MATRIX REMOVAL FOR DETERMINATION HEAVY METAL AND RADIONUCLIDE IMPURITIES FROM MULTIVITAMIN TABLETS BY ICP-MS

Jeremy White, Tasia Micthum and Zikri Arslan

Department of Chemistry and Geo and Physical Sciences, Jackson State University, Jackson, USA

Abstract: Multivitamin (MV) supplements are very complex samples containing heavy metal and radionuclides impurities originating from the materials used in manufacturing. Major elemental components of MV supplements include boron, calcium (Ca), chloride (Cl), magnesium (Mg), phosphorus (P), potassium (K), iron (Fe), manganese (Mn), copper (Cu), and zinc (Zn) and various proteins. The concentrations of heavy metals, such as arsenic (As), cadmium (Cd), lead (Pb) and uranium (U) are usually in sub-µg/g. Accurate quality control under such levels at such levels is a challenging task due the complexity of MV supplements by ICP-MS. Certain elements added as nutrients induce spectral and chemical interferences. Chloride causes ArCl interference on As. Tin (Sn) isotopes has direct overlap on Cd isotopes, while molybdenum (Mo) via various MoOs exhibit isobaric overlaps on Cd isotopes. Removal of MV matrix components is important to eliminate interfering components and alleviating the adverse effects of MV matrix on ICP-MS analysis. In this study, we developed a co-precipitation approach for selectively separating As, Cd, Pb and U from MV matrix. Sequential co-precipitations using trimethylamine (TEA) and hydrofluoric acid (HF) were performed. Proteinaceous and inorganic matrices (B, Ca, Mg, Cl, Fe, K and K) were successfully removed. Sn matrix eliminated to extent. Mo levels reduced from 400 ppm to 0.02 ppm in analysis solutions alleviating the spectral interference on Cd. The method was applied to the determination of As, Cd, Pb and U in multivitamin certified reference material (SRM 3280) then applied to the analysis of various commercially available MV tablets.

Keywords: Arsenic; cadmium; lead; uranium; multivitamin tablet; co-precipitation; ICP-MS

Acknowledgments: This research is supported by grants from the National Center for Research Resources (5 G12 RR013459-15), the National Institute on Minority Health and Health Disparities (8 G12 MD007581-15) from the National Institutes of Health, and the Department of Defense (DOD) Center of Excellence in Science, Technology, Engineering & Mathematics Education (CESTEME) program (Grant No W911NF-11-1-0123).