

# *Preface*

The last two decades have brought a surge of interest in speciation analysis, a field of trace element analytical chemistry that deals with the detection, identification and determination of individual chemical forms of metals and metalloids. Indeed, it is now generally accepted by environmental chemists, nutritionists and toxicologists that information on the total element concentration in the sample is not only insufficient to evaluate its toxicity, essentiality or bioavailability, but may even be misleading. The increasing awareness of the importance of elemental speciation is resulting in a growing demand from research and routine laboratories for analytical techniques capable of providing species-specific information for the environment, agriculture and nutrition, clinical chemistry and toxicology, medicine and pharmacology and industrial process chemistry.

Hyphenated techniques, based on the combination of high resolution separation techniques with element or molecule specific detectors, represent a unique analytical tool able to provide qualitative and quantitative information on element species at trace and ultratrace levels in complex matrices. A growing number of chromatographic and electrophoretic separations can be efficiently coupled with element specific detection, *e.g.* atomic emission or inductively coupled mass spectrometry as well as with molecule specific detection, *e.g.* electrospray mass spectrometry. Couplings such as GC-AAS, GC-MIP AES and GC-ICP MS, HPLC-ICP MS, CZE-ICP MS and HPLC or CZE-electrospray MS/MS, have become well established tools for elemental speciation analysis.

The field of speciation analysis itself has been undergoing a continuous evolution. The classical activities have involved species-specific determination of anthropogenic organometallic contaminants: organolead, organomercury or organotin compounds, and products of their environmental degradation. These are giving way to a search for endogenous metal and metalloid species, that are present in living organisms as a consequence of the biochemical evolution or have been bio-induced in response to a metal stress. In terms of analytical developments the demonstration of the analytical craft and skills of an analyst to determine a particular elemental species in a sample is being replaced by

exploratory investigations aimed at the detection of unknown elemental species in the tissues of a living organisms, their identification and/or structural characterisation.

The book is intended as not only an introductory text to newcomers to the field of elemental speciation analysis. It also offers a critical overview of the research carried out in the field that may serve an already practising analyst. The book is organised in two parts: the first is focused on the technical aspects of the different analytical techniques available and the second on their application to analytical problems in different disciplines. On the subject of analytical techniques individual chapters are devoted to gas chromatography, liquid chromatography and electrophoretic techniques with element specific detection, and electrospray mass spectrometry. The importance of quality control and assurance in speciation analysis is reflected by a dedicated chapter. On applications the selection and organisation of chapters reflect the different maturity of various research areas. The methodology for speciation analysis of methylated species, organolead, -tin and -mercury is well established so these chapters are focused on validated methods that are being implemented in routine laboratories. Regarding naturally occurring metallospecies preference has been given to approaches that have been allowing the exploration of the field in terms of the detection, characterisation and identification of new metallobiomolecules.

The representative coverage of the many facets of this broad and dynamically evolving field has been a difficult task. Indeed, during recent years speciation has become a fashionable area of inorganic trace element research that has resulted in the exponential proliferation of research and review publications. Over 2000 speciation-related papers have been published, many of which have unfortunately only contributed to the information noise. Therefore, the techniques, methods and applications discussed in this book had to be and are a critical selection from the massive literature available. The choice was made on the basis of our practical experience gathered over the last 12 years of research in the field where we have had the opportunity to follow the development of analytical methods in real time and to develop, test or adopt many of the applications in our laboratory.

Joanna Szpunar and Ryszard Łobiński  
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