The role that trace elements play in both normal biological function and issues of toxicity has been of increasing importance. As demand increases for analytical services to determine the concentrations of trace metals in blood samples, through both industrial and environmental exposures, laboratories need methods that are accurate and quick, with no obvious interferences. The use of inductively coupled plasma mass spectrometry (ICP-MS) allows for fast, quantitative, multi-elemental analysis of biological samples with detection limits in the part-per-billion range. Due to the matrix complexity of blood samples, ICP-MS analysis can be performed in a simple and repeatable manner, which, when combined, can serve as a basis for trace metal analysis.

In this study, a comparative analysis of the dilution techniques for the analysis of trace metals in whole blood samples were performed. The following dilution techniques were used: a 1:50 dilution in 1% (v/v) HNO₃ in reagent water (Dilution Method #1), a 1:50 dilution in 0.05% (w/v) EDTA, 1% (v/v) TMAH, 1% (v/v) ethyl alcohol, and Milli-Q water (Dilution Method #3). A comparative study of the analysis of Cd, Cu, Ni, and Pb in whole blood samples was performed for all colleagues. Colleagues' blood duplicate precision (RPD < 10%) throughout the experiment. This data indicates that many potential interferences can be overcome by using a 1:50 dilution in 0.05% (w/v) EDTA, 1% (v/v) TMAH, 1% (v/v) ethyl alcohol, and Milli-Q water (Dilution Method #3). Dilution Method #3 was found to be the most accurate technique for the analysis of Cd, Cu, Ni, and Pb in whole blood samples. Additionally, it was found that the addition of ethyl alcohol to the dilution method could improve the accuracy and precision of the analysis of Cd, Cu, Ni, and Pb in whole blood samples.

Introduction

The focus of this ongoing comparative study is to determine a simple and precise technique for the analysis of multiple trace metals in whole blood. For this comparison, three simple dilution techniques were used: a 1:50 dilution in 1% (v/v) HNO₃ in reagent water (Dilution Method #1), a 1:50 dilution in 0.05% (w/v) EDTA, 1% (v/v) TMAH, 1% (v/v) ethyl alcohol, and Milli-Q water (Dilution Method #3). A comparative study of the analysis of Cd, Cu, Ni, and Pb in whole blood samples was performed for all colleagues. Colleagues' blood duplicate precision (RPD < 10%) throughout the experiment. This data indicates that many potential interferences can be overcome by using a 1:50 dilution in 0.05% (w/v) EDTA, 1% (v/v) TMAH, 1% (v/v) ethyl alcohol, and Milli-Q water (Dilution Method #3). Dilution Method #3 was found to be the most accurate technique for the analysis of Cd, Cu, Ni, and Pb in whole blood samples. Additionally, it was found that the addition of ethyl alcohol to the dilution method could improve the accuracy and precision of the analysis of Cd, Cu, Ni, and Pb in whole blood samples.

Dilution Method #1: The 1:50 dilution in 1% (v/v) HNO₃ in reagent water was the simplest method to perform. The results from this investigation indicate a preference for Dilution Method #1 and Dilution Method #2 for the analysis of Cd, Cu, Ni, and Pb in whole blood. These methods are used to perform, on relatively small amounts of reagents, provide good accuracy and precision, and have only one obvious interference (HNO₃) that would be removed due to interferences. The Dilution Method was validated for more reagents and, in general, provide good accuracy and precision. In conclusion, Dilution Method #1 would be recommended for the analysis of these trace metals in whole blood. For this investigation, trace elements will be studied using atomic emission (AAS) and inductively coupled plasma mass spectrometry (ICP-MS), as well as the inductively coupled plasma laser ablation ICP-MS. This has been cited that ethanol addition, as in the previous study, would improve the accuracy and precision of the analysis of Cd, Cu, Ni, and Pb in whole blood samples. Additionally, all experiments were performed to rule out any possibility of bias caused by instrumental interference.

Discussion

Trace element Cu is essential for most animals, including humans. Cu is part of enzymes which are proteins that help biochemical reactions occur very quickly and are important for human health. Cu is involved in the absorption, storage, and metabolism of iron. Co is toxic at low levels but can be toxic at higher levels. Cu also has been shown to be a 3% reduction of cognitive performance, while the alkyl Pb species are highly toxic to the nervous system.

Concentrations of Cu in human blood are generally measured in the range of 65-104 μg/L. Cu is a constituent in enzymes which are proteins that help biochemical reactions occur very quickly and are important for human health. Cu is involved in the absorption, storage, and metabolism of iron. Co is toxic at low levels but can be toxic at higher levels. Cu also has been shown to be a 3% reduction of cognitive performance, while the alkyl Pb species are highly toxic to the nervous system.

Occupational exposure is the most common cause of increased Cu levels. Principal populaions reported were metal workers who were exposed to Cu in the form of Cu metal. Cu levels range from 50 to 400 μg/L of Cu metal in the bloodstream. This has been estimated that mild exposure is to 40 μg/L and acute to 400 μg/L.