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Concentration and chemical speciation in drinking water in an affected area of Chronic Kidney Disease of unknown etiology (CKDu) in Sri Lanka

Janitha A Liyanage and K A D H Perera
University of Kelaniya, Sri Lanka

In the last two decades, new form of Chronic Kidney Disease (CKD) that cannot be attributed to diabetes, hypertension, primary glomerular nephritis or other known etiologies has encountered in the predominantly agricultural areas in the northern central province of Sri Lanka. Concentrations of Ca^{2+}, Mg^{2+}, Fe^{2+}, Cd^{2+}, Cr^{3+}, Cu^{2+}, Mn^{2+}, Ni^{2+}, Zn^{2+}, Pb^{2+}, Al^{3+} and dissolved PO_4^{3-}, SO_4^{2-}, F^-, CO_3^{2-} were determined in drinking water in Ampara and Kabithigollawa area. Kabithigollawa is the affected area and Ampara is the reference. Apparently, complexation of cations with high affinity for (dissolved) PO_4^{3-} , SO_4^{2-} , F^- and CO_3^{2-} anions may lead to increase the risk of CKDu. This study shows that chemical speciation able to do both, decrease and increase the chemical toxicity, bioavailability and environmental fate of heavy metals present in drinking water. Visual MINTEQ version 3.0 software was used for the determination of the species distribution of water in above affected two areas. 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. The Ca^{2+}, Mg^{2+}, Ni^{2+}, Zn^{2+}, Pb^{2+}, Cd^{2+}, Cr^{3+} concentrations in drinking water in Kabithigollawa area were higher than the Ampara and the Mn^{2+}, Fe^{2+}, Al^{3+}, Cu^{2+} concentrations in water in Kabithigollawa area were lower than, those metal ion concentrations in drinking water in Ampara. Temperature was varied from 26 °C to 32 °C and obtained the chemical species distribution of drinking water at Ampara and Kabithigollawa. At Ampara percentage of total concentration in different chemical speciation of most of the elements which determined not varied very much with each other with the temperature change. But in Kabithigollawa $Pb(OH)^+$, Cu^{2+}, $CuOH^+$, $CuHCO^{3+}$ were varied. When pH was varied from 5.0 to 8.0 in two areas, percentage of total concentration in different chemical speciation such as Pb^{2+}, $Pb(OH)^+$, $PbCO^3$, Al^{3+} , $Al(OH)^{2+}$, $Al(OH)^{4-}$, Cu^{2+}, $Cu(OH)^+$, $CuCO^3$, $Cr(OH)^+$, $Cr(OH)^{2+}$ and $Cr(OH)^3$ were varied considerably at Ampara and Kabithigollawa. The variations of other elements with the pH are not considerable. Ionic strength was varied from 0.001 to 0.01 in two areas and the percentage of total concentration of Pb^{2+}, $Pb(OH)^+$, $Al(OH)^3$, $Al(OH)^{4-}$ and Fe^{2+} were varied slightly.

janitha@kln.ac.lk

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