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TRACE METAL CONCENTRATION IN SELECTED MEDICINAL PLANTS IN ABRAKA AND OLOMORO COMMUNITIES IN DELTA STATE, NIGERIA

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ABSTRACT

The increasing interest in the therapeutic benefits of medicinal products has led to increased concern over the safety and toxicity of medicinal plants. Niger delta is the hotspot of oil exploration activities in Nigeria; this has caused different forms of pollution. Heavy metals like Iron (Fe), Maganese (Mn), Zinc (Zn), Chromium (Cr), Copper (Cu) and Lead (Pb) were analysed in four selected medicinal plants (*Ocinum gratissimum*, *Vernonia amygdalina*, *Spinacia oleracea* and *Citrus aurantifolia*) using Atomic Absorption Spectrophotometer (AAS). The results showed that the levels of metals were in the range of 7.33-8.37 mg/kg for Fe, 0.09-0.10 mg/kg for Pb, 0.18-0.36 mg/kg for Mn, 0.12-0.14 mg/kg for Zn, 0.01-0.12 mg/kg for Cu and below detectable limit (– 0.02 mg /kg) for Cr. This shows that most of the metal concentration levels in the herbs were within the WHO maximum permissible limits of 15 mg/kg for Fe, 100 mg/kg for Zn, 10 mg/kg for Cu and Pb and 2 mg/kg for Mn. Heavy metal contents differed in the same medicinal plant collected from different sites. *Vernonia amygdalina* (from Abraka) had the highest concentration (8.37 mg/kg) of Fe while *Ocimum gratissimum* from Olomoro had the least concentration (7.30 mg/kg) of Fe. The highest content of Mn (0.36 mg/kg) was observed in *Ocimum gratissimum* from Olomoro while the least (0.18 mg/kg) was observed in *Citrus aurantifolia*. Chromium was below detectable limit in all the samples from Abraka while the highest concentration (0.02 mg/kg) was observed in *Spinacia oleracea* from Olomoro. The level of heavy metal concentration differed in the same medicinal plant collected from different sites, indicating the consequences of oil-related activities and other anthropogenic sources. Pharmaco-vigillance of medicinal products and further studies to determine long-term cumulative risks on consumers' health is hereby recommended.

Key words: Medicinal plants; heavy metals; contamination; safe limit
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INTRODUCTION

The use of plants as medicine predates human history (Niaze *et al*., 2013). Many plants used by humans as food also yield useful medicinal compounds (Lictcherman, 2004). Plant studies are often significant in revealing locally important plant species especially for the discovery of crude drugs. Secondly, there has been interest in traditional systems of medicine, and in particular herbal medicine has increased substantially in both developed and developing countries over the past two decades (Wazir *et al.,* 2007). Global and national markets for medicinal herbs have been growing rapidly and significant economic gains have been realised. Today, many of the modern drugs seen are obtained from plants (Huffman, 2003). Medicinal plants are traditionally used for the treatment of diseases like skin infection, diarrhoea, diabetes, malaria, respiratory problem, fungal and bacterial infections (Khan *et al.,* 2008a). Humans use different medicinal plants in many respects, as food for nutritional purpose, medicine for treatment of infection and constituents of cosmetics for maintenance of healthy skin (Soylak *et al.,* 2004). These plants play significant roles in the regulation of various body systems (Schoo *et al.,* 2010).

Heavy metal distribution in medicinal plants is gaining importance not only as an alternative medicine, but also for the purpose of concern due to effects of metal toxicity (Niaz *et al.,* 2013). These metals are extremely small quantities present in plants and animal cells and tissues (Maharia *et al.,* 2010). They are a necessary part of nutrition and physiology. Ingestion of or exposure to excess quantities is often toxic. Insufficient tissue levels of certain trace metals can cause pathology (Hemen*et al.,* 2011). Trace metals include iron, manganese, magnesium, zinc, copper, chromium, molybdenum, selenium and others. Some metals are naturally found in the body and are necessary for proper human health. For instance, iron can help to prevent anaemia and zinc is a co-factor in over fifty enzyme reactions (Roohani *et al.,* 2013).

Although trace metals are good for humans, consumption of high doses can be toxic. Copper is one of the most important trace metals. It has many uses in the body. it helps to oxidize glucose in the body (Rahimi *et al*., 2012). Lead and cadmium are non-essential heavy metals, which are very toxic even in very minute quantities (Overah, 2018). There is, therefore, the need to investigate the chemical composition of these plants for public awareness (Khan *et al.,* 2008b). Based on the importance of medicinal plants and the associated problems of heavy metal toxicity caused by pollution from point to non-point sources, there is the need to evaluate the level of these metals in plants. This study evaluated the heavy metal concentration of some medicinal plants in some communities in Delta State.

MATERIALS AND METHODS

Sources of Samples

A total of 40 (10 sub- samples each) of fresh leaves of medicinal plant species (*Ocinum gratissimum*, *Vernonia amygdalina*, *Spinacia oleracea* and *Citrus aurantifolia*) were collected from two communities in Delta State (Abraka and Olomoro) notable for traditional medicine. Abraka Community is in Ethiope East L.G.A. of Delta State, Nigeria. Abraka has a tropical wet and dry climate and is located on latitude $5^{0}47^{'}24^{''}$N and longitude $6^{0}06^{'}17^{''}$E at an altitude of 67 m above sea level. The climate is equatorial, hot, 23 to 37°C and humid with relative humidity of 50-70% (Akpoborie and Efobo, 2014). Olomoro Community is in Isoko South L.G.A. of Delta State, Nigeria. It is located in a region of deciduous and evergreen forest. It is an oil-producing community located at latitude $5^{0}25^{'}00^{''}$N and longitude $6^{0}9^{'}00^{''}$E and at an elevation of 17 m above sea level (Idodo-Umeh and Oronsaye, 2003).

Sample Preparation and Analysis

Plant samples (leaves) were air-dried for three days and ground into powder with a mortar and pestle. Ten (10) grams of the powdered samples was weighed into a conical flask. The digestion mixture (surphuric acid, perchloric acid and nitric acid in the ratio 1:4:40) in volumetric flask was left to stand overnight. Thereafter, the flask was heated at 70^{0}C for about 40 minutes after which the heat was increased to 120^{0}C. The mixture turned black after 17 minutes and the digestion was complete when the solution became clear with the appearance of white fumes. The digest was diluted with 10 cm^3 of water and boiled for 15 minutes, allowed to cool and transferred to 50 cm^3 volumetric flask. The Atomic Absorption Spectrophotometer was then used to analyse the trace elements in the powdered mixture.

RESULTS

The results showed that Cu concentration in the four medicinal plants was well below WHO permissible limits (i.e. 10 mg/kg). *Vernonia amygdalina* collected from Abraka had the highest concentration while *Ocinum gratissimum* collected from Olomoro had the least concentration ranging from 0.005 to 0.02 ppm (mg/kg). Table 2 shows that Zn was higher in concentration in Olomoro than in the other location. Zn was similar in *Citrus aurantifolia* at the two locations. The highest Zn content was observed in *Ocinum gratissimum* from Olomoro while the lowest was observed in *Spinacia oleracea* from Abraka. Zinc content was below the WHO recommended limit of 50 mg/kg.

The lead concentration was highest in *Ocinum gratissimum* from Olomoro while the least was observed in Abraka samples. *Spinacia oleracea* and *Vernonia amygdalina* from Abraka and Olomoro had similar concentrations of Pb. The trace element difference per region ranged from 0.002 to 0.01 mg/kg. The results obtained were below WHO permissible limit for Pb (i.e. 10 mg/kg). Also, iron content was highest in *Vernonia amygdalina* from Olomoro and least in *Ocinum gratissimum* from Olomoro. Similar concentrations were observed in *Spinacia oleracea* in both communities. The trace element difference per region ranged from 0.0002 to 0.6ppm (mg/kg). All results were below WHO permissible limit for Iron (20 mg/kg).

The concentration for Mn in Olomoro was higher than that of Abraka. The highest content was observed in *Ocinum gratissimum*, while the least was observed in *Citrus aurantifolia*. The results obtained were below WHO recommended level for Mn (200 mg/kg). Chromium was below detectable limit in *Ocinum gratissium* at both Abraka and Olomoro locations. It was below detectable limit in *Spinacia oleracea* at Abraka but was highest at Olomoro. Chromium was not detected in *Veronia amygdalina* at Abraka but was 0.0114±0.0003 mg/kg at Olomoro. Chromium concentration in *Citrus aurantifolia* was below detectable limit at Abraka, but was 0.012±o.0003 mg/kg at Olomoro location. In all cases, the concentration of chromium was below the WHO permissible limit in medicinal plants (15 mg/kg).

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Table 1: Trace metal concentration in the different plant samples from Abraka and Olomoro

S/N	Sample name	Cu	Zn	Pb	Fe	Mn	Cr
1	*Ocinum gratissimum* 2	0.0114±0.0003	0.1336±0.0004	0.0902±0.0003	7.3302±0.0003	0.3618±0.0004	0.00±0.00
2	*Ocinum gratissimum* 1	0.0164±0.0003	0.1261±0.0003	0.1057±0.0004	8.0027±0.0004	0.2161±0.0003	0.00±0.00
3	*Spinacia oleracea* 2	0.0174±0.0003	0.1301±0.0003	0.1060±0.0003	7.3771±0.0003	0.3176±0.0004	0.0160±0.0003
4	*Spinacia oleracea* 1	0.0131±0.0003	0.1226±0.0004	0.1060±0.0003	7.3771±0.0003	0.2167±0.0004	0.00±0.00
5	*Vernonia amygdalina* 2	0.0146±0.0004	0.1287±0.0004	0.1060±0.0003	8.3706±0.0003	0.2618±0.0005	0.0114±0.0003
6	*Vernonia amygdalina*1	0.02772±0.0003	0.1282±0.00026	0.1057±0.00040	7.3847±0.00040	0.2416±0.00040	0.00±0.00
7	*Citrus aurantifolia* 2	0.1180±0.0003	0.1301±0.0003	0.1058±0.0004	7.7837±0.0004	0.2561±0.0003	0.0120±0.0003
8	*Citrus aurantifolia* 1	0.0134±0.0003	0.1301±0.0003	0.1061±0.0003	7.7837±0.0004	0.1841±0.0003	0.00±0.00

Values are presented as means±SEM (Standard Error of Mean)

1=Abraka sample, 2= Olomoro sample

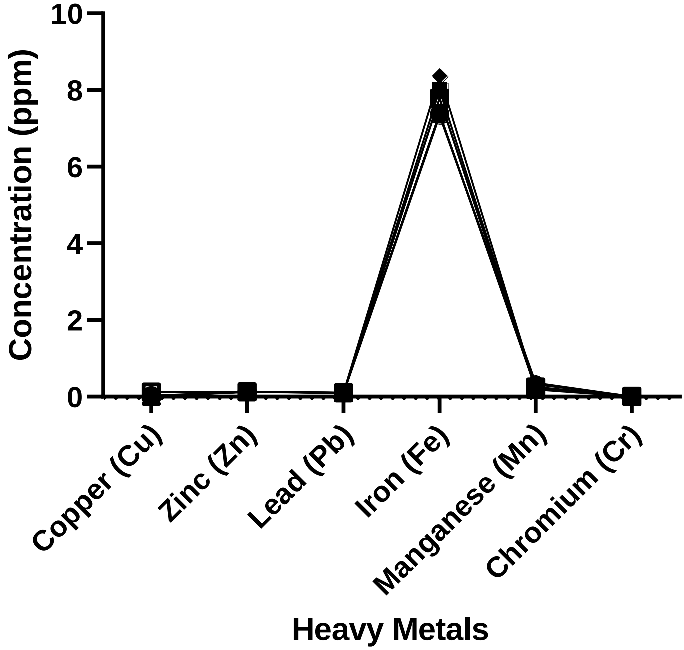

Figure 1: Level of metal concentration (ppm) in leaf samples across the study areas

DISCUSSION

The mean concentration of iron ranged from 7.33-8.37 mg/ kg. Similar findings have been reported by Nwajei *et al.* (2012) in tomato leaves grown in the study area. Lower values of iron (1.34-1.84 mg/kg) were reported in fruits (Obi-Iyeke, 2018). Hemen *et al.* (2011) reported a lower concentration of 4.86 mg/kg Fe in cassava tubers. Iron had the highest concentration compared with other metals because iron content is high in Nigerian soils. (Nwadinigwe *et al.*, 2015). Zn concentration in all samples analysed ranged from 0.12 to 0.13 mg/kg. These values are similar to those reported in fruits and vegetables (Obi-Iyeke, 2018) and in selected herbal products (Sarpony and Boateng, 2013). Higher concentrations of Zn have been reported in vegetables (Obi-Iyeke, 2014). The concentration of Zn in the samples analysed was below the permissible limit (50 mg/kg) for Zn in medicinal plants.The levels of lead observed in the medicinal plant samples did not pose any toxicological risk. Plants and humans require adequate amount of micronutrient like Fe and Zn. However, the excessive accumulation of non-essential metals like Pb can be harmful. Zn activates enzymes and forms complex with deoxyribonucleic acid (DNA) and ribonucleic acid. It has been reported that Zinc supplements decrease HIV progression and patients with deficient level of Zinc are at risk as they experience immunological failure (Rahimi *et al.*, 2012). Usually, the highest content of Zn is found in young plants as it is a co-factor of over two hundred (200) enzymes involved in metabolic pathways (Schoo *et al.,* 2010). Pb concentration ranged from 0.09- 0.12 mg/kg, as has also been reported by Saeed *et al.* (2011) in herbal plants. Higher values of Pb in medicinal plants were reported by Khan *et al.* (2008a). The functional roles of trace elements are inter-related and balanced against each other. Generally, they are not considered as any elements with independent and self-sufficient role (Maobe *et al.*, 2012). Although all the samples contained trace elements within permissible limits, there is the need for regular monitoring to avoid health hazards associated with bioaccumulation over time.

CONCLUSION

The results showed that samples collected from Olomoro had higher concentrations of heavy metals than those collected from Abraka, indicating the effect of different locations on soil metallic load. Many oil wells and oil exploration activities are cited at Olomoro with cases of oil spillages. Medicinal plants should be screened to ensure safety before they are recommended for use as herbs by the public.

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