OP 5.7

HPLC-ICPMS and ESI-MS to study the possible synergic effect of Cadmium and Selenium in induced metallothionein

M.R. Fernández de la Campa, M. B. Fricker, and A. Sanz-Medel

Department of Physical and Analytical Chemistry. Faculty of Chemistry.
Julián Clavería 8, 33006 Oviedo (Spain).

Metallothioneins (MTs) are a group of low molecular mass sulfhydryl-rich proteins with a high affinity for essential and toxic trace metals. It is also recognised that Metallothioneins play a central role in the homeostasis of the essential elements (e.g. Zn and Cu) and in the detoxification of toxic metals (e.g. Cd and Hg) in vertebrates. In fact, an increase in heavy metal concentration in cells stimulates the “de novo” synthesis of apothionein, which can then bind metal cations to produce a non-toxic form [1].

On the other hand, selenium compounds have demonstrated to produce a detoxification effect against toxic metals such as As and Hg. There is also a controversy about the effect of selenium administration on the detoxification of cadmium. While some authors reported the formation of a Se-S bond in MTs, others found that selenium compounds may catalyze the oxidation of MTs even at the reducing conditions existing in the cytosol as a whole.

Previous research in our group [2] on the simultaneous administration of Cd and Se to mussel seemed to indicate that Se did not bind to Metallothionein-Like proteins in mussel hepatopancreas (although it influenced Cd redistribution among MTs-sub-isoforms.

In this communication, the effect of selenium administration on the MTs induction by Cadmium, as a possible mechanism of detoxification, will be discussed. Two complementary separation mechanisms were coupled to UV and inductively coupled plasma mass spectrometric detection to investigate the simultaneous speciation of Cd, Se, Cu and Zn (in rat liver tissue exposed to cadmium and cadmium plus selenium). Initially, the samples were fractionated by SEC and then, the MTs fraction was further purified by RP-HPLC. This latest mechanism allows the separation of the different isoforms of metallothioneins and to study the different patterns of separation between rats exposed to cadmium or to cadmium plus selenium [2]. These in vivo experiments revealed that the coadministration of Cd and Se to rats induced the synthesis of a special isoform containing Se, Cu, Zn and probably Cd which was isolated and analyzed by ESI-MS. On the light of our overall results mechanisms of selenium protection against important toxic metals will be discussed.

[1] G. Nordberg, Talanta, 46 (1998) 243.
[2] C.N. Ferrarello, M.R. Fernández de la Campa, J.F. Carrasco and A. Sanz-Medel, Spectrochim. Acta, Part B, 57 (2002) 439.