food packaging, e.g. for food lipid preservation and stabilization of polymers, or as a food supplement was investigated. HSCG efficiently delayed lipid peroxidation in fish and soybean oils. Moreover, films made of polyethylene/2% HSCG blends displayed greater stability to thermal and photo-oxidative degradation. Regarding the possible use as a food supplement, in other experiments HSCG was subjected to a simulated digestion-fermentation treatment in vitro [6]. The potentially bioaccessible (soluble) fractions thus obtained exhibit high chemoprotective activity in human hepatocellular carcinoma (HepG2) cells against oxidative stress. Structural analysis of both the indigestible (insoluble) and soluble material revealed partial hydrolysis and release of the lignin components in the potentially bioaccessible fraction. A high prebiotic activity as determined from the increase in Lactobacillus spp. and Bifidobacterium spp. as well as the production of short chain fatty acids following microbial fermentation of HSCG was also observed. Finally, the results of ongoing studies

describing the use of HSCG as a natural reducing agent for the synthesis of silver nanoparticles with promising antibacterial activities (MIC100< 0.1 mg/mL) particularly against Gram-negative bacteria such as Escherichia coli and Pseudomonas aeruginosa will be reported [7]. So, in conclusion, HSCG may represent an easily accessible and sustainable alternative to currently available antioxidant materials for biomedical, food and technological applications.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

spent coffee grounds | antioxidant | food packaging | antibacterial

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