STUDIES ON THE INTERACTION BETWEEN Se, Te, Cd, As AND Zn AND THE DISTRIBUTION OF Fe, Co, Rb AND Hg IN MICE BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS

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The incorporation of Se and Te into liver, kidneys, heart, spleen, lung and small intestine after i.p. injections of Balby mice with seleno-cystine (CySe) and Na2TeO4 in the presence of Cd (as CdCl2), As (as As2O3) and Zn (as ZnSO4) has been studied. The change of contents of Co, Fe, Rb and Hg were determined in all investigated organs after injections with the above compounds. Instrumental neutron activation analysis was applied as the analytical method. It was found that a competitive interaction occurs between As and Se or Te. Similarly, this interaction has been observed between Se and Cd. The data obtained suggest that Cd has a higher competitive ability to displace Te than Zn and Se. Injection with the above compounds affects the contents of Fe, Co, Rb and Hg in all mice organs.

Introduction

The ability of Se to reduce heavy metal toxicities was discovered years ago. Arsenicals were found in the 1930s to counteract Se toxicity but the interrelationship between Se and As has yet to be clarified. Similarly, counteraction of Cd testicular injury by a half molar equivalent of Se was partly clarified by recent research. The finding that traces of Ag+, Cd2+, Hg2+ or arsenite increase interference with the function of Se and tocopherol. Moreover, Se has a high affinity for Ag, Cd or Hg and will form complexes with them in vivo, causing a decrease in the biological activity of both Se and the heavy metals. Obviously, interactions may be either positive or negative, i.e. if an element requires the presence of at least another one for its normal efficacy in metabolism, there is a positive interaction (synergistic), e.g. Cu–Fe. A negative interaction occurs whenever the normal function of an element in metabolism is impaired by the relative excess of another element (antagonistic), e.g. Cu–Zn. This interactions can frequently be explained by the fact that competing metals ions possess the same or a very similar electron configuration and ionic radius, e.g. Cd–Zn. Considering the above mentioned facts we found reasonable to study the
interactions between Se (as Se-cystine \((\text{CySe})_2\)) and Zn, Cd, Te or As as these elements—apart from their biological importance—are environmental toxicants. Furthermore, the incorporation efficiency of Se upon Zn, Cd, Te or As and coupled with it, the changes of the contents of Co, Fe, Rb and Hg were determined after intraperitoneally injected compounds. In terms of the importance of the interactions between trace elements it seems also interesting to study the influence of Zn, Cd, As and Se on the incorporation of Te into the examined mice organs. Instrumental neutron activation analysis (INAA) was applied as the analytical method for its advantage both in sensitivity and chemically non-destructive procedure.

**Experimental**

Seleno-cystine \(\[(\text{CySe})_2\]\) was obtained from Sigma, \(\text{Na}_2\text{TeO}_3\) from Merck. The other chemicals: \(\text{RbCl, Co(NO}_3\text{)}_2 \cdot 6\text{H}_2\text{O, ZnSO}_4 \cdot 6\text{H}_2\text{O, FeSO}_4 \cdot 7\text{H}_2\text{O, As}_2\text{O}_3, \text{CdCl}_2 \cdot 2.5\text{H}_2\text{O and HgNO}_3\) were purchased from Polish POCh works. All chemicals (standard reagent purity) were used as received.

Healthy Balby mice (males, aged 3 months) were taken for the examination. The mice were divided in 18 groups (three mice per set) and then injected intraperitoneally with \(100\ \mu\text{l of an aqueous solution of the appropriate compounds. In all treatments with Se, Te or As-compounds the mice were injected with (CySe)\(_2\), As\(_2\)O\(_3\) or Na\(_2\)TeO\(_3\) at a dose of 0.3 \mu\text{M of each element per mouse due to the low LD}_{50} \text{ value. In the treatments with Zn (as ZnSO}_4 \cdot 6\text{H}_2\text{O) or Cd (as CdCl}_2 \cdot 2.5\text{H}_2\text{O) the mice were dosed with 0.6 \mu\text{M of each metal per mouse. In all experiments the animals were decapitated 2 hours after the injection with these compounds:}

- Group I — was the control group;
- Group II — Zn;
- Group III — Cd;
- Group IV — As\(_2\)O\(_3\).

In the second part of the experiment examined mice were first injected with Se [as(CySe)\(_2\)] and 2 h later the animals were given solutions of Zn (as ZnSO\(_4 \cdot 6\text{H}_2\text{O}), As (as As\(_2\)O\(_3\)) and Cd (as CdCl\(_2 \cdot 2.5\text{H}_2\text{O}) alone or together:

- Group V — Se;
- Group IV — Se and Zn;
- Group VII — Se and Cd;
- Group VIII — Se and As;
- Group IX — Se, Zn and As;
- Group X — Se, Cd and As.

All animals were decapitated 4 h after Se-injection.