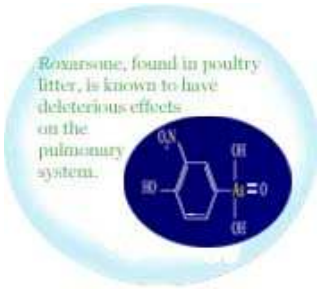
Applied Speciation and Consulting, LLC

Total Arsenic and Arsenic Speciation in Human Biological Samples

Applied Speciation and Consulting is one of the few firms in the world with the capacity and capability to deliver a holistic approach to trace metals investigations

Arsenic and other toxic metals are becoming an increasing concern to human health as higher density populations expand to rural and industrialized zones. Although arsenic occurs naturally in the environment, anthropogenic sources exceed all naturally occurring sources by a factor of three. When coupled with the locality, anthropogenic sources pose a significantly greater threat than almost all naturally occurring sources.

Anthropogenic sources of arsenic range significantly from smelters, pesticides, metal plating, chicken farms, folk medicine, to your own backyard deck (CCA treated lumber). Due to the ubiquitous nature of arsenic in our surroundings, the first step in identifying the probability and prevention of exposure is to determine the sources.



The source of arsenic may assist in deducing the form of arsenic. The molecular form, along with the source and exposure pathway, must be taken into consideration when determining causative effects. The qualitative and quantitative determination of the molecular form of an element is defined as speciation analysis. The interactions of different arsenic species with human systems, specifically detoxification mechanisms, are dictated by, amongst other variables, the reactive nature of the arsenic species and the associated metabolic mechanisms associated with the exposure pathways.

The exposure pathways are typically dictated by the contaminant source and the application. Arsenic present in CCA treated

lumber is a projected dermal hazard; however, burning of such material may result in the volatilization of arsenic which, when inhaled, is more efficiently transported into the blood stream than via dermal contact of arsenic. In this case, although the source material and arsenic species was known, the application of the material significantly altered the projected impact on human health.

Human exposure assessment to arsenic containing substances includes short term and long term tests that can be performed to monitor detoxification efficiencies. Monitoring the arsenic concentration in urine, accompanied by blood tests provide short term supportive evidence of exposure and detoxification. Urine provides a more stable basis for identifying arsenic exposure than blood due to a more efficient scrubbing process. Arsenic concentrations in blood and urine are typically below 50 µg/L and 7 µg/L, respectively. Long term exposure can be identified by analysis of epithelial tissue such as hair and skin; however, due to the increased possibility of external contamination (dermal contact) the application of such results should be exercised with caution.

www.appliedspeciation.com

953 Industry Drive, Tukwila, WA 98188 Phone: (206) 219-3779 Fax (206) 388-3485

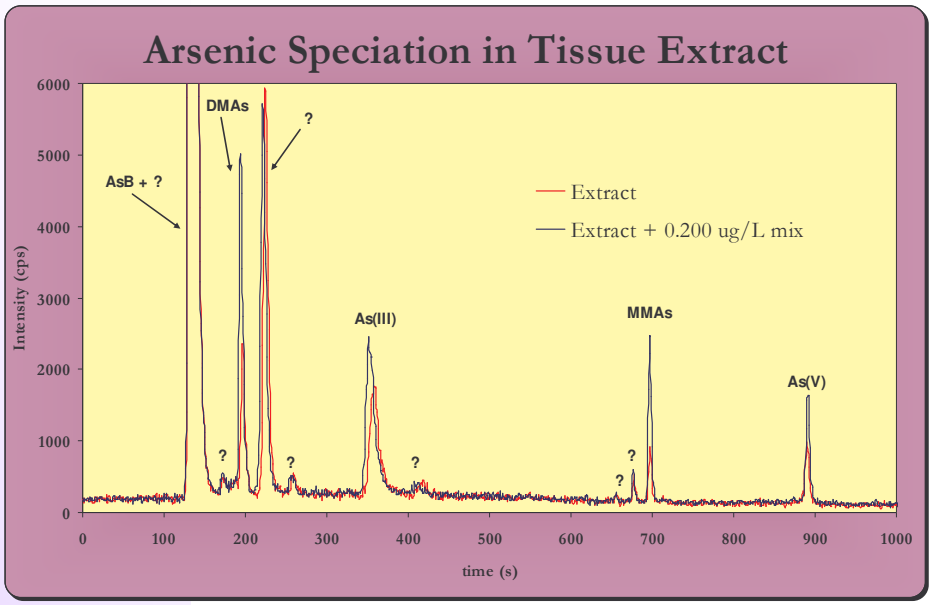
As stated previously, identifying the arsenic species at the point of exposure, can assist in explaining the symptoms and projected long term health affects. Arsenic is typically found in two valence states (+3 and +5). The valence state, redox conditions, pH, temperature, presence of UV light, biological organisms, and other chemical compounds in the immediate environment dictates the form of arsenic and its association with other molecules. Often times, by identifying the different environmental parameters, the form of arsenic can be speculated which can then be confirmed by analytical methods.

The identification of the specific arsenic species plays a paramount role in projecting and rationalizing affects on human biological mechanisms. Most organic arsenic species (arsenobetaine,arsenocholine, arsenoribosides, etc.) result in negligible affects on human systems while inorganic arsenic species (arsenate and arsenite) are known carcinogens and mutagens having detrimental impacts on life supporting functions. Generalizing the effects of arsenic species on human functions must be limited as the environment and exposure pathways must be taken into consideration as well.

Arsenic exposure investigations typically begin with correlating symptoms which necessitate confirmational analysis. Although total arsenic analysis may seem straightforward, interferences inherent with nearly all analytical platforms can result in significantly biased results. Applied Speciation and Consulting has developed a very robust method that utilizes an inductively coupled plasma mass spectrometer (ICP-MS) equipped with a dynamic reaction cell (DRC) for all total arsenic and trace metals analysis in human tissue samples. The DRC can eliminate the inherent spectral interferences associated with mass spectrometry to provide more absolute results. Detection limits of less than 5 ng/g can be achieved in tissues with no false positives. If initial testing does not correlate symptoms with the total arsenic concentrations, speciation may be required.

Applied Speciation and Consulting applies ion chromatography inductively coupled plasma - mass spectrometry (IC-ICP-MS), the most robust and widely accepted method for speciation analysis of arsenic and other metalloids. Aqueous samples can be introduced directly into an ion exchange column which separates the different metalloid species according to their interactions with the column packing material. The eluting species are then introduced into an ICP-MS serving as a very sensitive detector. For tissues and blood samples an extraction procedure is necessary to get all arsenic species in solution before analysis.

Our experience allows us to choose different ion exchange columns and eluants for different matrices to provide better resolution of target species. More importantly, for higher profile cases, secondary confirmation using different columns and eluants can provide indisputable data when needed. As a BSL-2 laboratory, Applied Speciation and Consulting can accept most human tissue samples under the safest conditions.



The unparalleled analytical capabilities and consulting services provided by Applied Speciation and Consulting are designed to support all aspects of arsenic and other metalloid investigations associated with human health concerns.

For all inquiries, please contact our senior research scientist Hakan Gürleyük, Ph.D. at Hakan@appliedspeciation.com.

www.appliedspeciation.com

Applied Speciation And Consulting, LLC

953 Industry Drive, Tukwila, WA 98188 Phone: (206) 219-3779 Fax (206) 388-3485