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APLICAȚII ALE METODELOR VOLTAMETRICE ȘI ALE SPECTROMETRIEI OPTICE ÎN CUANTIFICAREA ȘI STUDIUL STRUCTURII ANALIȚILOR ȘI AL ECHILIBRELOR LA CARE PARTICIPĂ

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ABSTRACT

Instrumental analysis, with its two main components – electrochemistry and spectrometry, is an essential element of modern chemical education and research. Nowadays, an acute necessity is the interdisciplinary approach of education and scientific research, and, in this respect, the importance and usefulness of investigation methods based on instrumental techniques is supported by their wide applicability to the study of various analytes, in order to establish or to confirm their structure, to clarify the level of their involvement in the associated equilibria and reaction mechanisms or to calculate certain physical constants and, last but not least, to quantify chemical species from different matrices.

The subject of this habilitation thesis entitled „*Application of Voltammetric and Optical Spectrometric Methods to the Quantification and Investigation of Analytes and the Equilibria Involving Them*", falls like a glove within the above discussed framework presenting the results of my research activity, directly correlated with the academic and professional ones, carried out after the defense of my doctoral thesis "The Electroanalytical Behavior of Some Pharmaceutical Important Compounds" in 1998 elaborated under the supervision of Prof. Dr. Vasile Magearu.

This habilitation thesis includes the following three sections: A. *Scientific, Academic and Professional Achievements*; B. *Scientific, Academic and Professional Career Evolution and Development Plan* and C. *References*.

Section A presents the achievements of my research activity performed in the field of voltammetry (Chapter I) and optical spectrometry (Chapter II) directly integrated within the context of their evolution and the current state of knowledge in the field, but also in close correlation with my activity related to supervising the bachelor and master theses of my students, their experimental results being often published in WoS/Clarivate indexed scientific journals.

Chapter I starts with the presentation of the classes of investigated compounds (Section I.1.), classified according to their applications (pharmaceuticals, polyphenols with antioxidant activity and other types of compounds) and the types of working electrodes employed in the voltammetric studies carried out by us (Section I.2).

Since the analytical performances of a voltammetric method depend to a large extend on the investigated electroactive surface material the electrochemical sensor is manufactured, an extensive discussion on this topic has been presented in Section I.3. Both, conventional solid (Pt, GCE) and disposable (SPE, PGE) electrodes, as commercially available (Section I.3.1) or with surface modified (Section I.3.2) by electrochemical pretreatment (electroactivation) (Section I.3.2.1.) or by immobilization

of various (nano)materials (e.g. carbon nanotubes, metallophthalocyanines, imprinted and non-imprinted polymers) (Section I.3.2.2) were considered.

The analytical applications of the voltammetric methods developed using the described electrochemical sensors were presented in Section I.4., their performance characteristics being summarized in Section I.4.1. The importance of the voltammetric methods in quantitative analysis was demonstrated by the selective quantification of some analytes (Section I.4.1.1) or by estimating the total content of chemical species with related structure and similar electrochemical behavior (alkylphenols, hydroxycinnamic acids and bioflavonoids) (Section I.4.1.2.).

The voltammetric methods are also useful tools for investigating the equilibria, reaction mechanisms and other processes associated with the electroactive molecules under scrutiny (Section I.4.2.). These aspects were exemplified for the determination of the acidity constants (Section I.4.2.1) and the elucidation of the electrode mechanisms (Section I.4.2.2.) of some analytes. Section I.5. presents the results of some voltammetric research, as complementary studies, of certain newly synthetized complexes obtained by my colleagues, converging towards the same goal.

Optical spectrometry methods have been applied both independently, but also in correlation with other analytical techniques and methods, providing information to confirm or complement those obtained by other techniques. Thus, Chapter II presents some applications of optical spectrometry techniques, developed by us. In Section II.1., dedicated to atomic spectrometry techniques, the single-laboratory validation of a HG-AAS method for the determination of total arsenic in natural and waste water is presented (Section II.1.1.), as well as the results obtained by ICP-AES analysis of some environmental samples (water and sediments of some rivers from Romania) (Section II.1.2.) carried out as part of studies of bioaccumulation of some metal ions in food chains.

Sections II.2. contains results acquired using investigation methods based on UV-Vis molecular absorption spectrometry. These methods were applied in both quantitative analysis (direct or following the derivatization of analytes) (Section II.2.1) and in the study of chemical equilibria (Section II.2.2). For the quantification of the chemical species mainly the 0-order spectra (Section II.2.1.1.), but also the derived ones (Section II.2.1.2.) were exploited.

Section B presents the plan for the development of my scientific career in close correlation with the evolution of my university teaching career. In this respect, starting from the existing premises, the research directions that are either ongoing or that I intend to follow as further works in the future are discussed.

Section C contains the references corresponding to the content of the first two sections.