ELEMENTAL PROFILE OF SELECTED PLANT SPECIES USED IN THE TREATMENT OF REPRODUCTIVE HEALTH PROBLEMS IN NORTHWEST STATES, NIGERIA

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Abstract

The study of elements traditional medicinal plants revealed that they contained major and trace elements that have significant roles in combating a variety of human ailments and diseases. However, it is widely known that in higher concentration, trace elements in medicinal plants are responsible for the plants toxicity. This study was aimed at determining the elemental composition of some medicinal plants used for treatment of reproductive health problems. Fresh sample of plant materials was obtained from local farms in Kano, Katsina and Jigawa States. They were authenticated and elemental analysis was performed. The identified elements included: Zinc (Zn), Magnesium (Mg), Lead (Pb), Manganese (Mn), Selenium (Se), Copper (Cu), Iron (Fe), Cadmium (Cd), Arsenic (As) and Nickel (Ni). The concentrations of Pb and Mn in Ziziphusabyssinica, Jatrophacurcus, Dalbergiasaxatilis, Burkeaafricana and Nymphaelotus have exceeded the WHO standard values of edible plants. However, the values of Cd and Ni in all the samples plants were below the WHO standard limit. Levels of Cu in all plants is above the WHO standard with exception of Securidacalongipedunculata and below for all with the exception of Burkeaafricana for Zn. This shows that some plants possess higher elemental composition which if taken over time might produce some negative effects on the living organism.

Keywords: Elemental Profile; Reproductive Health Problems; Medicinal Plants

Introduction

Medicinal plants play an important role in traditional medicine and are widely consumed as home remedies. Recent study by the World Health Organization (WHO) has shown that about 80% of the world’s population still relies on traditional medicine for their primary healthcare needs. Thus it can safely be presumed that a major part of traditional therapy involves the use of plant extracts or their active principles (Farnsworth et al., 1985). The past decade has seen a significant increase in the use of herbal medicine due to their minimal side effects, availability and acceptability to the majority of the populace especially in third world countries. Consumption of these plants contributes to the intake of minerals (essential and non-essential) by the people including infants and the elderly (Ajiasab et al., 2004).

Many metabolic disorders resulting in human ailments have experimentally been shown to be managed by traditionally used medicinal plants. Among the factors attributing to the healing potential of these medicinal plants, are the trace elements present in them. The study of such elements with respect to traditional medicinal plants reveal that major and trace elements have significant roles in combating a variety of human ailments and diseases (Shirin et al., 2010). However, it is widely known that in higher concentration, trace elements in medicinal plants are responsible for their toxicity. Due to their potential impact on human health, the pharmacological properties of these medicinal plants must be studied. The knowledge on concentrations of these trace elements is important for determining the effectiveness of the plants in treating various ailments so as to understand their pharmacological actions.

Materials and Methods

Collection and Identification of Plant Materials

Fresh sample of plant materials was obtained from local farms in Kano, Katsina and Jigawa States and authenticated in the Department of Plant Biology, Bayero University Kano. The plant materials were shade-dried and grounded into coarse powder using mortar and pestle and then pulverized into a fine powder using a dry grinder. The powder was stored in an air tight container at 25°C.
Elemental analysis of Plant species
Acid Digestion of the samples
The elemental analyses of the plant materials were carried out in Ahmadu Bello University Zaria, Multi-user Research Laboratory. The mineral elements estimations indicated the amount of macro, trace elements and heavy metals present in the Plant samples. 0.5 grams of the powdered plant material was weighed into 10 different beakers each of 50 ml, to which 2.5ml of Hydrochloric Acid (HCl) and 7.5ml Nitric Acid (HNO₃) were added to each beaker. The 10 beakers used were placed in an open space for 2 hours and mixture of hydrochloric acid (HCl) and nitric acid (HNO₃) in 1:1 ratio was added to each beaker. It was kept on a hot plate at 100°C-170°C for 1-4 hours. After the contents in beakers is about to dried; 5 ml of Hydrochloric acid (HCl) was added to each beaker and be kept on the hot plate until the entire liquid content in the beakers got evaporated.

Then, 5 ml of de-ionized water was added to each beaker and the solutions were poured in sterile bottles and tested for the quantification of the metals. The mineral elements detected include; Zinc (Zn), Magnesium (Mg), Lead (Pb), Manganese (Mn), Selenium (Se), Copper (Cu), Iron (Fe), Cadmium (Cd), Arsenic (As) and Nickel (Ni) and these were done by Spectrophotometric methods. The concentration of the elements was read using the flame atomic absorption spectrophotometer (FAAS), AA 500 model, Atomic Emission Spectrophotometer, HACH Spectrophotometry (DR/4200) and Atomic Absorption Spectrophotometer were used for other elements detected. Before determining the concentration of any element in the sample, calibration curve of the element in the sample was prepared using prepared standard stock solutions for the elements as reported by AOAC (2000); 2005 (Akpabio) and Ikpe (2013).
Results and Discussion

Table 1: Elemental composition of selected plant species used for the treatment of reproductive health problems in North-West States, Nigeria.

<table>
<thead>
<tr>
<th>Plant species</th>
<th>Concentration (ppm)</th>
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<tbody>
<tr>
<td></td>
<td>Zn</td>
<td>Cd</td>
<td>Cu</td>
<td>Pb</td>
<td>Mn</td>
<td>Al</td>
<td>Cr</td>
<td>Fe</td>
<td>Ni</td>
<td>As</td>
<td>Se</td>
<td>WHO/FAO Standard</td>
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<tr>
<td><em>Mitracarpushirtus</em></td>
<td>16.427</td>
<td>-0.011</td>
<td>0.315</td>
<td>0.335</td>
<td>1.951</td>
<td>9.728</td>
<td>0.021</td>
<td>6.357</td>
<td>0.188</td>
<td>0.351</td>
<td>0.307</td>
<td>27.40</td>
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<tr>
<td><em>Ziziphusabyssinica</em></td>
<td>0.450</td>
<td>-0.019</td>
<td>0.102</td>
<td>0.823</td>
<td>2.310</td>
<td>12.152</td>
<td>0.031</td>
<td>20.085</td>
<td>0.130</td>
<td>0.743</td>
<td>0.608</td>
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<tr>
<td><em>Laptadeniahastata</em></td>
<td>0.616</td>
<td>-0.006</td>
<td>0.082</td>
<td>0.304</td>
<td>0.910</td>
<td>6.182</td>
<td>0.029</td>
<td>8.848</td>
<td>0.137</td>
<td>0.166</td>
<td>0.178</td>
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<tr>
<td><em>Moringaoleifera</em></td>
<td>0.482</td>
<td>-0.007</td>
<td>0.047</td>
<td>0.372</td>
<td>0.658</td>
<td>5.355</td>
<td>0.032</td>
<td>5.171</td>
<td>0.170</td>
<td>0.159</td>
<td>0.102</td>
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<tr>
<td><em>Jatropha curcus</em></td>
<td>0.133</td>
<td>-0.007</td>
<td>0.099</td>
<td>0.538</td>
<td>7.415</td>
<td>1.990</td>
<td>0.026</td>
<td>2.578</td>
<td>0.187</td>
<td>0.149</td>
<td>0.098</td>
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<tr>
<td><em>Securidacalongipedunculata</em></td>
<td>0.251</td>
<td>-0.003</td>
<td>0.039</td>
<td>0.328</td>
<td>0.799</td>
<td>1.319</td>
<td>0.017</td>
<td>1.933</td>
<td>0.282</td>
<td>0.095</td>
<td>0.008</td>
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<tr>
<td><em>Dalbergiasaxatilis</em></td>
<td>0.154</td>
<td>-0.008</td>
<td>0.085</td>
<td>0.538</td>
<td>2.583</td>
<td>5.370</td>
<td>0.027</td>
<td>7.104</td>
<td>0.126</td>
<td>0.201</td>
<td>0.161</td>
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<tr>
<td><em>Piliostigmathonningii</em></td>
<td>0.461</td>
<td>0.003</td>
<td>0.066</td>
<td>0.254</td>
<td>0.165</td>
<td>0.667</td>
<td>0.010</td>
<td>0.811</td>
<td>0.064</td>
<td>-0.049</td>
<td>-0.002</td>
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<tr>
<td><em>Fadogiaagrestis</em></td>
<td>0.544</td>
<td>-0.007</td>
<td>0.116</td>
<td>0.373</td>
<td>0.977</td>
<td>14.302</td>
<td>0.021</td>
<td>11.737</td>
<td>0.223</td>
<td>0.159</td>
<td>0.101</td>
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<tr>
<td><em>Burkeaafricana</em></td>
<td>29.485</td>
<td>0.000</td>
<td>0.435</td>
<td>0.678</td>
<td>0.529</td>
<td>7.415</td>
<td>0.029</td>
<td>6.025</td>
<td>0.245</td>
<td>0.038</td>
<td>0.044</td>
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<tr>
<td><em>Nymphae lotus</em></td>
<td>0.348</td>
<td>-0.013</td>
<td>0.044</td>
<td>0.446</td>
<td>23.718</td>
<td>20.485</td>
<td>0.033</td>
<td>76.301</td>
<td>-0.015</td>
<td>0.729</td>
<td>0.441</td>
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<tr>
<td>WHO/FAO Standard</td>
<td>27.40</td>
<td>0.21</td>
<td>3.00</td>
<td>0.43</td>
<td>2.00</td>
<td>-</td>
<td>-</td>
<td>20.00</td>
<td>1.63</td>
<td>-</td>
<td>-</td>
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</table>
The concentrations of Cr, Mn, Fe, Co, Ni, Cu, Zn, Cd and Pb in the herbs are presented in (Table 1). The elements are rich sources of macro and minor elements that aid in the growth of plants, and as well in human body functions such as muscle contraction, bone formations, growth, metabolism, osmotic balance, regulatory processes activation and other organic bimolecular activities (Rabiah et al., 2012). The concentrations of elements gotten from this study were within FAO/WHO (2004) permissible limits for edible plants.

**Chromium:** The highest concentration of Chromium was found in *Nymphae lotus* 0.033 ppm, followed by *Ziziphus abyssinica* 0.031 ppm, *Burkea africana* and *Laptadenia hastata* 0.029 ppm each, *Dalbergia saxatilis* 0.027 ppm, *Jatropha curcus* 0.026 ppm, *Fadogia agrestis* and *Mitracarpus turitus* 0.021 ppm each, *Pilostigma reticulatum* has the least concentration of chromium with 0.010 ppm in that order (Table 1). For medicinal plants, the WHO (2005) limits for Chromium have not yet been established. However, permissible limits for Chromium set by Canada were 2 ppm in raw medicinal plant material and 0.02 mg/day in finished herbal products WHO (2010).

Comparison of metal levels in the medicinal plants investigated with those proposed by FAO/WHO (1984) showed that the herbs have Chromium concentrations equivalent to the limits permissible in edible plants. It was observed that the selected herbs have concentration within permissible limits for Chromium as set by Canada (Jabeen et al., 2010). Chronic exposure to chromium may result in liver, kidney and lung damage (Khan et al., 2008). It was also reported by Khan et al. (2008) that the toxic effects of Chromium intake causes skin rash, nose irritations, bleeds, upset stomach, kidney and liver damage, nasal itch and lungs cancer. However, chromium deficiency is characterized by disturbance in glucose, lipids and protein metabolism.

**Manganese:** Results showed that Manganese concentration is high in few herbs studied. The highest concentration of Manganese was found in *Nymphae lotus* 23.718 ppm, followed by *Jatropha curcus* 7.415 ppm, *Dalbergia saxatilis* 2.583 ppm (Table 1). It was observed that *Pilostigma reticulatum* has comparatively lowest concentration of Manganese at 0.165 ppm. However, for medicinal herbs the WHO (2005) limits not yet been established for Manganese. It was reported by Jabeenet al. (2010) that the range of Manganese in selective medicinal herbs of Egypt in the study carried out was between 44.6 to 1239 ppm. The concentration of all the selected eleven herbs is in the range of 0.165 to 23.718 (ppm), indicating that the concentration of the eleven studied herbs is within normal level for the element in selective medicinal herbs of Egypt.

Deficiency of Manganese in human causes myocardial infection and other cardiovascular diseases, also disorder of bony cartilaginous growth in infants and children and may lead to immunodeficiency disorder and rheumatic arthritis in adults (Khan et al., 2008). Manganese (Mn) is often found in minerals in combination with iron. It is helpful in carbohydrate metabolism and served in the body as a co-factor for the enzymes involved in hydrolysis, phosphorylation, transamination and decarboxylation. It promotes the activities of transferases such as superoxide dismutase and aids as antioxidant to scavenge damaging particles (superoxide) known as free radicals in the body (Dias, 2012). Low levels of manganese can cause infertility, bone malformation weakness and seizures.

**Iron:** The results revealed that highest concentration of iron in the herbs studied was found in *Nymphae lotus* with 76.301 ppm followed by *Ziziphus abyssinica* 20.085 ppm, *Fadogia agrestis* 11.737 ppm, *Laptadenia hastata* 8.848 ppm, and *Dalbergia saxatilis* 7.104 ppm. The range of iron in the studied herbs was lowest in *Pilostigma reticulatum* 0.811 ppm and highest in *Nymphae lotus* 76.301 ppm (Table 1). The permissible limit set by FAO/WHO (1984) in edible plants was 20.00 ppm. After comparison, metal limit in the studied medicinal herbs with those proposed by FAO/WHO (1984), it was found that majority of the herbs have iron below this limit. However, for medicinal plants the WHO limits not yet been established for iron. It was reported by Jabeenet al. (2010) that the range of iron in selective medicinal herbs of Egypt in the study carried out was between 261 ppm to 1239 ppm. However, the concentration of the selected eleven studied herbs is within normal range for the element in selective medicinal herbs of Egypt. Iron is an essential element for human beings and animals and is an essential component of haemoglobin.

It facilitates the oxidation of carbohydrates, protein and fat to control body weight which is very important factor in diabetes (Ullah et al., 2012). Iron is necessary for the formation of haemoglobin and also plays an important role in oxygen and electron transfer in human body (Ullah et al., 2012). Low iron content causes gastrointestinal infection, nose bleeding and myocardial infection (Ullah et al., 2012). The main function of iron is the transport of oxygen to the tissues (haemoglobin) and also in cough.
associated with angiotensin-converting enzyme (ACE) inhibitors, haemopoietic and cell mediated immunity (Faizul et al., 2012). The deficiency of iron has been related to anemia and described as the most prevalent nutritional deficiency.

**Nickel:** Results obtained showed that maximum concentration of nickel was found in *Securidacalagonipenduculata* root with 0.282ppm, *Burkea africana* 0.245ppm, *Mitracarpushirtus* leaves 0.188ppm, *Jatropha curcus* root 0.187ppm. It was observed that *Nymphae lotus* root has lowest nickel of 0.015 ppm and *Securidacalagonipenduculata* has highest nickel of 0.282ppm (Table 1). It was reported by Jabeen et al. (2010) that the permissible limit set by FAO/WHO (1984) in edible plants was 1.63 ppm. After comparison, metal limit in the studied medicinal herbs with those proposed by FAO/WHO (1984) it was found that selected eleven herbs have nickel below the limit of edible plants.

However, for medicinal plants the WHO limits not yet been established for nickel. The nickel toxicity in human is not a very common occurrence because its absorption by the body is very low (Jabeen et al., 2010). The most common ailment arising from nickel is an allergic dermatitis known as nickel itch, which usually occurs when skin is moist, further more nickel has been identified as a suspected carcinogen and adversely affects lungs and nasal cavities. Although nickel is required in minute quantity for body as it is mostly present in the pancreas and hence plays an important role in the production of insulin. Its deficiency results in the disorder of liver (Khan et al., 2008).

**Copper:** The highest concentration of copper was found in *Burkea Africana* 0.435 ppm, followed by *Mitracarpushirtus* 0.315ppm, *Fadogiaagrestis* 0.116ppm, *Ziziphus abyssinica* 0.102ppm. The highest concentration of copper observed was 0.434 ppm in *Nymphae lotus* root. It was reported by Jabeen et al., (2010) that the permissible limit set by FAO/WHO (1984) in edible plants was 3.00 ppm. After comparison, metal limit in the studied medicinal herbs with those proposed by FAO/WHO, it is found that all the selected herbs from North West States Nigeria have copper below the permissible limit set by FAO/WHO in edible plants. However, for medicinal herbs the WHO (2005) limits not yet been established for copper.

Although in medicinal plants, permissible limits for copper set by China and Singapore were 20 ppm and 150 ppm respectively (WHO, 2005). The selected eleven herbs were found to have permissible limits for copper below that set by China and Singapore. It was reported by Jabeen et al. (2010) that the range of copper contents in the 50 medicinally important leafy materials growing in India was 17.6 ppm to 57.3 ppm. The high levels of copper may cause metal fumes fever with flue like symptoms, hair and skin decolouration, dermatitis, irritation of the upper respiratory tract, metallic taste in the mouth and nausea. Copper deficiency results in anaemia and congenital inability (Ullah et al. 2012). The systemic decrease in Copper levels causes iron deficiency. Therefore it is antianaemic and essential for the formation of iron and haemoglobin. Copper (Cu) play important role in treatment of chest wounds and prevent inflammation in arthritis and similar diseases (Faizul et al., 2012).

**Zinc:** Results obtained show that high concentration of zinc was found in *Burkea africana* 29.485ppm followed by *Mitracarpushirtus* leaves 16.427ppm. *Dalbergiasaxatilis* has the least concentration of zinc with 0.154ppm. It was reported by Jabeen et al. (2010) that the permissible limit set by FAO/WHO in edible plants was 27.4 ppm. The zinc concentration in the selected eleven herbs analysed ranges between 0.154 ppm to 29.485 ppm compared to 27.4 ppm permissible limit set by FAO/WHO (1984) in edible plants.

Therefore the zinc concentration in the eleven herbs is below permissible limit set by FAO/WHO (1984) with exception of *Burkea africana*29.485ppm which above the permissible limit in edible plants. Zinc is an essential trace element and plays an important role in various cell processes including normal growth, brain development, behavioural response, bone formation and wound healing. Zinc deficient diabetics fail to improve their power of sensitivity and cause loss of sense of touch and smell (Jabeen et al. 2010). Dietary limit of Zn is 100 ppm as reported by Jabeen et al. (2010).

**Cadmium:** Results obtained show that high concentration of cadmium was found in *Ziziphus abyssinica* 0.019ppm and *Securidacalagonipenduculata* and *Piliostigma reticulatum* possess minimum concentration of cadmium 0.003ppm. It was reported by Jabeen et al. (2010) that the permissible limit set by FAO/WHO(1984). in edible plants was 0.21 ppm. However, for medicinal herbs the permissible limit for cadmium set by WHO, China and Thailand was 0.3 ppm. Similarly, permissible limits in medicinal plants for cadmium set by Canada was 0.3 ppm in raw medicinal plant material and 0.006 mg/day in finished herbal products (WHO, 1999).
After comparison, metal limits in the studied eight medicinal herbs with those proposed by FAO/WHO (1984) it was found that all studied eleven herbs have cadmium below the permissible limit set by WHO, Canada, China and Thailand. Cadmium causes both acute and chronic poisoning, adverse effect on kidney, liver, vascular and immune system (Jabeen et al., 2010).

**Lead:** Results obtained show that highest concentration of lead was found in *Ziziphus abyssinica* leaves with 0.823ppm followed by *Burkea africana* 0.678ppm, *Dalbergia saxatilis* and *Jatropha curcas* root with 0.538ppm each. The herb *Ziziphus abyssinica* exhibited higher lead concentration of 0.823ppm and *Piliostigma reticulatum* fruit possess minimum concentration of lead 0.254ppm. It was reported by Jabeen et al. (2010) that the permissible limit set by FAO/WHO (1984) in edible plants was 0.43ppm. The WHO (2005) prescribed limit for lead contents in herbal medicine is 10 ppm while the dietary intake limit for lead is 3 mg/week. However, for medicinal herbs, the limit was 10 ppm set by China, Malaysia, Thailand and WHO. Similarly plants with those proposed by WHO (1999) it was found that all the selected eleven herbs have Lead below permissible limit set by China, Malaysia, Thailand and FAO/WHO. Lead causes both acute and chronic poisoning and also poses adverse effects on kidney, liver, vascular and immune system (Jabeen et al. 2010). Lead is non-essential trace elements having functions neither in human’s body nor in plants. They induce various toxic effects in humans at low doses. The typical symptoms of lead poisoning are colic, anemia, headache, convulsions and chronic nephritis of the kidneys, brain damage and central nervous system disorders (Jabeen et al. 2010). Lead (Pb) is toxic and a non-essential element for human body, it causes a rise in blood pressure, kidney damage, miscarriages and subtle abortion, brain damage, declined fertility of men through sperm damage, diminished learning abilities of children and disruption of nervous systems (Khan et al., 2011 and Obiajunwa et al., 2002) Trace metals such as Fe, Mn and Ni detected in all the selected plant species were below the FAO/WHO (1984) permissible limit for edible plants. Concentration of elements in plants varies from region to region due to factors such as environmental, atmospheric, pollution, season of collection of sample, age and soil conditions in which plant grows (Faizul and Rahat, 2011).

**Conclusion**

The concentrations of Lead (Pb) and Manganese (Mn) in *Ziziphus abyssinica*, *Jatropha curcas*, *Dalbergia saxatilis*, *Burkea africana* and *Nymphaea lotus* have exceeded the WHO standard values of edible plants. However, the values of Cadmium(Cd) and Nickel (Ni) in all the samples plants were below the WHO standard limit. Levels of Copper (Cu) in all plants is above the WHO standard with exception of *Securidaca longipedunculata* and below for all with the exception of *Burkea africana* for Zinc (Zn). This shows that some plants possess higher elemental composition which if taken over time might produce some negative effects on the living organism.
References


