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Neutralization by Metal Ions of the Toxicity of Sodium Selenide

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Abstract:

Inert metal-selenide colloids are found in animals. They are believed to afford cross-protection against the toxicities of both metals and selenocompounds. Here, the toxicities of metal salt and sodium selenide mixtures were systematically studied using the death rate of *Saccharomyces cerevisiae* cells as an indicator. In parallel, the abilities of these mixtures to produce colloids were assessed. Studied metal cations could be classified in three groups: (i) metal ions that protect cells against selenium toxicity and form insoluble colloids with selenide (Ag^{+}, Cd^{2+}, Cu^{2+}, Hg^{2+}, Pb^{2+}, and Zn^{2+}), (ii) metal ions which protect cells by producing insoluble metal-selenide complexes and by catalyzing hydrogen selenide oxidation in the presence of dioxygen (Co^{2+} and Ni^{2+}) and, finally (iii) metal ions which do not afford protection and do not interact (Ca^{2+}, Mg^{2+}, Mn^{2+}) or weakly interact (Fe^{2+}) with selenide under the assayed conditions. When occurring, the insoluble complexes formed from divalent metal ions and selenide contained equimolar amounts of metal and selenium atoms. With the monovalent silver ion, the complex contained two silver atoms per selenium atom. Next, because selenides are compounds prone to oxidation, the stabilities of the above colloids were evaluated under oxidizing conditions. 5,5´-dithiobis-(2-nitrobenzoic acid) (DTNB), the reduction of which can be optically followed was used to promote selenide oxidation. Complexes with cadmium, copper, lead, mercury or silver resisted dissolution by DTNB treatment over several hours. With nickel and cobalt, partial oxidation by DTNB occurred. On the other hand, when starting from ZnSe or FeSe complexes, full decompositions were obtained within a few tens of minutes. The above properties possibly explain why ZnSe and FeSe nanoparticles were not detected in animals exposed to selenocompounds.

Key-words: metal ions, inert metal-selenide colloids, S. cerevisiae, selenide oxidation, toxicity