

An Improved Method for Trace Level Arsenic Quantification in Water

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Arsenic, "king of poisons," threatens public health on an unprecedented scale with over 140 million people in 50 countries drinking water contaminated with arsenic at levels above the EPA/WHO guideline of 10 ppb. The EPA reports that As 3+ is probably the most difficult substance encountered in the water purification industry, where its high toxicity and widespread occurrence create the need for effective monitoring. Quantification methods for arsenic are complex, expensive, and time-consuming. Herein, a simple method for trace level quantification of arsenic in water meeting EPA limits using methyl red bromination and spectrophotometry is proposed. First, bromine oxidizes As 3+ to As 5+. Then, the residual bromine reacts with methyl red to form colorless brominated methyl red. Residual methyl red absorbance at 518nm forms the basis of quantification. With an increase in arsenic levels, less bromine remains to react with methyl red, leading to higher absorbance intensities of residual methyl red. Detailed optimization studies with bromine, acid, and indicator levels led to significant improvements over a previous study (Pandurangappa, 2011). While the earlier study quantified arsenic only in the 50-250 ppb range (not EPA levels), the current study quantifies in the 5-20 ppb range, providing a ten-fold improvement and encompasses the EPA limit of 10 ppb. These insights were also applied to create a simple point-of-use test which is ten times cheaper and faster than current test kits. This study is the first in literature using a common indicator, methyl red, and spectrophotometry to quantify arsenic below EPA limits.

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