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Development of a Cost Effective TISAB Buffer for Fluoride Analysis

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Abstract

Fluoride in drinking water is well recognized for its both beneficial and detrimental effects on human health. Excessive amounts of fluoride in drinking water have affected the well-being of thousands of people in the dry climate zone of Sri Lanka. Fluoride content in aqueous samples is frequently analyzed by fluoride ion selective electrode (ISE) method; however, the TISAB (Total Ionic Strength Adjusting Buffer) reagent used in the ISE method is expensive and costs around Rs. 25,000.00 per liter and therefore, ISE is not a cost effective method. The main objective of this project is to develop a cost effective TISAB solution that could produce comparable results to commercial off-the-shelf TISAB solutions.

At the initial stages, three TISAB solutions were developed and their performance was evaluated with respect to a WTW branded TISAB solution (TISAB-W). TISAB-1 is a 1.0 M NaCl solution, TISAB-2 is a 1.0 M NaCl solution buffered to pH=5.5 and TISAB-3 is 1.0 M NaCl solution containing of EDTA buffered to pH=5.5. Fifty six (56) natural water samples were analyzed for fluoride using a WTW fluoride electrode connected to a pH/ION 340 i meter and the above mentioned TISAB solutions. The data produced by TISAB-W was considered as the accurate fluoride concentration of the samples for statistical evaluation. All the experiments were duplicated. In addition, other physico-chemical parameters, including pH, conductivity, hardness and metal ion concentrations were also analyzed.

The fluoride concentration of the samples varied from 0.292 to 5.521 mgL⁻¹. Approximately 90% and 50% fluoride data produced by TISAB-1 and -2 solutions were significantly different from TISAB-W data and the results were unacceptable. Often, TISAB-1 and -2 solutions produced significantly lower fluoride concentrations than TISAB-W. On the other hand, approximately 75% of samples tested using TISAB-3 produced acceptable results. This observation suggests that that most of the fluorides ions present in the analyzed samples are complexed to metal ions and a strong metal ion chelating agent is required to decomplex them. In the second stage of the research, TISAB solutions containing strong metal chelating agents including CDTA, triethanolamine, and tartrate were produced. The initial results are encouraging and more data is required to evaluable their performance.

Keywords: Fluoride, ISE, TISAB