P.O. Box 144345 Austin, TX 78714-4345 ▪ 512.926.4900 ▪ Fax: 512.926.2345 ▪ www.herbalgram.org

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File: ▪ Chinese Herbal Medicines
▪ Heavy Metals
▪ Pesticides

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RE: Contaminants in Commonly Prescribed Chinese Botanical Drugs

Harris ESJ, Cao S, Littlefield BA, et al. Heavy metal and pesticide content in commonly prescribed individual raw Chinese herbal medicines. *Sci Total Environ*. September 15, 2011;409(20):4297-4305.

Traditional Chinese medicine (TCM), including Chinese Herbal Medicines (CHMs), is used worldwide. Previous reports have shown that CHMs possibly contain heavy metals as well as pesticides. As a component of a broader study focusing on drug discovery from CHMs, this investigative study evaluated traditionally prepared, authenticated botanicals for heavy metal and pesticide content. The authors hypothesized that collected CHMs would not contain large amounts of heavy metals due to the lack of commercial processing.

This study analyzed a collection of 334 plants representing 126 species in 3 locations, collected from cultivation (n=210), as well as wild locations (n=124). Collected samples were in the Chinese Pharmacopoeia and not endangered. Samples consisted of 10 kg dry weight of the medicinal plant parts and were handled and prepared in line with traditional usage; visual, microscopic, and chemical authentication was completed on each sample using standards from the Chinese Pharmacopoeia. Additionally, global positioning system (GPS) data were obtained for each collection site. From the final material, 250 g were taken for assessment of heavy metal and pesticide content. The heavy metals analyzed were arsenic, cadmium, chromium, lead, and mercury, reported to be the most prevalent in botanical contamination. Standards of heavy metals and pesticides were used to establish limits of both detection and quantitation.

This study employed three ways to determine contamination. The first involved comparing the results with limits stated for dietary supplements by the NSF International/American National Standards Institute (NSF/ANSI), as well as those used by the European Pharmacopoeia. Secondly, findings of the analysis were calculated as percentage of reference dose (RfD) for heavy metal content or population adjusted dose (PAD) for pesticide content. Thirdly, minimal risk levels (MRLs) were used for comparison as used by the Agency for Toxic Substances and Disease Registry (ATSDR); results were analyzed as percentage of MRL of the largest botanical daily dose. To further interpret results, it was assumed that contaminants were consumed at either 100% ("most-conservative" or "chronic exposure" estimate) or 10% ("more-likely" or "acute exposure" estimate), based on preparations used in TCM.

All samples analyzed contained 1 heavy metal, with 115 containing all 5 heavy metals. When the more-likely estimate was applied, 3 samples had high enough levels of heavy metals to constitute an "elevated level of background exposure." This was also seen for 231 samples when applying the most-conservative estimate of consumption. If chronic exposure was assumed, such as with a soup or a tea, 39 samples had high enough levels of heavy metals to result in elevated background exposure. Arsenic was found in 0.3% of samples; enough cadmium was found in 0.6% of samples to cause elevated background exposure when applying the more-likely consumption estimate. Using the most-conservative estimate of consumption, elevated background levels would be present for arsenic (34% of samples), cadmium (52% of samples), chromium (53% of samples), lead (12% of samples), and mercury (1% of samples).

Pesticides were found in 108 samples, and 42 different pesticides were reported. Of the 42 pesticides, 21 are not registered to be used in the United States. According to the more-likely estimate, elevated background exposure would result from 14 plants without chronic exposure and from 69 plants if the chronic exposure assumption is applied. According to the most-conservative estimate, consumption of 81 samples would lead to elevated background exposure. The most prevalent pesticide found was chlorpyrifos. Individually, with the most-conservative estimate of consumption, samples were high in chlorpyrifos (26%), esfenvalerate (0.3%), fenvalerate (0.3%), fipronil (0.3%), lindane (0.3%), methyl-parathion (1.4%), and quintozene (0.3%). When geographic location of collection site was incorporated, lead and cadmium had elevated clusters in Southwest China, chromium was clustered in Northeast China, and chlorpyrifos was highly clustered in Southeast China. Additionally, samples that were wild-collected had more contamination (arsenic, cadmium, lead, chromium, and chlorpyrifos) than those from cultivation.

In conclusion, this study reports that in regards to individual heavy metals, consumption of the samples herein would not lead to mercury toxicity, and that, depending on the types of arsenic or chromium, estimated concentrations may be elevated more than expected levels. It is recommended that further study be done on the presence of chromium, cadmium, and chlorpyrifos. It is noted that samples collected from wild sites had elevated levels of cadmium, lead, chlorpyrifos, and arsenic. The authors suggest that this may be due to site proximity to cultivated sites using pesticides or sites with heavy metal contamination.

The authors' main conclusions are that the heavy metal and pesticide contamination of the samples in this study may not be harmful overall, but that all samples need to be screened, and further research is necessary. Also, international standards for the screening of botanicals used in TCM and exported throughout the world should be designed and implemented. This would include the identification of contaminants as well as geographical locations of contamination sources.

—Amy C. Keller, PhD

Referenced article can be found at www.ncbi.nlm.nih.gov/pmc/articles/PMC3163780.