Journal of Current Chemical & Pharmaceutical Sciences

J. Curr. Chem. Pharm. Sc.: 2(1), 2012, 17-23
ISSN 2277-2871

QUALITATIVE AND QUANTITATIVE ASSESSMENT OF MINERAL ELEMENTS IN THE LEAVES OF *CORCHORUS FASCICULARIS* AND *CORCHORUS OLITORIUS* HARVESTED IN CAMEROON

ROBERT M. NEMBA*, ALPHONSE EMADAK, GILBERT C. MOUZONG and CHRISTIANE E. NEMBA

Faculty of Sciences, Laboratory of Physical and Theoretical Chemistry, Section of Molecular Topology and Radiochemistry, University of Yaounde I, P.O. Box 812, YAOUNDE, CAMEROON

(*Received : 27.11.2011; Revised : 09.12.2011; Accepted : 11.12.2011*)

ABSTRACT

Corchorus Olitorius and *Corchorus Fascicularis* are two species of *Tiliaceae* plants encountered in the humid forest zones of the sub-Saharan Africa. Both species exist in Cameroon and are cultivated as legumes and exploited by the local populations for food and medical issues. The present survey, achieved in two main sites of production called Ezazou and Nkolbisson in the suburban area of Yaoundé capital city of Cameroon, consists in valuing the mineral content of the leaves of these plants in one hand and to discuss the differences of concentrations within species on the other hand. The analyses performed by Energy Dispersive X-Ray Fluorescence (EDXRF) reveal in both species a similar uptake of the following mineral elements: K, Ca, P, Mg, Cl, Na, Al, Fe, Mn, Sr, Ni, Cu, Br, Cd, Pb, Se, Th, Hg, Cr and V. These elements are partitioned in three groups. The first group includes K, Ca, P, Mg and Cl, which totalize a global concentration of more than 98% of the total concentration of the elements previously enumerated. The second group totalizes less than 1.8% of the total mineral uptake and consists of Na, Al, Fe, Mn, Sr, Rb, Ni, Cu, Ba and Br. The third group of mineral constituents includes Cd, Pb, Se, Th, Hg, Cr and V, which totalize less than 0.2% of the total mineral uptake. It is to be noticed that in both sites, Na is three times more concentrated in the samples of *Corchorus Fascicularis* in relation to those of *Corchorus Olitorius* while K, Ca, P, Mg and Cl are invariably the major mineral constituents of these two plant species.

Key words: Edible leaves, Tiliaceae, *Corchorus Olitorius, Corchorus Fascicularis* X-ray Fluorescence, Mineral elements.

INTRODUCTION

The Genus Corchorus which belongs to the family of tiliaceae plants, comprises 60 species disseminated in the world and about 30 have been enumerated in Africa[1]. In this family of plants *Corchorus Olitorius* and *Corchorus Fascicularis* are two main species traditionally cultivated in the tropical humid forest zone of Cameroon[2,3]. Their edible leaves play an economical role in the strategy of food security of urban populations[4,5]. Different parts of *Corchorus Olitorius* and *Corchorus Fascicularis* are also used in folk medicine notably the seeds as laxative, the leaves to relieve stomach pains, the roots for treating toothache and the stems for treating cardiovascular disorder[6].

The emphasis of the present survey, conducted in two main production sites called Esazou and Nkolbisson respectively located in the south and the north east of the suburban zone of Yaoundé, capital city of Cameroon with two millions city dwellers, is to carry out a qualitative and quantitative assessment of the

Available online at www.sadgurupublications.com
*Author for correspondence; E-mail: nembarobertmartin@yahoo.com

minerals contained in the leaves of *Corchorus Olitorius* and *Corchorus Fascicularis* and to discuss the main differences observed. Information on the mineral content, in food products consumed by the population is needed to make nutrition programs, or to establish databases relative to quality control of the mineral composition of these leafy vegetables.

Material and methods

Study area

Two agricultural areas where farming communities produce edible leaves of *Corchorus olitorius* and *Corchorus fascicularis* are located in the suburban zone of Yaoundé, capital city of Cameroon which has about two millions town dwellers. The first one is Nkolbisson in the western region of Yaoundé in latitude 3°86′ north and longitude 11°45′ east. The second is Ezazou in the south-east of the same city in latitude 3°82′ north and longitude 11°53′ East. The region of Yaoundé is tropical in nature with two climatic seasons viz: wet season which begins in March/April and ends in October with a break in August, and the dry season which begins in November and ends in March. The soil of Yaoundé is generally lateritic with some clay intercalation, while its geology is essentially crystalline basement complex with dominant rock suites being granite gneisses charnokites[7].

Samples preparation

During the crop season of April-July 2010, we have collected from Nkolbisson agricultural farms and kept in polyethylene bags 6 leaves samples for *Corchorus Olitorius and* 6 other leaves samples for *Corchorus Fascicularis.* Then in Ezazou farms we have collected the same number of samples for each *Corchorus* species. At the end of this stage we have 12 samples for each plant species for a total of 24 samples. Afterwards 100 g of ripe and fresh leaves were removed from each sample, washed, rinsed, cut and dried at 105^{o}C for 24 hours[8]. These grass materials were cooled, ground and sieved using a mesh of 2 mm to obtain a fine powder. The pellets were then prepared with Hoechst wax as binder material. The mixture consisted of 90 weight % of grass powder and 10 weight % of wax. Two grams of each mixture were pressed by a hydraulic press from 0 to 20 tonnes in order to obtain pellets of 32 mm diameter[9].

EDXRF Analysis

Energy Dispersive X-Ray Fluorescence analyses of the pellets were performed using an ARL Quant'X spectrometer. This system comprises three main units: the sample chamber, the X-ray excitation and X-ray detection sub systems. The Quant' X system includes the following functional components: An aluminium or a cellulose X-ray filter, a Rh-anode X-ray tube with an operational range between 8 and 12 KV and a current intensity between 0.32-0.34 mA. Emergent X-rays are detected by a Si (Li) detector cooled with nitrogen. Accurate energy and efficiency calibrations of the spectrometer were made using a standard source supplied by the International Energy Agency (IAEA), Vienna, Austria. The descriptions of the energy dispersive spectrometry system as well as more details on the calibration are well documented[10-13]. The spectrum acquisition time was 120 s for each sample and the dead time was around 50%. The treatments of the data were performed by the WINTRACE software version 4.1 build 9. Three replicate were made for each sample measurement.

RESULTS AND DISCUSSION

Minerals contained in leaves

The EDXRF analyses reveal that the leaves of *Corchorus fascicularis* and *Corchorus olitorius* harvested at Ezazou and Nkolbisson contain the same mineral constituents which are: K, Ca, P, Mg, Cl, Na, Al, Fe, Mn, Sr, Ni, Cu, Br, Cd, Pb, Se, Th, Hg, Cr and V, respectively. The mean concentrations of these elements for the dry leaves samples are reported in Table 1 with the standard deviations of the measurements. One may easily deduce from the numerical values given in Table 1 that the mineral uptake of these two plant species comprises three groups. The major mineral constituents which exist at higher concentration ranging between 47243 to 1473 ppm are the first five elements previously enumerated.

Table 1: Average mean concentrations (in ppm) of the mineral elements in dry leaves of *Corchorus fascicularis* and *Corchorus olitorius* harvested in Ezazou and Nkolbisson.

Mineral elements	Mean ± standard deviation in *Corchorus fascicularis* (Ezazou)	Mean ± standard deviation in *Corchorus olitorius* (Ezazou)	Mean ± standard deviation in *Corchorus fascicularis* (Nkolbisson)	Mean ± standard deviation in *Corchorus olitorius* (Nkolbisson)
K	47243 ± 10000	45493 ± 800	40889 ± 20000	42897 ± 4000
Ca	12438 ± 2000	12120 ± 600	11381 ± 1000	13874 ± 600
P	6268 ± 700	6690 ± 200	6376 ± 700	7800 ± 2000
Mg	2691 ± 2000	3338 ± 400	4130 ± 700	2941 ± 300
Cl	3186 ± 800	3748 ± 2000	1473 ± 90	1962 ± 200
Na	567 ± 300	163 ± 300	874 ± 300	211 ± 200
Al	259 ± 60	241 ± 90	308 ± 100	315 ± 80
Fe	102 ± 7	135 ± 9	145 ± 30	118 ± 30
Mn	62 ± 40	65 ± 3	101 ± 40	120 ± 60
Rb	9 ± 20	2.48 ± 0.07	2.0 ± 0.3	2.6 ± 0.5
Sr	20.0 ± 0.8	20.3 ± 0.8	16.4 ± 0.3	20 ± 2
Ni	13 ± 6	42 ± 5	48 ± 30	18 ± 20
Cu	13 ± 4	14 ± 3	13 ± 2	11 ± 2
Ba	5 ± 2	3.7 ± 0.8	5 ± 2	3 ± 3
Br	6.7 ± 0.3	7 ± 2	3 ± 3	6 ± 4
Cd	0.2 ± 0.2	0 ± 0	0 ± 0	0.1 ± 0.1
Pb	0.4 ± 0.2	0.2 ± 0.2	0.6 ± 0.5	0.4 ± 0.3
Se	0.37 ± 0.09	0.29 ± 0.08	0.4 ± 0.2	0.24 ± 0.06
Th	0.20 ± 0.08	0.16 ± 0.03	0.21 ± 0.04	0.24 ± 0.02
Hg	0.07 ± 0.04	0.11 ± 0.03	0.14 ± 0.05	0.15 ± 0.07
Cr	0.3 ± 0.3	2.7 ± 0.5	3 ± 2	0.8 ± 0.4
V	0.2 ± 0.2	0.2 ± 0.2	0.1 ± 0.2	0.3 ± 0.2

They totalize more than 98% of the total mineral uptake of the leaves. The second group totalizes less than 1.8% of the global mineral uptake and consists of Na, Al, Fe, Mn, Sr, Rb, Ni, Cu, Ba and Br, which have been detected with concentrations ranging between 874 to 3 ppm. The third group totalizes about 0.2 % of the global mineral uptake and includes Cd, Pb, Se, Th, Hg, Cr and V which have been detected at extremely low concentrations ranging from 0.8 to 0.07 ppm. It is to be noticed that Cr is not detected in *Corchorus Olitorius* and *Corchorus fascicularis* harvested in Ezazou and Nkolbisson respectively. The diagrams in Fig. 1 and 2 depict and compare the mean concentrations of each mineral elements present in dry leaves of *Corchorus fascicularis* and *Corchorus olitorius* harvested in the same site. Fig. 3 and 4 depict and compare the concentrations of each mineral element in the dry leaves of the same plant specie harvested in two different sites. *Corchorus fascicularis* harvested in Ezazou contains more potassium and calcium than the one harvested in Nkolbisson. On the other hand, *Corchorus olitorius* harvested in Nkolbisson absorbs more calcium and phosphorus than the one harvested in Ezazou. The very low concentrations reported in table 1 for Pb (0.4 ± 0.2; 0.2 ± 0.2; 0.6 ± 0.5; 0.4 ± 0.3), Cd (0.2 ± 0.2; 0.1 ± 0.1) of Hg (0.07 ± 0.04; 0.11 ± 0.03; 0.14 ± 0.05; 0.15 ± 0.07), Cu (13.0, 14.0, 11.0) and Cr (0.3, 2.7, 3.0, 0.8) ppm detected in *Corchorus olitorius*) and *Corchorus fascicularis* are negligible in comparison with permissible concentration limits (ppm) for (Pb : 2.5); (Cd : 1.5); (Hg : 1.0); (Cu : 30.0); (Cr : 20.0) given by Indian Standard[14] and safe concentration limits (Cd : 0.2), (Cu : 40.0), (Pb : 5.0) given by FAO/WHO[15]. In Fig. 1-4, the boxed graphics shows in different scales the concentrations (< 1000 ppm) of mineral elements of groups II and III aforementioned.

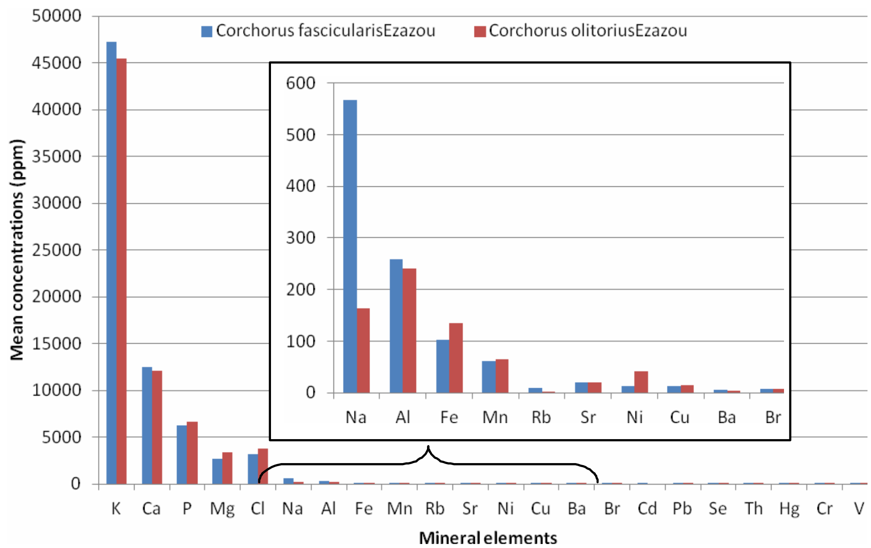

Fig. 1: Mean concentrations of mineral elements in dry leaves of *Corchorus fascicularis* versus *Corchorus olitorius* harvested in Ezazou.

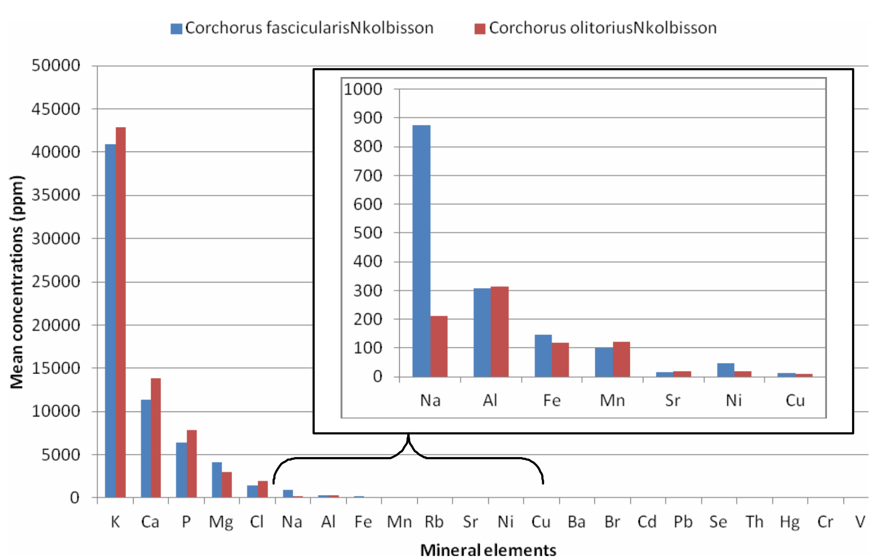

Fig. 2: Mean concentrations of mineral elements in dry leaves of Corchorus fascicularis *Corchorus fascicularis* versus *Corchorus olitorius* harvested in Nkolbisson.

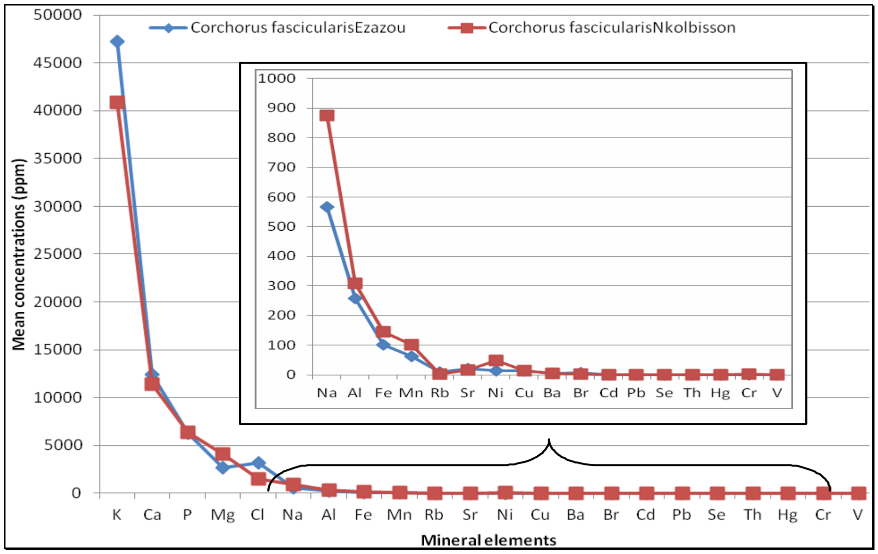

Fig. 3: Comparative profile of mean concentrations of mineral elements detected in dry leaves of *Corchorus fascicularis* harvested in Ezazou and Nkolbisson.

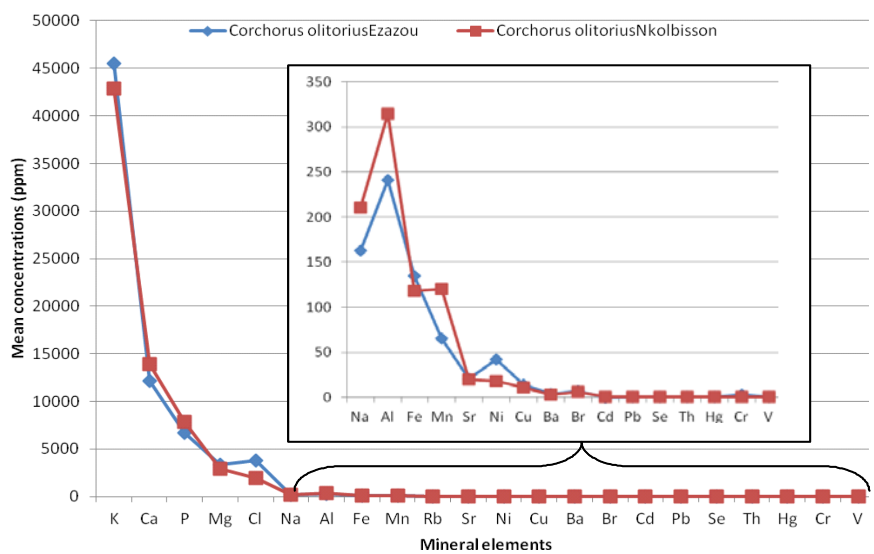

Fig. 4: Comparative profile of mean concentrations of mineral elements obtained from samples of dry leaves of *Corchorus olitorius* harvested in Ezazou and Nkolbisson.

CONCLUSION

The aim of this study was to assess qualitatively and quantitatively mineral elements present in edible leaves of *Corchorus oliterius* and *Corchorus fascicularis*. The results obtain in this study give evidence that these two plant species have a common trend to uptake similar types of mineral elements. The slight discrepancies observed between concentrations of mineral constituents in the leaves of *Corchorus oliterius* and *Corchorus fascicularis* harvested in the same sites or in two different sites are probably due to interdependent factors such that the species, the type and mineral concentration of soil, the stage and plant maturity, the climatic or seasonal conditions, etc.[16] Three groups of mineral nutrients classified according to their concentration range were found. The first group of concentrations ranging from 4.8 x 10^4 to 10^3 ppm includes K, Ca, P, Mg and Cl which totalize a global concentration of more than 98% of the total concentration of the elements previously enumerated. The second group of concentrations ranging from 10^3

to 1 ppm totalizes less than 1.8% of the total mineral uptake and consists of Na, Al, Fe, Mn, Sr, Rb, Ni, Cu, Ba and Br. The third group of concentrations less than 1 ppm includes Cd, Pb, Se, Th, Hg, Cr and V, which totalize less than 0.2% of the total concentration of mineral elements. It is well known from the chemical literature that some mineral elements found naturally in soils are essential for the growth and nutrition of the plants. Meanwhile, trace mineral elements play a key role in some biological metabolisms and their deficiencies or excesses in the human body can result in some physiological disorders[17,18]. The edible leaves of *Corchorus Olitorius* and *Corchorus fascicularis* contain some trace minerals useful to alleviate mineral deficiencies of the human body. For instance, potassium (K) is known to be necessary for muscular and nerve functions. Calcium and phosphorus are components of bones and teeth. Manganese is a cofactor of some enzymes and acts in the synthesis of glycoproteins. Iron is mainly involved as a component of haemoglobin, the molecule that carries oxygen in red blood cells. It also occurs in myoglobin (oxygen carrier in muscle cells). On the other hand, these two plants species manifest a propensity to uptake at extremely low concentrations some toxic metals like Cu, Ni, Cd, Pb and Hg. This observance needs further investigations notably the detection of potential contamination in leafy vegetables collected in suburban agricultural farms.

ACKNOWLEDGEMENT

The authors wish to express their sincere gratitude to the International Atomic Energy Agency (IAEA) for granting Cameroon, through its Technical Cooperation Project.

REFERENCES

1. H. D. Tindall, Vegetables in the Tropics, Macmillan, U.K. (1983) p.553.
2. L. A. Denton, Review of Corchorus Olitorius in Nigeria, in R. Schippers and L. Budd, Workshop on African Indigenous Vegetables, Rome, Italy (1997) pp. 25-30.
3. C. W. Van Epenhuijsen, La Culture Des Légumes Indigènes au Nigeria, F.A.O., Rome Italy (1978) p. 108.
4. R. Schippers, Légumes Africains indigènes, Présentation Des Espèces Cultivées, Margraf Publishers, CTA, (2004) pp. 410-429.
5. J. Gockowski and M. Ndoumbe, The Transformations of Leafy Vegetables Cropping Systems Along the Humid Forest Margins of Cameroon, Workshop on African Indigenous Vegetable, R. Schippers and L. Budd, Rome, Italy (1997) pp. 46-51.
6. S. Mbayem, Nobak, S. Sarr and Kanea, J. M. Sambou and B. A. Tidiane , Eléments De precision Sur la Systématique D'espèces Advenntices Du genre Corchorus au Sénégal, African J. Sci. Technol. (AJST), **2** (2001) pp. 51-64.
7. T. B. Makon, R. M. Nemba and P. Tchokossa, Investigation of Gamma-Emitting Natural Radioactive Contents in Three Types of Vernonia Consumed in Cameroon, World J. Nuclear Sci. Technol., **1** (2011) pp. 37-45.
8. J. F. Sabouang, R. M. Nemba, Assessment of Mineral Oligo-Elements in the Leaves of Gnetum Africanum and Gnetum Buchholzianum Harvested in the Forests of South Cameroon, Physical and Chemical News, **(50)** (2009) pp. 94-97.
9. V. E. Buhrke, R. Jenkins and D. K. Smith, A Practical Guide for the Preparation of Specimens for XRF and XRD Analysis, Wiley, New York (1998).
10. B. K. Agarwal, X-ray Spectroscopy, 2nd Ed., Springer-Verlag, Berlin (1991).

11. R. E. Van Grieken, A. A. Markowicz, Handbook of X-Ray Spectrometry 2nd Ed., Marcel Dekker Inc., New York, **29** (2002).
12. B. Beckhoff, B. Kanngießer, N. Langhoff and R. Wedell, H. Wolff, Handbook of Practical X-Ray Fluorescence Analysis, Springer (2006).
13. J. C. Russ, Fundamentals of Energy Dispersive X-ray Analysis, Butterworths, London, (19 dans le Transfert Du Cadmium à la Luzerne 84).
14. A.Singh, R. K. Sharma, M. Agrawal and F. M. Marshall, Risk Assessment of Heavy Metals Toxicity Through Contaminated Vegetables from Waste Water Irrigated Area of Varanasi, India, Tropical Ecology, **51** (2010) pp. 375-387.
15. WHO/FAO, Joint FAO/WHO Food Standard Programme Codex Alimentarius Commission, 13th Session (2007).
16. L. L. Berger, Factors Affecting the Trace Mineral Composition of Feedstuffs, Salt and Trace Minerals, Salt Institute, **26**, 2 (1995).
17. Harper, Précis de Biochimie, DE Boeck Université, Presses de l'Université Laval (1995) pp. 691-694.
18. G. I. Venkatesh, P. N. Padmanabhan, The Science of Total Environment, **249** (2000) pp. 331-346.