

Title of research project	Mechanism Underlying the Demethylation of Methylmercury and Evaluation of Biogenic Mercury Selenide Toxicity in Foods
Research project number	1905
Research period	FY 2019 – 2020
Name of principal research investigator (PI)	Yasumitsu Ogra

Abstract/Summary

Mercury (Hg) is a highly toxic environmental contaminant, and is biocondensed via the food chain. Selenium (Se) is an essential trace element that possesses an antagonistic property towards Hg *in vivo*. The antagonistic property is explained by the assumption that Hg and Se directly interact to form HgSe nanoparticles (HgSe-NPs) in organs. Because the major naturally occurring chemical form of Hg is methylmercury, a demethylation process is needed to interact with selenium. It is presumed that the toxic effects of HgSe-NPs are lower than those of ionic Hg; however, no precise evaluation has been conducted so far. In the present study, we intended to clarify the mechanism underlying the demethylation of methylmercury, and evaluated the distribution of HgSe-NPs in Se-deficient rats. We obtained that selenonein being a unique selenoamino acid found in marine animals efficiently drove the demethylation process *in vitro*, and its reaction mechanisms were reasonably explained. In the *in vivo* experiments for the evaluation of toxicity, the recovery of serum selenoproteins from a deficient level was not observed in rats orally administered HgSe-NPs. In addition, the excretion of Hg and Se via urine was not observed. Interestingly, the biosynthesis of selenoproteins and urinary selenometabolites would have required the production of selenide through the degradation of HgSe-NPs. Therefore, it seems that selenide and Hg are not released from HgSe-NPs *in vivo*. The administration of HgSe-NPs did not increase Hg and Se concentrations in organs, and almost all HgSe-NPs were recovered in feces, indicating no or low bioaccessibility of HgSe-NPs even in Se-deficient rats. These results suggest that HgSe-NPs are biologically inert and do not show any acute toxicities.

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1. List of papers published on the basis of this research
 - Kazuaki Takahashi, Jorge Ruiz Encinar, José M. Costa-Fernández, Yasumitsu Ogra: Toxicokinetics of mercury selenide nanoparticles in rats. *Ecotoxicology and Environmental Safety*, submitted.
2. List of presentations based on this research
 - Three presentations in domestic conferences.

3. Number and summary of patents and patent applications

NONE.

4. Other (awards, press releases, software and database construction)

NONE.