

Original Research Article

HEAVY METAL PROFILES OF MEDICINAL PLANTS FOUND WITHIN THE VICINITY OF QUARRY SITE IN DEMSA, ADAMAWA STATE, NIGERIA.

ABSTRACT

Heavy metals profile of ethanolic leaves extracts of some medicinal plants was carried out. The plants include *Anogeissus leiocarpus*, *Bauhinia reticulata*, *Prosopis oblonga*, *Sterculia tomentosa* and *Tamarindus indica*. The digests were analyzed for the trace metals using Atomic Absorption Spectrophotometer (AAS) model 210VGP. The highest value for Manganese (Mn) was obtained from *Anogeissus leiocarpus* sample with 5.31mg/l from the Quarry site, followed by *Sterculia tomentosa* with 1.6mg/l, *Tamarindus indica* with 1.56mg/l, *Prosopis oblonga* with 1.46mg/l and least is *Bauhinia reticulata* with 1.22mg/l. Chromium (Cr) has value of <0.04, Cadmium (Cd) with <0.01 and Nickel (Ni) having <0.05 in all the samples. The samples away from the Quarry site has 0.68mg/l of Mn in *Bauhinia reticulata* while both *Anogeissus leiocarpus* and *Tamarindus indica* has values of 0.03mg/l. Lead (Pb) is detected in only one of the control sample site which is 0.08mg/l of *Bauhinia reticulata* and in three plant samples from the Quarry site which include *Anogeissus leiocarpus* with 0.06mg/l and 0.07mg/l for *Bauhinia reticulata* and 0.07mg/l for *Prosopis oblonga* respectively. Other trace metals results obtained away from the quarry site include (Cr) with value of <0.04, (Cd) with <0.01 and (Ni) with <0.05 in all the samples. Some plants in the quarry site contain Mn and Pb above their threshold levels, therefore these plants are not recommended for consumption by animals to avoid bioaccumulation which will in further bring about health hazard.

Keywords: Heavy metals, *Sterculia tomentosa*, sample, manganese, quarry

INTRODUCTION

27 Any toxic metal may be called heavy metal, irrespective of their atomic mass or density [1].
28 Heavy metals are a member of an ill-defined subset of elements that exhibit metallic
29 properties. These include the transition metals, some metalloids, lanthanides, and actinides.
30 One source defines heavy metal as one of the common transition metals, such as copper, lead,
31 and zinc. These metals are a cause of environmental pollution from sources such as leaded
32 petrol, industrial effluents, and leaching of metal ions from the soil into lakes and rivers by
33 acid rain [2].

34 Any metal (or metalloid) species may be considered a “contaminant” if it occurs where it is
35 unwanted, or in a form or concentration that causes a detrimental human or environmental
36 effect. **Heavy** Metals/metalloids include lead (Pb), cadmium (Cd), mercury (Hg), arsenic
37 (As), chromium (Cr), copper (Cu), selenium (Se), nickel (Ni), silver (Ag), and zinc (Zn).
38 Other less common metallic contaminants include aluminium (Al), cesium (Cs), cobalt (Co),
39 manganese (Mn), molybdenum (Mo), strontium (Sr), and uranium (U) [3].

40 Living organisms require varying amounts of heavy metals. Iron, cobalt, copper, manganese,
41 molybdenum, and zinc are required by humans [4]. All metals are toxic at higher
42 concentrations [5]. Excessive levels can be damaging to the organism. Other heavy metals
43 such as mercury, plutonium, and lead are toxic metals that have no known vital or beneficial
44 effect on living organisms, and their accumulation over time in the bodies of animals can
45 cause serious illness. Certain elements that are normally toxic are for certain organisms or
46 under certain conditions, beneficial. Examples include vanadium, tungsten, and even
47 cadmium [1].

48 Metal concentration in soil typically ranges from less than one to as high as 100,000 mg/kg
49 [6]. Heavy metals are the main group of inorganic contaminants and a considerable large
50 area on land is contaminated with them due to use of sludge or municipal compost, pesticides,
51 fertilizers, and emissions from municipal wastes incinerates, exudates, residues from

52 metalliferous mines and smelting industries. Irrespective of the origin of the metals in the
53 soil, excessive levels of many metals can result in soil quality degradation, crop yield
54 reduction, and poor quality of agricultural products, posing significant hazards to human,
55 animal, and ecosystem health [7].

56 Heavy metal contaminations of land resources continue to be the focus of numerous
57 environmental studies and attract a great deal of attention worldwide. This is attributed to
58 non--biodegradability and persistence of heavy metals in soils. In order to identify spatial
59 relationship of heavy metals in soil-rice system at a regional scale, 96 pairs of rice and soil
60 samples were collected from Wenling in Zhejiang province, China, which is one of the well-
61 known electronic and electric waste recycling centers. The results indicated some studied
62 areas had potential contaminations by heavy metals, especially by Cd. The spatial distribution
63 of Cd, Cu, Pb, and Zn illustrated that the highest concentrations were located in the northwest
64 areas and the accumulation of these metals may be due to the industrialization, agricultural
65 chemicals and other human activities [8].

66 Human health has become threatened due to exposure to hazardous and toxic substances,
67 such as industrial effluents and emissions, Sewage sludge, fertilizers and agrochemicals [9].

68 The possibility of their movement along the food chain cannot be over ruled out, Cd, Pb and
69 Hg are major contaminants of food and may be considered an important problem to our
70 environment while others like Fe, Zn and Cu are essential for biochemical reactions in the
71 body [10].

72 Medicinal plants represent a rich source from which powerful drugs are produce [11]. Herbal
73 medicine has shown to be effective and about 60percent of the rural population depends on it
74 for their primary health care [12, 13]. The interest in the scientific investigation of medicinal
75 plants from Nigeria is based on the claims of their effective use for the treatment of many
76 diseases, therefore research into the effects of these local medicinal plants is expected to

77 enhance the use of these plants against diseases caused by the test pathogens, however must
78 of these plants used in herbal medicine have not been screened for their toxicity effects.
79 Traditional medical herbs used for strengthening the body immune system and nutritional
80 elements. According to Sofowora [14], many plants have been documented to have the
81 efficacy to treat many diseases in Nigeria. In order to control and prevent the inevitable
82 progression of the immune system destruction that these stresses causes, therapy must be
83 diverse, involving all levels of health, diet, use of mineral supplements and life style. It has
84 been revealed that, elements in biological sources are more efficient than pure elemental
85 status, because of presence of element as well as presence of vitamins and other physiological
86 active compounds [15]. A research report by Rajurkar and Damame [16] shows correlation
87 between elemental content of medicinal plants and their curative ability, so the quantitative
88 estimation of various micro element concentrations is important for determining the
89 effectiveness of the medicinal plants. In treating various disease, as sources of supplement and
90 also to understand their pharmacological action. Moreover macro and micro elemental
91 analysis of medicinal plants can be used to decide the dosage the herbal drugs prepared from
92 these plant materials and also the concentration of toxic element like Pb, Cd and Hg [16]. It
93 has been reported that the relative high levels of essential elements such as Fe, Mn, Zn and
94 Ca have been demonstrated to influence the retention of toxic elements in animals and human
95 beings [17, 18].

96 Therefore, the main aim of the research is to carry out the heavy metal analysis of some
97 medicinal plants found in the vicinity of quarry site.

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101 **MATERIALS AND METHODS**

Study Area

The study area is quarry site situated in Demsa Local Government Area of Adamawa State, Nigeria. Fig 1 shows the map of the study area. Demsa is a Local Government Area of Adamawa State, Nigeria. Demsa lies on the Benue River. Coordinates: 9°25'N 12°08'E with population of 180,251. The state spans two vegetation zones namely Sudan and Sahel savannah. Effective rains start in late June and end in late October. They dry seasons start in October and end in June. The occupation of the rural community of Demsa LGA has always been agrarian. The local government communities of these areas have been using these medicinal plants under investigation to cure various diseases for a long time.

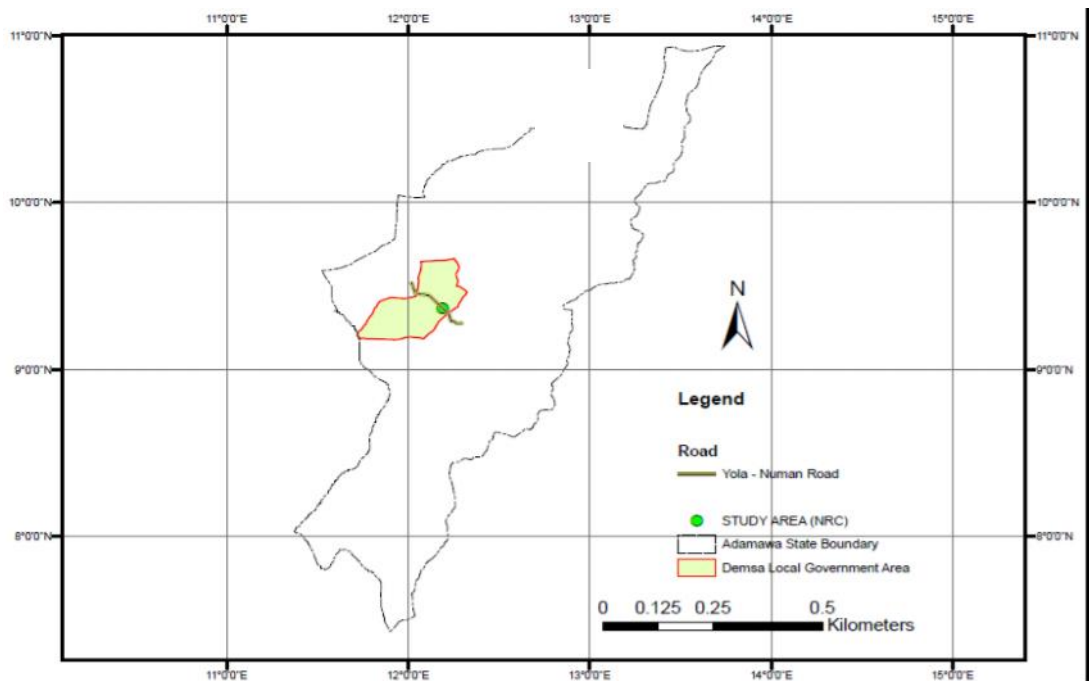


Fig. 1: Map of Adamawa State Showing Demsa LGA and the Study Area

Sample Collection

117 Leave samples of *Bauhinia reticulata*, *Prosopis oblonga*, *Sterculia tomentosa*, *Tamarindus*
118 *indica* and *Anogeissus leiocarpus* were collected from the Quarry site (N R C) along Numan
119 road in Demsa L.G.A and transported to Modibbo Adama University of Technology, Yola,
120 where they were identified and authenticated by Dr A. Jauro from forestry department.
121 Voucher specimens of these plants were deposited at the University Herbarium.

123 Sample Preparation

124 The plant samples were washed thoroughly with tap water to remove the soil particles from
125 the leaves. The samples were then cut into smaller pieces and air dried for some days. The
126 dried samples were ground into powder and stored in labeled polythene bags. Each powdered
127 sample was digested as reported by Barminas et al. [19]. 2gm of each sample was weighed into
128 separate beakers and treated with 20cm³ of HNO₃ acid. It was then digested on an electric hot
129 plate at 70°-90° for 60minutes. Blank was prepared similarly by digesting 20cm³ of HNO₃
130 acid in an empty beaker. It was cooled and the content filtered through Whatman No. 42 filter
131 paper into a volumetric flask and made up to 100cm³ with deionised water. The digests were
132 analyzed for the trace metal contents using Buck scientific model 210VGP Atomic
133 Absorption Spectrophotometer. A calibration curve was constructed using standard stock
134 solution for each element. The unknown sample absorbance is read off on the
135 spectrophotometer and the concentration in ppm is obtained by extrapolation on the curve.

137 Determination of essential and heavy elements in the sample

138 This was achieved by means of absorbance measurements of the dilute solutions using the
139 advantage of the sensitivity of the AAS spectrophotometer. The instrument was calibrated by
140 allowing some warm up time for the AAS machine and the control knob adjusted until the
141 meter reads 0% transmittance. Three glass cuvettes were obtained and blotted with tissue

142 paper. One of them was used for the solvent blank which is distilled water while the others
143 were used for the analyte samples. The absorbance reading was measured for each metal
144 serial dilution of the various samples. Calibration **curve** for each metal was prepared from
145 which unknown **concentration** in the samples **was** extrapolated. A plot of the absorbance (A)
146 versus concentration gives a straight line graph.

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148 **RESULTS AND DISCUSSION.**

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Table 1: Mean levels of some heavy metal (mg/l) in the plants in quarry site

Element	<i>Anogeissus</i>	<i>Bauhinia</i>	<i>Prosopis</i>	<i>Sterculia</i>	<i>Tamarindus</i>	WHO
	<i>Leiocarpus</i>	<i>reticulate</i>	<i>Oblonga</i>	<i>tomentosa</i>	<i>indica</i>	Standard limit
Cr	<0.04	<0.04	<0.04	<0.04	<0.04	0.05
Cd	<0.01	<0.01	<0.01	<0.01	<0.01	0.005
Pb	0.060±0.01	0.07±0.01	0.07±0.01	<0.04	<0.04	0.05
Mn	5.31±0.01	1.22±0.01	1.46±0.01	1.61±0.01	1.56±0.01	0.1
Ni	<0.005	<0.005	<0.005	<0.005	<0.005	0.02

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Table 2: Mean levels of some heavy metal (mg/l) in the plants away from quarry site

Element	<i>Anogeissus</i>	<i>Bauhinia</i>	<i>Prosopis</i>	<i>Sterculia</i>	<i>Tamarindus</i>	WHO
	<i>leiocarpus</i>	<i>recticulata</i>	<i>oblonga</i>	<i>tomentosa</i>	<i>indica</i>	Standard Limit
Cr	<0.04	<0.04	<0.04	<0.04	<0.04	0.05
Cd	<0.01	<0.01	<0.01	<0.01	<0.01	0.005
Pb	<0.04	0.08±0.01	<0.04	<0.04	<0.04	0.05
Mn	0.03±0.01	0.68±0.01	<0.03	<0.03	<0.03	0.1
Ni	<0.005	<0.005	<0.005	<0.005	<0.005	0.02

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Table 1 and 2 shows the summaries of the mean concentrations of the heavy metals that are found on the leaves of each plant sample. Most of heavy metals analyzed were below detection limit of Atomic Absorption Spectrophotometer AAS Buck 210VGP used. However, Manganese (Mn) and Lead (Pb) that were significantly present in both samples from Quarry site and away.

Pd concentration in the plants species studied was above 0.05mg/l permissible limit given by Barminal et al. [19] and WHO [20]. Levels for Mn accumulation during the present study as contained in table 1 and 2 revealed *Anogeissus leiocarpus* sample collected from the quarry site had the highest Mn content of 5.31mg/l while the sample of *Anogeissus leiocarpus* collected away from the quarry site had the least Mn content of 0.03mg/l . The permissible limit for Mn set by WHO [20] is 0.01mg/l while the permissible limit of FEPA [9] is 0.05mg/l. Hence Mn does appear to present a hazard to both Human and animal that ingest the plants extract as medicine.

Most of the heavy metals analyzed were not detected except in few plants where Mn and Pb were noted. High values for both Mn and Pb were found in plant samples collected within the vicinity of the quarry site. The levels recorded for Mn and Pd were observed to exceed the permissible limit of FEPA [9] and Barminas et al. [19]; therefore, the plants should not be used for medicinal purposes due to their suspected toxicity to the consumers

CONCLUSION AND RECOMMENDATION

The medicinal plants within the vicinity of the quarry site contain elevated levels of lead and manganese above their threshold levels and therefore the plants are not recommended for consumption by animals in order to avoid bioaccumulation in their body systems which could lead to health hazards. It is recommended that another study should be carried out on other edible plants that are cultivated around the quarry site in order to know if they are safe to be consumed or not.

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