



## Young Forensic Scientists Forum— 2019

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### Y7 Detection of Undeclared Substances and Heavy Metals in Alternative Medicines by Chemical Analysis

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**Learning Overview:** After attending this presentation, attendees will understand the possible dangers of herbal medicines that can be legally purchased in the United States. Attendees will recognize useful presumptive and confirmatory tests that can be used to characterize these medicines and to identify possible heavy metals and undeclared drugs.

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by providing a variety of analytical techniques that can be used to characterize unknown substances within complex matrices.

Modern herbal medicines based on traditional Chinese medicines have become an increasingly common choice for consumers to treat many ailments from backaches to allergies to migraines. Many people choose these medicines because they believe they are safer alternatives to, or contain more natural ingredients than, western pharmaceuticals. However, recent reports in scientific literature have indicated possible heavy metal poisoning or adverse effects from undeclared substances present in herbal medicines. Despite these case reports, herbal medicines, like other dietary supplements, are unregulated by the Food and Drug Administration (FDA). Herbal medicines are forensically relevant because undeclared substances may appear in toxicological analysis or these medicines may be found at a crime scene and analyzed by a forensic chemist. Thus, more research is needed to characterize possibly adulterated herbal medicines.

This research aims to identify heavy metals, including arsenic, lead, and mercury and/or organic adulterants, including undeclared drugs, in herbal medicines through various analytical techniques that can be implemented in a forensic laboratory. Ten different herbal medicines have been purchased from traditional Chinese medicine shops in different cities in the United States, including Seattle, WA, New York City, NY, and Philadelphia, PA. Presumptive tests, such as polarized light microscopy, Fourier Transform Infrared Spectroscopy (FTIR), and color tests have been performed. These tests are important because they can guide the analysis of herbal medicines that often contain unknown substances and have complex matrices.

Polarized light microscopy was found useful to identify fillers in these medicines, including sand and starch. Both transmission and Attenuated Total Reflectance (ATR) sampling were used with FTIR in order to indicate possible adulterants, including warfarin, dextromethorphan, and netilmicin, as well as provide information on major components of the medicines. Color tests were used to test for heavy metals and possible drugs. Using the Reinsch test, four samples had a positive indication for arsenic and one sample had a positive indication of mercury. Using Mandelin's reagent, one sample had a positive indication of ibuprofen. From the results of these tests, future work can include analysis by Atomic Absorption (AA) spectroscopy and Gas Chromatography/Mass Spectroscopy (GC/MS).

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#### Herbal Medicines, Undeclared Substances, Heavy Metals