An Unanswered Question about Heavy Metals in Chinese Herbal Medicinal Preparations: Environmental Contamination or Medicinal Elements?

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With globalization of Traditional Chinese Medicine (TCM), more and more attentions have been drawn to the efficiency and safety of Chinese herbal medicine. With global industrialization, environmental pollution especially with heavy metals poses serious problem on the quality of medicinal plants and their products. Many metal elements such as mercury, arsenic, lead, zinc, cadmium, ammonium, etc, are listed as indexes for quality control of Chinese herbal medicines preparations. On the other hand, many Chinese medicinal preparations use heavy metal materials as therapeutic components. Arsenic trioxide (As2O3) is one of the famous cases. Other famous TCM formulas like An-Gong-Niu-Huang Wan (AGNH), Liu-Shen-Wan(LSW), and Niu-Huang-Jie-Du-Pian pills(NHJDP), etc., use realgar and cinnabar for therapeutic purposes although their potential toxic effects are not well defined. It is important to assess the efficacy and safety of those medicinal preparations. In this study, we conducted systematical literature reviews on the investigations of safety-and-risks aspects of those commonly prescribed realgar-and cinnabar-containing Chinese herbal-metallic preparations. In the meantime, we also detected the contents of heavy metals in many row materials and products. Current studies indicate that both realgar and Cinnabar were insoluble and had potent therapeutic efficacy with less toxicity and low bioavailability when compared to the similar form of them. However, the efficacies and safety of those medicinal preparations remain to be carefully evaluated since the variations in terms of the efficacy and safety of these preparations coupled with the lack of unified standard in the recommended dosages and treatment recipes are adopted by TCM practitioners in China and other countries. Therefore, further studies are necessary for understanding the efficacy and biological safety of those medicinal formulas with the heavy metals for medical purposes.

Cadmium Uptake and Functional Impact in Pancreatic Insulin Producing Beta Cells

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Evidence suggests that chronic low level cadmium exposure impairs the function of insulin producing beta cells and may be associated with type 2 diabetes mellitus. In the present study we describe the native cadmium content in primary human insulin producing islets. We furthermore examine the uptake kinetics and effects of exposure to environmentally relevant concentrations of cadmium on insulin producing beta cells. The cadmium (Cd) content in islets from 10 human subjects ranged between 7.4 and 71.92 nM/g protein. The concentration of mercury (Hg) was significantly lower. Exposure of the beta cell line MIN6 to CdCl2 concentrations between 0.1 and 1.0μM resulted in a dose and time dependent uptake of cadmium over 72 hours. Exposure of MIN6 cells to CdCl2 1.0μM but not 0.5 or 0.1μM significantly inhibited glucose stimulated insulin secretion (GSIS). In contrast, the threshold concentration of CdCl2 for GSIS inhibition in primary murine islets was 0.1μM. Exposure of MIN6 cells or primary murine islets to 0.1μM CdCl2 induced expression of metallothionein, likely enhancing cellular cadmium accumulation. No increase in cell death, the level of HSP70, ZnT8, ZnT1, ZIP10, INS-1, INS-2, MafA, MafB, or IRS-2 was observed in primary murine islet cells exposed to CdCl2 0.1μM. We conclude that human islets contain measureable quantities of Cd that are higher than these of Hg. Furthermore, beta cells take up cadmium gradually in a dose and time dependent manner at environmentally relevant concentrations. This uptake leads to a functional impairment of beta cell function without significant alterations in cell viability, expression of genes important for beta cell function or induction of oxidative stress.