ANALYSIS OF MICRONUTRIENTS AND HEAVY METALS OF INDIGENOUS REED SALTS AND SOILS FROM SELECTED AREAS IN WESTERN KENYA

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A Research Thesis Submitted to the Graduate School in Partial Fulfilment of the Requirement for the Award of Doctor of Philosophy Degree in Chemistry of Egerton University

EGERTON UNIVERSITY

NOVEMBER, 2016
DECLARATION AND RECOMMENDATION

DECLARATION

This is my original work and has not been submitted in part or whole for an award in any other institution.

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RECOMMENDATION

This thesis has been submitted for examination with our approval as University supervisors.

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DEDICATION

This work is dedicated to my husband Peter, my children Brian, Teddy and Marvelynne; my parents Patrick and Joyce Fedha and Susan Nyongesa and my sisters and brothers.
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I give thanks to God for giving me grace to accomplish this task. Accordingly, the culmination of a journey that started with a single step and gradually developed into one mighty task is complete with the support of people so dear to me. My joy and sense of fulfillment would not be complete without making mention of everyone who offered help and support, in one way or another, during the entire period of this PhD study. The brevity of this acknowledgement does not in any way downplay the support I have received from anyone mentioned, or not mentioned, herein.

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ABSTRACT

Most communities in Western Kenya use plant indigenous salts for cooking, medicinal and numerous uses. *Typha latifolia* and *Cyperus rotundus* reeds are widely used in Busia and Lugari regions of Western Kenya to prepare indigenous salts. The suitability of these salts and validation of micronutrients and heavy metals is unknown. The objective of this study was to assess the suitability of the indigenous reed salt used in selected parts of Western Kenya. Micronutrients and heavy metal concentrations in soil habitats, *C. rotundus* and *T. latifolia* and reed salts were determined; In addition, the effect of the various methods of processing, storage conditions and the stability of iron and iodine nutrients has been investigated. Iodometric titration (Iodine), 1, 10-phenanthroline method (Iron II), flame photometric method (Na and K) and Atomic absorption spectrophotometric method (Pb, Cd, Fe, Cr) were used for analysis. Results showed that 85% of Lugari and Busia inhabitants in Western Kenya use *C. rotundus* and *T. latifolia* reed salts. Heavy metal in the soil was of the order Fe> Cr >Pb > Cd for the dry season and Cr > Fe > Cd > Pb for the wet season both in top and sub-surface soils with higher levels in the dry season. Salt iodine was of the order Kensalt >Top-chef salt > Herbal sea salt > Sea salt > *C. rotundus* salt > *T. latifolia* and Herbal sea salt >*C. rotundus* salt = *T. latifolia* salt > Sea salt > Kensalt = Top-chef salt for Fe$^{2+}$. *C. rotundus* and *T. latifolia* reed salts had higher iodine (1.1 mg/kg) than the WHO limit of 0.015 - 1.1 mg/kg, while the concentration of Fe$^{2+}$ (0.9 mg/kg and 1.0 mg/kg) was below the recommended limit of 8 - 45 mg/kg. The Na: K ratio of *T. latifolia* salt (3.2:1) was within the recommended limit of 2.5:1 - 4:1 while that of *C. rotundus* salt (0.9:1) is lower. Fe, Pb and Cd levels in both *C. rotundus* reed and *T. latifolia* reed salts exceeded the WHO/FAO permissable. Effectively all iodine and Fe$^{2+}$ present in the reed salts was lost within six months of storage under normal conditions of temperature and RH with more losses at elevated temperature and relative humidity. *T. latifolia* salt prepared using complete evaporation method and stored in LDPE container for a period not more than three months is suitable for use as table salt. *C. rotundus* prepared by complete evaporation method is ideal for use as a low-sodium salt.
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