

Dynamic Aspects of Selenium Metabolism Based on Metabolomics

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Selenium is an essential element, and both inorganic (selenite and selenate) and organic (selenoamino acids, selenocysteinyl and selenomethioninyl residues) forms are utilized as nutritional sources. All of the nutritional sources are transformed to the common intermediate, selenide, and then utilized for the synthesis of selenoenzymes as gene products. Surplus selenium and selenium liberated from used selenoenzymes are excreted mostly in the form of selenosugar into urine through the common intermediate, selenide. Selenosugar is accompanied by trimethylselenonium (TMSe) in the case of excessive doses. Metabolic pathways leading to the common intermediate, selenide, from each selenium source, and starting from selenide to the excretion metabolites are proposed based on speciation study by HPLC-ICP MS with use of enriched stable isotopes. Several examples will be presented. ⁷⁷Se-Enriched methylselenite was injected intravenously into rats at a dose of 25 µg/kg body weight, and then the body fluids and organs were obtained. The time-related changes in the distribution profiles on a gel filtration column by HPLC-ICP MS suggested that methylselenite was reduced to methylselenol, and then it was transformed to selenide for the syntheses of selenoproteins (utilization) and also selenosugar (excretion). The metabolic pathway for the demethylation of methylselenol to selenide was proposed based on the appearance of the GSH-conjugated form of selenosugar followed by the urinary form of selenosugar in the liver. Similar but different metabolic pathways between methylselenite and selenite were demonstrated by simultaneous speciation of metabolites after a simultaneous injection of ⁷⁷Se-methylselenite and ⁸²Se-selenite. The metabolic pathway leading to the two urinary metabolites was also proposed.