

Spectroscopic (Ir, Raman, Uv-Vis) and Biological Study of Copper and Zinc Complexes and Sodium Salt with Cichoric Acid

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Abstract : Forming a complex of a phenolic compound with a metal not only alters the physicochemical properties of the ligand (including increase in stability or changes in lipophilicity), but also its biological activity, including antioxidant, antimicrobial and many others. As part of our previous projects, we examined the physicochemical and antimicrobial properties of phenolic acids and their complexes with metals naturally occurring in foods. Previously we studied the complexes of manganese(II), copper(II), cadmium(II) and alkali metals with ferulic, caffeic and p-coumaric acids. In the framework of this study, the physicochemical and biological properties of cichoric acid, its sodium salt, and complexes with copper and zinc were investigated. Cichoric acid is a derivative of both caffeic acid and tartaric acid. It has first been isolated from *Cichorium intybus* (chicory) but also it occurs in significant amounts in Echinacea, particularly *E. purpurea*, dandelion leaves, basil, lemon balm and in aquatic plants, including algae and sea grasses. For the study of spectroscopic and biological properties of cichoric acid, its sodium salt, and complexes with zinc and copper a variety of methods were used. Studies of antioxidant properties were carried out in relation to selected stable radicals (method of reduction of DPPH and reduction of FRAP). As a result, the structure and spectroscopic properties of cichoric acid and its complexes with selected metals in the solid state and in the solutions were defined. The IR and Raman spectra of cichoric acid displayed a number of bands that were derived from vibrations of caffeic and tartaric acids moieties. At 1746 and 1716 cm⁻¹ the bands assigned to the vibrations of the carbonyl group of tartaric acid occurred. In the spectra of metal complexes with cichoric these bands disappeared what indicated that metal ion was coordinated by the carboxylic groups of tartaric acid. In the spectra of the sodium salt, a characteristic wide-band vibrations of carboxylate anion occurred. In the spectra of cichoric acid and its salt and complexes, a number of bands derived from the vibrations of the aromatic ring (caffeic acid) were assigned. Upon metal-ligand attachment, the changes in the values of the wavenumbers of these bands occurred. The impact of metals on the antioxidant properties of cichoric acid was also examined. Cichoric acid has a high antioxidant potential. Complexation by metals (zinc, copper) did not significantly affect its antioxidant capacity. The work was supported by the National Science Centre, Poland (grant no. 2015/17/B/NZ9/03581).

Keywords : cichoric acid, metal complexes, natural antioxidant, phenolic acids

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