

7.1.6 GRAPHITE FURNACE BASED(GFAAS) METHOD IS MORE APPROPRIATE THAN HYDRATE GENERATOR BASED (HGAAS) METHOD IN USING ATOMIC ABSORPTION SPECTROMETRY TO DETECT ARSENIC IN HARDWATER COLLECTED FROM AQUIFERS ON CKDu ENDEMIC AREAS IN SRI LANKA

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Introduction: In water, arsenic is commonly found in inorganic species such as arsenite (AsO_3^-) and arsenate (AsO_4^{3-}), which mostly have harmful effects on life. According to previously published data on presence of trace metals in groundwater in CKDu- prevalent areas in Sri Lanka show that As-content measured in groundwater is lower than the maximum permissible level, i.e. 10 ppb. Apart from spotted and diffused pigmentation in palms/soles, relatively high levels of As was detected in urine and hair samples of CKDu patients. These unconvincing evidence on sparing presence of As in groundwater therefore demanded further investigations.

Objective: To investigate the presence of arsenic in groundwater using Atomic Absorption Spectrometry with Hydride Generator (HGAAS) and Graphite Furnace (GFAAS) in CKDu prevalent areas of Sri Lanka and it's potential link to the hardness of groundwater.

Study design, setting and methods: Water samples in triplicate were collected from CKDu endemic areas, both from ground and surface water sources as well as from non-CKDu areas, as the controls. A total of 88 water samples were collected from above areas. Hardness (Ca^{2+} and Mg^{2+}) of water were measured using EDTA titration (EPA 130.2) and arsenic contents in water samples were detected using GFAAS (EPA 7060A) and HGAAS (EPA 1632) separately. Relationship between As content measured using GFAAS and hardness of all 88 water samples was statistically analyzed using linear regression and criterion for significance was set at $p < 0.05$ and analyses were performed using Minitab 2.5.

Results: Total hardness ranged from 150 – 815 mg L^{-1} and the results indicated that even within a smaller area, groundwater hardness varies considerably. Comparison of mean As contents detected with GFAAS and HGAAS reveals that the As content measured using the two methods is significantly different ($P < 0.05$) from each other, confirming that the As content measured using GFAAS shows a statistically significant increase to that measured with HGAAS. For example As content of a hardwater (410 mg L^{-1}) sample when measured with GFAAS and HGAAS was $40.23 \pm 1.67 \mu\text{g L}^{-1}$ and $0.6 \pm 0.21 \mu\text{g L}^{-1}$ respectively. One of the reasons could be the hardwater in the CKDu-endemic areas that is rich in Ca^{2+} can form thermodynamically stable hydrates, $(\text{Ca}_3(\text{AsO}_4)_2 \cdot x\text{H}_2\text{O})$, $\text{Ca}_4(\text{OH})_2(\text{AsO}_4)_2 \cdot 4\text{H}_2\text{O}$, $\text{Ca}_5(\text{AsO}_4)_3 \cdot 4\text{H}_2\text{O}$ which are not readily ionized in aqueous solutions. The relationship between total hardness and their arsenic content of groundwater samples tested shows a statistically significant ($p < 0.05$) linear relationship

among the two variables.

Conclusion: Atomic Absorption Spectrophotometry with Graphite Furnace (GFAAS) was proved to be more appropriate in measuring arsenic in hardwater and the results generated with GFAAS revealed a positive relationship between arsenic content and groundwater hardness.