



## Heavy Metals Contamination in Some Medicinal Plants from Onigambari Forest Reserve

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### Abstract

Heavy metal toxicity related to the use of traditional medicines has been reported worldwide. Heavy metals may be introduced into medicinal plant products through various anthropogenic process such as mining, contaminated agricultural resources etc. Poisoning from heavy metal contamination of medicinal plant products has caused countless health challenges including liver and kidney failure and even death. Hence, monitoring the content of mineral elements in medicinal plants and their extracts is of particular importance. This study investigated the heavy metal contents of six medicinal plants obtained from Onigambari Forest Reserve Oyo State. Using an atomic absorption spectrophotometer, the heavy metals Lead (Pb), Zinc (Zn), Cadmium (Cd), Copper (Cu), Mercury (Hg), Chromium (Cr) and Magnesium (Mg) were assessed. Lead, Cd, Hg and Cr were absent in the medicinal plants analyzed in this study. The concentrations of Zn ranged from 0.20ppm in *Khaya grandifoliola* to 0.40ppm in *Khaya ivorensis* and 0.30 *Magnifera indica*. Copper concentration ranged from 0.015 ppm in *Khaya grandifoliola* to 0.23 ppm in *Garcinia kola*; while that of Mg was 0.55 ppm in *Kigelia africana*. The heavy metal content of most of the Medicinal plants were below WHO/FAO permissible limits.

**Keywords:** Heavy Metals, Medicinal Plants, Herbal Medicine, Metallophytes

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### INTRODUCTION

Herbal medicines have multiple physiological activities and could be used to treat varieties of diseases (Pieme *et al*, 2006). They could be administered in most disease states over a long period without proper dosage, monitoring and toxic effects consideration (Ogbonnia *et al*, 2010). Medicinal plants (used in manufacturing herbal medicines) become contaminated with toxic metals during growth, development and processing (Ali *et al*, 2012). Most medicinal plants used in herbal medicines are not well researched and their formulations and sales need to be monitored (Oshikoya *et al*, 2008).

The use of herbal medicines is increasing recently in south west Nigeria, due to their low prices in the market. Heavy metals mostly occur as cations which interact with the soil matrix and can become mobile due to changing environmental conditions (Qishlaqi and Farid Moore, 2007). Due to the high prevalence of heavy metals in the environment, their residues also reach high levels and are assimilated into medicinal plants (Sarma *et al*, 2012). There is now extensive interest in heavy metal transport by metal-tolerant plants (metallophytes) because of the repercussions for phytoremediation (Sharma, 2011). A copious

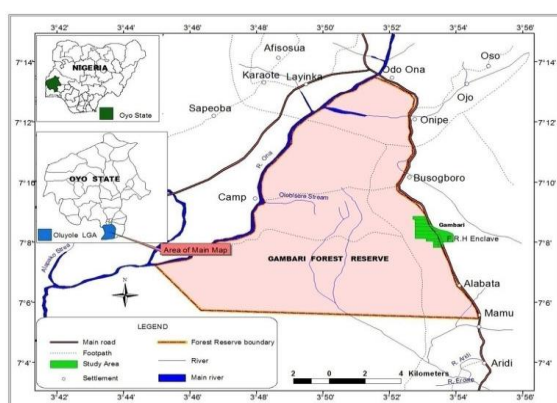
number of plants have been explored for phytoremediation e.g *Chromolaena odorata*, *Solanum nigrum* etc (Sharma, 2011). However the accumulation of heavy metals in edible and medicinal plants need thorough investigation to prevent elevated concentrations from reaching the consumer (Sharma *et al*, 2006). Elevated levels of heavy metals in plants are reported in areas having; long-term use of treated/ untreated wastewater (Sinha *et al*, 2005., Sharma *et al*, 2006), plants growing along heavy traffic ways (Liu *et al*, 2007) and dumpsites (Nwachukwu *et al*, 2010). Other anthropogenic sources of heavy metals include quarry activities, manures, fertilizers and pesticides (Hina *et al*, 2011). Usually, uptake of heavy metals is mostly affected by changing the physico-chemical properties of the soil. The addition of chemicals such as fertilizers change the structure of the heavy metals and hence immobilize them. These may be deposited on soil and are absorbed by plants and/or deposited on leaves, barks and fruits.

### MATERIALS AND METHODS

#### Study Area

The study was conducted in Onigambari forest reserve along old Lagos – Ibadan Express way in

Oyo State. Onigambari forest reserve is located in Oluyole local government of Oyo State. Oluyole Local Government was established in 1976 and the Council occupies about 629 square kilometers. Based on 2006 population Census, its population is 202,725. The Agricultural products in the area include, cocoa, citrus, cassava, maize etc. The area is located between Latitude 7.2333° - 7° 14' north and Longitude 3.8667° - 3° 52' east. Maize, Cocoa-yam, plantain and cassava are the major food crops planted in the area. Major livestock reared in the zone are cattle, sheep and goats. The rainfall starts from May to July with a short dry spell in August and relative humidity of about 60 to 80%, which fluctuates during January and February.



**Figure 1: Map of Onigambari Forest**

## Reserve

### Sample collection

Six medicinal plant samples were collected from the Onigambari forest reserve in Ibadan. Samples were taken to the Nigeria Institute of Science Laboratory Technology Ibadan for heavy metal analyses.

### Heavy metal analyses

Nitric acid (Laboratory grade reidel – de Haen) 65% was used for digestion of samples. Methods described by Henok and Ariaya (2013) and Idu *et al.*, (2014) were used in this study. Plant sample (0.2 g) was ashed at 550°C overnight in a muffle furnace. Ashed samples were then transferred quantitatively to 100 ml glass (Pyrex) beaker. Crucibles used for ashing were washed with 25 ml of 20% Nitric acid (HNO<sub>3</sub>) solution as part of qualitative transferring. The washouts were added to the ashed samples in a beaker and then warmed in fume hood to boiling point. The volumetric flask solution was made to the mark with distilled water (AOAC, 1990). Samples were run on Atomic Absorption Spectrophotometer to obtain the absorbance values.

## Statistical Analysis

The results are presented as Mean ± SEM (standard error of mean) and n represents the number of replicates used in each experiment. Data were analyzed with one-way ANOVA and multiple comparisons using Graph pad computer software version 6.0.

## Results

Six medicinal plants were obtained from Onigambari forest reserve were analysed (Table 1). Heavy metals such as lead (Pb), zinc (Zn), cadmium (Cd), copper (Cu), Mercury (Hg), chromium (Cr) and magnesium (Mg) assessed (Table 2). However, Pb, Cd, Hg and Cr were absent in the plants analyzed while concentrations of Zn ranged from 0.20 ppm in *Khaya grandifoliola* to 0.40 ppm in *Khaya ivorensis* and 0.30 ppm in *Mangifera indica*. Copper concentration ranged from 0.015 in *Khaya grandifoliola* to 0.23 ppm in *Garcinia kola*; while Mg was 0.55 ppm in *Kigelia africana*.

**Table 1: Medicinal plants obtained from Onigambari forest reserve**

| S/N           | Medicinal Plant samples                  |
|---------------|------------------------------------------|
| Disease cured |                                          |
| 1.            | <i>Zingiber officinale</i>               |
|               | Malaria, typhoid.                        |
| 2.            | <i>Khaya ivorensis</i>                   |
|               | Energy booster                           |
| 3.            | <i>Garcinia kola</i>                     |
|               | Malaria, typhoid.                        |
| 4.            | <i>Mangifera indica</i>                  |
|               | Malaria                                  |
| 5.            | <i>Khaya grandifoliola</i>               |
|               | Pile, dysentery, constipation, diarrhea. |
| 6.            | <i>Kigelia africana</i>                  |
|               | Purifies the blood, Prevents oedema.     |

**Table 2: Heavy metal evaluation in medicinal plants**

| Medicinal plants           | Pb (ppm) | Zn (ppm)  | Cd (ppm) |
|----------------------------|----------|-----------|----------|
| Cu (ppm)                   | Hg (ppm) | Cr (ppm)  | Mg (ppm) |
| <i>Zingiber officinale</i> | ND       | 0.28±0.06 | ND       |
| 0.22±0.20                  | ND       | ND        | ND       |
| <i>Khaya ivorensis</i>     | ND       | 0.40±0.05 | ND       |
| 0.20±0.04                  | ND       | ND        | ND       |
| <i>Garcinia kola</i>       | ND       | 0.31±0.05 | ND       |
| 0.23±0.02                  | ND       | ND        | ND       |

|                            |    |           |    |
|----------------------------|----|-----------|----|
| <i>Mangifera indica</i>    | ND | 0.30±0.03 | ND |
| 0.20±0.01                  | ND | ND        |    |
| <i>Khaya grandifoliola</i> | ND | 0.20±0.06 | ND |
| 0.15±0.03                  | ND | ND        |    |
| <i>Kigelia africana</i>    | ND | 0.35±0.05 | ND |
| ND                         | ND | 0.55±0.10 |    |

**Key: Values are Mean±SEM; n=3, ND= Not Determined.**

## DISCUSSION

Environmental pollution with chemicals and heavy metals due to industrial and motorized activities along with extensive use of pesticides and fertilizers have become a major concern. These pollutants and heavy metal deposits get into the human food chain through plant parts. Continuous release of fertilizers, sewage sludge and fuel combustion are the major reasons for the increase in Pb pollution in the environment. The permissible limit of lead (Pb) is 10 ppm (WHO, 2007). However, lead which causes renal failure and liver damage in humans, was not detected in the plant samples. Cadmium (Cd) is another hazardous heavy metal which can reduce plant yield at concentrations ranging from 5–30 mg/kg. Cadmium is gaining more attention due to its occurrence in water, soil, herbal products and medicinal plants. Phosphate fertilizers, zinc mines and combustion of fossil fuels are some of the sources leading to accumulation of cadmium in soil and plants. However, the samples analyzed in this study had no Cadmium, whose permissible limit 0.03 ppm (WHO, 2007). Zinc (Zn) is a major component of proteins in plants. Zinc content ranged from 0.20 ppm in *Khaya grandifoliola* to 0.40 ppm in *Khaya ivorensis*. These values are low compared to the dietary limit of Zinc (100ppm). This result is in agreement with the research findings of Idu *et al.* (2014). Zinc provides protection against both cadmium and lead, and a deficiency of Zn is associated with loss of taste, hypogonadism, retarded growth, and fertility problems.

Concentration of copper ranges from 0.015 ppm in *Khaya grandifoliola* to 0.23 ppm in *Garcinia kola*. These concentrations are below the permissible limit of 2 ppm (WHO, 2007). Copper is an essential part of several enzymes and it is necessary for the synthesis of hemoglobin, deficiency can lead to anemia and hypo-proteinemia. Magnesium (Mg) detected was 0.55 ppm in *Kigelia Africana*, which was lower than

the WHO permissible limit for Mg (10 ppm) (WHO, 2007). Magnesium deficiency is associated with leaching and low concentration of magnesium results in loss of chlorophyll in old leaves of plants. Chlorosis, or yellowing between leaf veins is the major symptoms of magnesium deficiency. The work of Gajalakshmi *et al.* (2012) revealed a high deposition of heavy metals in vegetables in the Southern part of Nigeria. They reported the following concentrations (mg/kg) of metals: Cr (1.50-10.25), Mn (9.75-62.75), Ni (15.75-19.25), Co (1.75-3.00), Cu (7.75-11.00), Cd (1.25-1.50), Zn (79.75-186.95) and Pb (6.25-8.00).

## CONCLUSION/RECOMMENDATION

Poisoning due to heavy metal contamination poses a threat to the public that consume medicinal plants for the treatment of disease conditions. Hence, adequate screening and monitoring of heavy metal contents in herbal remedies before consumption is recommended. Also, pharmacovigilance of medicinal plants is required to ensure permissible limits of heavy metals in herbal remedies. The absence of Pb, Cr and Cd in the medicinal plants analyzed in this study indicate that the plants from the area are safe for consumption.

## References

- Ali A, Akhtar N, Khan B.A, Khan M.S, Rasul A, Zaman S.U, Khalid N, Waseem K, Mahmood T, Ali L. (2012). *Acacia nilotica*: a plant of multipurpose medicinal uses. *J. Med Plant Res*; 6:149296.
- Gajalakshmi S, Iswarya V, Ashwini R, Divya G, Mythili S, Sathivelu A. (2012). Evaluation of heavy metals in medicinal plants growing in Vellore District. *Eur J Exp Biol*; 5:1457–1461.
- Henok B, Ariaya H. (2013). Levels of heavy metals in common medicinal plants collected from environmentally different sites. *Middle-East J Sci Res*; 13(7): 938-943.
- Hina B, Rizwani G.H, Naseem S. (2011). Determination of toxic metals in some herbal drugs through atomic absorption spectroscopy. *Pak J Pharm Sci*; 24: 353–358.
- Idu M, Erhabor J, Timothy O, Ovuakporie-Uvo O. (2014). Market survey and

- heavy metal screening of selected medicinal plants sold in some markets in Benin City, Nigeria. *Intl J Human, Arts, Med Sci*; 2 (2):7-16.
- Idu M., (2014). Presence of Mn, Zn, Fe, Cr, Ni, Hg and Pb in medicinal plants sold in local markets in Benin City, Edo State. *Academia J. Med. Plants*; 2(5): 79-84.
- Liu C, Zhang Y, Zhang F, Zhang S, Yin M, Ye H et al. (2007). Assessing pollutions of soil and plant by municipal waste dump. *Environl Geol*: 52: 641-651.
- Nwachukwu M.A, Feng H, Alinor J. (2010). Assessment of heavy metal pollution in soil and their implication within and around mechanic villages. *Intl J. Environl Sci Techn*: 7: 347-358.
- Ogbonnia S.O, Mbaka G.O, Igbokwe N.H, Anyika E.N, Alli P, Nwakwaka N. (2010). Antimicrobial evaluation, acute and subchronic toxicity studies of Leone Bitters, a Nigerian polyherbal formulation in rodents. *Agric Biol J. N RR Am*; 1(3): 366-67.
- Oshikoya K.A, Senbanjo I.O, Njokanma O.F, Soipe A. (2008). Use of complementary and alternative medicines for children with chronic health condition in Lagos, Nigeria. *BMC Compl Altmed*; 8(66):8-20.
- Pieme C.A, Penlap V.N, Nkegoum B, Taziebou C.L, Tekwu E.M, Etoa Fgongang J. (2006). Evaluation of acute and subacute toxicities of aqueous ethanolic extract of leaves of *Senna alata* (L.) Roxb (Casalpinaceae). *Afr J. Biotech*: 5:283-89.
- Qishlaqi, A., Farid Moore, F. (2007). Statistical analysis of accumulation and sources of heavy metals occurrence in agricultural soils of Khoshk River banks, Shiraz, Iran. *American-Eurasian Journal of Agriculture & Environmental Science* 2: 565–573.
- Sinha S, Pandey K, Gupta A.K, Bhatt K. (2005). Accumulation of metals in vegetables and crops grown in the area irrigated with river water. *Bull Environl Contamin Toxicol*: 74: 210-218.
- Sharma R.K, Agrawal M, Marshall F.M. (2006). Heavy metals contamination in vegetables grown in waste water irrigated areas of Varanasi, India. *Bull Environl contam toxicol*: 77: 311-318.
- Sarma, H., (2011). Metal hyperaccumulation in plants: a review focusing on Phytoremediation technology. *Journal of Environmental Science and Technology* 4: 118–138
- WHO. (2007). Guidelines for assessing quality of herbal medicines with reference to contaminants and residues. World Health Organization, Geneva.