

Sequential Extraction as Novel Approach to Compare 12 Medicinal Plants From Kenya Regarding Their Potential to Release Chromium, Manganese, Copper, and Zinc

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Abstract

This study is focusing on a novel approach to screen a large number of medicinal plants from Kenya regarding their contents and availability of selected metals potentially relevant for treatment of diabetes patients. For this purpose, total levels of zinc, chromium, manganese, and copper were determined by flame atomic absorption spectrometry and inductively coupled plasma mass spectrometry as well as BCR sequential extraction to fractionate the elemental species in anti-diabetic medicinal plants collected from five natural locations in two sub counties in Nyamira County, Kenya. *Solanum mauense* had the highest zinc level of 123.0 ± 3.1 mg/kg while *Warburgia ugandensis* had the lowest level of 13.9 ± 0.4 mg/kg. The highest level of copper was in *Bidens pilosa* (29.0 ± 0.6 mg/kg) while the lowest was in *Aloe vera* (3.0 ± 0.1 mg/kg). *Croton macrostachyus* had the highest manganese level of 1630 ± 40 mg/kg while *Clerodendrum myricoides* had the lowest (80.2 ± 1.2 mg/kg). The highest level of chromium was in *Solanum mauense* (3.20 ± 0.06 mg/kg) while the lowest (0.04 ± 0.01 mg/kg) were in *Clerodendrum myricoides* and *Warburgia ugandensis* among the medicinal plants from Nyamira and Borabu, respectively. The levels of the elements were statistically different from that of other elements while the level of a given element was not statistically different in the medicinal plants from the different sub counties. Sequential extraction was performed to determine the solubility and thus estimate the bioavailability of the four investigated essential and potentially therapeutically relevant metals. The results showed that the easily bioavailable fraction (EBF) of chromium, manganese, zinc, and copper ranged from 6.7 to 13.8%, 4.1 to 10%, 2.4 to 10.2%, and 3.2 to 12.0% while the potentially bioavailable fraction (PBF) ranged from 50.1 to 67.6%, 32.2 to 48.7%, 23.0 to 41.1%, and 34.6 to 53.1%, respectively. *Bidens pilosa*, *Croton macrostachyus*, *Ulrica dioica*, and *Solanum mauense* medicinal plants used to treat diabetes by 80 % of the herbalists in Nyamira County were found to be rich in chromium, manganese, copper, and zinc. The EBF of zinc, manganese, and chromium constitutes adequate amounts recommended for daily intake not exceeding the ADI and delivered a low percentage of RDA when estimating daily intake during therapy from typically applied doses. The plants did not show any significant differences at $p < 0.05$ in terms of concentrations of the elements between the two study areas though the levels of the different elements were statistically significant. Another major observation was that high total levels of the metals in a given plant did not necessarily translate to high bioavailable levels, and hence the need to determine bioavailable form as it is the one accessible to the patient.

Keywords: Essential elements; Medicinal plants; Nyamira; Sequential extraction.