World Academy of Science, Engineering and Technology
International Journal of Agricultural and Biosystems Engineering
Vol:9, No:06, 2015

Problems and Solutions in the Application of ICP-MS for Analysis of Trace Elements in Various Samples

Authors : Béla Kovács, Éva Bódi, Farzaneh Garousi, Szilvia Várallyay, Áron Soós, Xénia Vágó, Dávid Andrási

Abstract : In agriculture for analysis of elements in different food and food raw materials, moreover environmental samples generally flame atomic absorption spectrometers (FAAS), graphite furnace atomic absorption spectrometers (GF-AAS), inductively coupled plasma optical emission spectrometers (ICP-OES) and inductively coupled plasma mass spectrometers (ICP-MS) are routinely applied. An inductively coupled plasma mass spectrometer (ICP-MS) is capable for analysis of 70-80 elements in multielemental mode, from 1-5 cm3 volume of a sample, moreover the detection limits of elements are in µg/kg-ng/kg (ppb-ppt) concentration range. All the analytical instruments have different physical and chemical interfering effects analysing the above types of samples. The smaller the concentration of an analyte and the larger the concentration of the matrix the larger the interfering effects. Nowadays there is very important to analyse growingly smaller concentrations of elements. From the above analytical instruments generally the inductively coupled plasma mass spectrometer is capable of analysing the smallest concentration of elements. The applied ICP-MS instrument has Collision Cell Technology (CCT) also. Using CCT mode certain elements have better (smaller) detection limits with 1-3 magnitudes comparing to a normal ICP-MS analytical method. The CCT mode has better detection limits mainly for analysis of selenium, arsenic, germanium, vanadium and chromium. To elaborate an analytical method for trace elements with an inductively coupled plasma mass spectrometer the most important interfering effects (problems) were evaluated: 1) Physical interferences; 2) Spectral interferences (elemental and molecular isobaric); 3) Effect of easily ionisable elements; 4) Memory interferences. Analysing food and food raw materials, moreover environmental samples an other (new) interfering effect emerged in ICP-MS, namely the effect of various matrixes having different evaporation and nebulization effectiveness, moreover having different quantity of carbon content of food and food raw materials, moreover environmental samples. In our research work the effect of different water-soluble compounds furthermore the effect of various quantity of carbon content (as sample matrix) were examined on changes of intensity of the applied elements. So finally we could find “opportunities” to decrease or eliminate the error of the analyses of applied elements (Cr, Co, Ni, Cu, Zn, Ge, As, Se, Mo, Cd, Sn, Sb, Te, Hg, Pb, Bi). To analyse these elements in the above samples, the most appropriate inductively coupled plasma mass spectrometer is a quadrupole instrument applying a collision cell technique (CCT). The extent of interfering effect of carbon content depends on the type of compounds. The carbon content significantly affects the measured concentration (intensities) of the above elements, which can be corrected using different internal standards.

Keywords : elements, environmental and food samples, ICP-MS, interference effects
Conference Title : ICFAE 2015 : International Conference on Food and Agricultural Engineering
Conference Location : Vienna, Austria
Conference Dates : June 21-22, 2015