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Chemical Speciation Modeling of Drinking Water in Chronic Kidney Disease of Unknown Etiology (CKDu) Affected Areas

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Abstract

Chronic kidney disease of unknown Etiology (CKDu) has become a major health problem in many areas of Sri Lanka. Concentrations of Ca, Mg, Fe, Cd, Cr, Cu, Mn, Ni, Zn, Pb, Al and dissolved PO_4^{3-} , SO_4^{2-} , F^- were determined in drinking water in Ampara and Ruwanpura areas using Atomic Absorption Spectrophotometry. Ruwanpura is an affected area and Ampara is the reference. MINTEQ version 3.0 software was used for the determination of the species distribution of water in above affected two areas. Chemical speciation is critical for understanding chemical toxicity, bioavailability, and environmental fate. Chemical speciation of trace elements is in general highly dependent on temperature, pH, pE and concentration of major elements and mainly considered how chemical speciation change according to the temperature, pH and ionic strength. Temperature was varied from 25°C to 32°C and obtained the chemical species distribution of drinking water at Ampara and Ruwanpura. At Ampara mainly percentage of total concentration in different chemical speciation of most of the elements which determined not varied very much with each other. But the percentage of total concentration in chemical speciation of Cu^{2+} , Cu(OH)^+ , Pb^{2+} , Pb(OH)^+ and Al(OH)^{4-} were varied considerably. But in Ruwanpura only Pb(OH)^+ , PbSO_4 , AlF^{2+} and Al(OH)^{4-} were varied. When pH was varied from 5.0 to 8.0 in two areas, percentage of total concentration in different chemical speciation of Zn^{2+} , ZnOH^+ , Zn(OH)_2 , Pb^{2+} , Pb(OH)^+ , PbSO_4 , Al(OH)^{2+} , Al(OH)_3 , Al(OH)^{4-} and AlF^{2+} were varied considerably at Ampara and Ruwanpura. The variations of other elements with the pH is not considerable. Ionic strength was varied from 0.001 to 0.01 in two areas and the percentage of total concentration of Pb^{2+} , Pb(OH)^+ , PbSO_4 , Al(OH)_3 , Al(OH)^{4-} and Fe^{2+} , FeSO_4 were varied slightly.

Keywords: Chronic kidney disease, Chemical speciation, Ionic strength