

Spice Antioxidants as Objects of Analytical Chemistry

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Abstract—The literature data on the antioxidant composition of spices are summarized; methods of the extraction of antioxidants of various classes from plant material and their advantages and disadvantages are discussed. The possibilities of using ultrasonic, microwave, and enzymatic treatment of raw materials for increasing the recovery of target components and their stabilization are considered. The present-day approaches to the identification and quantification of antioxidants in extracts of spices, based on the use of high-sensitive and high-resolution detectors in chromatography and involving new materials (mostly nanoscale) as modifiers of the electrode surface in electrochemical methods, are described. A comparative analysis of the methods of the overall evaluation of the antioxidant properties of spices with the help of integral parameters is carried out.

Keywords: antioxidants, spices, extraction, general parameters, food analysis

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SPICE ANTIOXIDANTS AND METHODS FOR THEIR EXTRACTION

Since ancient times, spices obtained from various parts of plant materials have been used in cooking as preservatives and flavors, in herbal medicine as a constituent of pharmaceuticals based on vegetable raw materials, and in the manufacture of aromatherapy elixirs, perfume oils, incenses, and balsams. Recently, they have attracted the interest of researchers as objects of chemical analysis because of the wide range of properties exhibited, in particular, antimicrobial, anti-inflammatory, anticarcinogenic [1], and antioxidant [2]. A wide range of organic compounds from various classes, in particular, phenolic compounds, terpenes, carotenoids, etc. [3] that exhibit antioxidant properties can be distinguished among biologically active substances of spices; therefore, phyto-genous spices are an exogenous source of antioxidants in the human diet. The antioxidant composition of various spices is presented in Table 1. It should be noted that phenolic compounds are the main antioxidants in spices [7].

Spices are added to food in various forms, most often as plant materials or relevant extracts, and sometimes as individual components isolated from plant material using pre-extraction. As a rule, spices have a rich aroma and acrid taste, so their content in food is small.

During cooking, active components are extracted from the spices. In preparing spices extracts or extracting individual compounds, the conditions and type of extraction should be varied. With respect to antioxi-

dants, this problem is solved depending on the class of antioxidants that need to be extracted. The selection of a suitable extraction method makes it possible to isolate target antioxidants from plant raw materials and to preconcentrate them, which is especially important for minor components.

Dry, frozen, or lyophilized spice samples are most often used to isolate active components, because antioxidants in plant raw materials are easily decomposed by light, temperature, enzyme systems, etc. [6]. To isolate different classes of antioxidants, the polarity of the extractants is varied, for example, petroleum ether, toluene, acetone, ethanol, methanol, ethyl acetate, and water are used [6, 8]. Of particular interest is the extraction of antioxidants with oils or fats by incubating their mixtures at room or moderately elevated temperature followed by filtration [9].

As noted above, a significant portion of antioxidants in spices is attributed to phenolic compounds. It is known [10] that phenolic antioxidants easily interact with other components of plant material, in particular, proteins, carbohydrates, and lipids, with the formation of corresponding complexes characterized by different solubility. Therefore, the polarity of solvents must be varied in order to extract phenolic antioxidants. Often, there is a need in the additional purification of extracts from the coexisting components, for example, proteins, fats, or chlorophylls [11].

Liquid extraction, being the most straightforward and most accessible way of extracting antioxidants from spices, has become most widespread. For this purpose, polar solvents are mainly used. For example,