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University: Bradley University
Faculty Mentor: Dr. J. David Robertson
Mentor Department: Chemistry
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Effects of washings and treatments on the usefulness of hair as a biomarker

Stefanie Timpe, John Brockman, Vickie Spate and J. David Robertson

Hair is a useful matrix for the analysis of many trace elements found in the human body. Studies show that hair can incorporate trace metals into its structure during the growth process. Hair is an attractive monitor because unlike blood serum and urine, it is a metabolic end product and therefore inert. It is collected non-invasively, easily stored and disposed. Many studies in the literature attempt to correlate trace elements measured in hair to health, pollution exposure or to disease. Trace elements in hair can be accurately measured by Instrumental Neutron Activation Analysis (INAA). Hair samples must be cleaned before analysis to remove external contamination, there are many methods of sample cleaning, however there is not a standardized washing procedure. This study investigates pre and post collection cleaning techniques that may alter observed trace element concentrations in the hair. Two separate, post collection washing methods were studied: the International Atomic Energy Agency, IAEA, method, and the University of Missouri Research Reactor, MURR, method. The samples were then analyzed for Se, Ti, Mg, Mn, V, I and Zn using INAA at MURR. Selenium concentrations were unchanged. However, all other elements showed a significant reduction in concentration from the MURR to the IAEA method. It was also hypothesized that pre-collection cleaning with shampoos containing EDTA, a chelating agent, may be responsible for leaching some trace metals from hair. In order to determine the effects of shampoos on the sample, hair from a single subject was treated with three different types of shampoo. Two solutions of each shampoo were prepared in a 1:4, shampoo:water ratio. The hair was then washed in these solutions for either 1 or 24 hours for each type of shampoo. Hair washed with shampoo containing selenium sulfide resulted in a large selenium contamination despite cleaning with both the IAEA and MURR methods. The large variability between the post-collection cleaning techniques shows that a standard preparation method must be established before hair can be accurately used as a biomarker. Further studies must be done to determine if pre-collection shampoo treatment affects the validity of hair as a biomarker for trace elements.