LEVELS OF SELECTED TRACE ELEMENTS IN OLKARIA GEOTHERMAL FIELD AND THEIR HEALTH IMPLICATIONS FOR GRAZING WILD ANIMALS (Zebra *Equus burchelli* AND Buffalo *Syncerus caffer*) IN HELL'S GATE NATIONAL PARK, KENYA.

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Abstract

The study was aimed at investigating the concentrations of trace elements zinc (Zn), copper (Cu), cadmium (Cd), cobalt (Co), lead (Pb) and molybdenum (Mo) in water, soil and grass *Cynodon nlemfuensis* in Olkaria geothermal field and at the Amboseli reference site. The accumulation of these trace elements was also investigated at the tissue of zebra *Equus burchelli* and buffalo *Syncerus caffer* from the Olkaria area and in the Amboseli reference site. The Olkaria geothermal waters recorded the highest concentrations of trace elements, especially for Pb (21.0±11.0ppb and Mo (39.0±28.0ppb) compared to the reference area (5.0±2.0ppb and 3.0±1.0ppb), respectively. Calculated molar Cu:Mo ratio of geothermal water was below the 2-3 Cu deficiency indicator ratio.

The soils of the study area contained higher trace elements compared to the reference area. Notably, Zn and Pb soil maximum concentration values of 87.9ppm and 15.00ppm were above worldwide "normal" soil concentration values 1-50 ppm and 0.5-5.0 ppm, respectively. The dry season showed relatively high Pb concentrations, possibly due to evaporative concentrations. Concentrations of Pb, Cd, and Co in *Cynodon nlemfuensis* in Olkaria were above the "normal" plant concentration levels (0.1-2.0ppm Pb, 0.2-0.5ppm Cd and 0.1ppm Co).

Serum trace element concentrations were within "normal" serum/blood concentrations in healthy animals, except Co, which was low in serum obtained from zebra of the Olkaria zone. Bioconcentration factors indicated variability in animal species abilities to accumulate the trace elements in the organs. Generally the trace element concentrations had not accumulated to zootoxic levels. However, highest Cu concentrations (230 ppm) in the liver of buffalo *Syncerus caffer* and Cd concentrations (21.33ppm) in the kidney of zebra *Equus burchelli* both from Olkaria, were above those regarded as normal (55.7ppm Cu and 0.32-5.58ppm Cd) for healthy animals. This study established that geothermal waters, soils and grass studied, especially in terms of potentially toxic elements Pb and Cd, and deficiency related

elements Cu, Mo and Co are a potential health hazard to the grazing wild animals. Therefore it is suggested that the trace element levels in the habitat and in wild animals need to be monitored regularly in terms of animal and human health especially in the case of game meat consumption. There is also need for developing exposure model for predicting risk so as to warn in advance, in case geothermal activities surpassed the carrying capacity of the natural ecosystem, thereby threatening existence of biodiversity.