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Preliminary investigations on the groundwater hardness in Polpithigama and use of selected plants and plant parts for hardness reduction

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A frequent complaint of the inhabitants of Polpithigama Divisional Secretariat in the Kurunegala District is the increasing hardness in well water. A potential cause of increasing groundwater hardness may be the accumulating of ions (calcium, magnesium, carbonate, phosphate, nitrate etc) in water. A preliminary research was carried out to characterize ground water hardness using water samples from dug-wells used by the inhabitants of the area. Samples were taken in triplicate from the surface and bottom of the water column in the wells into polypropylene bottles (washed with 10% nitric acid). Calcium hardness, total hardness, concentrations of PO_4^{3-} , SO_4^{2-} , NO_3^- , CO_3^{2-} , Cl^- , turbidity and conductivity of water samples were measured. The Ca^{2+} and total hardness were measured using EDTA titrations. Concentrations of PO_4^{3-} , SO_4^{2-} and NO_3^- were measured using spectrophotometric methods. An acid titration was used to determine CO_3^{2-} concentration. Chloride ions were measured using Mohr method. The results revealed that hardness of water in six out of the ten wells was above 180 mg L^{-1} , which is considered as very high hardness and therefore, unsuitable for drinking. In 93% of the water samples (taken from surface and bottom layers of water in the wells) the phosphate concentration was higher than the permissible level (2 mg L^{-1}). Other ions however did not exceed the maximum permissible levels. In a few wells, hardness and concentrations of other ions in the bottom layer of water were significantly higher than in surface water.

Plants were hydroponically grown in hard water, and hard water with hydroponic solution. Plants were grown absorbing nutrient from the solution because the selected plants were aquatic. *Pistia stratiotes*, *Eichhornia crassipes* and *Lemna minor* were tested for their ability to remove / reduce hardness of water. After 12 days *Pistia stratiotes* could reduce 71%, *Lemna minor* L. 63% and *Eichhornia crassipes* 28% of the initial hardness of water. Suspensions of *Moringa oleifera* seeds of different concentrations (667 , 1143 , 1500 and 1778 mg L^{-1}) revealed that the maximum reduction was with 1778 mg L^{-1} . Among the plants tested in the present study, *Pistia stratiotes*, *Lemna minor* L and *Moringa oleifera* seed suspension were effective in reducing groundwater hardness while *Eichhornia crassipes* was capable of removing constituent ions in water, especially phosphates, sulfates and chlorides.

Keywords: Groundwater, hardness, hydroponic, Polpithigama, spectrophotometric