“Chemical Speciation in Biological Systems”

The biological activity of any component in a given system is strictly dependent on its speciation, unambiguously defined by IUPAC as the “distribution of an element amongst defined chemical species in a system”. As such, speciation plays an important role in toxicity and exposure of chemical components to living organisms, influences their availability, accumulation and bio-modification. It also affects the transport inside the organisms, as well as within and between environmental compartments. That is why speciation studies are of fundamental importance in order to be able to fully appreciate how a component behaves in a given system.

From a physico-chemical perspective, biological fluids can be considered as multicomponent aqueous solutions, in which a wide number of organic and inorganic ligands, as well as metal and organometal cations, are simultaneously present. Therefore, the knowledge of speciation in these systems is as difficult as it is fundamental, especially when their variability in composition is considered.

In this talk we intend to present some of the various aspects related to chemical speciation in (and of) biological fluids. The focus will be on 1) definition (what speciation really is), 2) relevance (why it is important, presenting some examples), 3) characteristics of systems (where to study "speciation" - characteristics of real systems, with particular reference to biological fluids). Also some practical details on how to perform speciation studies, how to calculate species formation percentages in addition to the key aspects to consider during the study (complexity of real systems, constancy of constants, mixed species) will be discussed. The role of thermodynamics in speciation studies (the problem of activity) and the dependence of formation constants on medium, ionic strength, temperature, among other parameters, will be also touched upon. After mentioning some qualitative characteristics of metal/ligand interactions, the application of speciation analysis to real systems (the problem of sequestration) will be shown with some experimental details on data generation, ending with some real examples of speciation in/of biological fluids.