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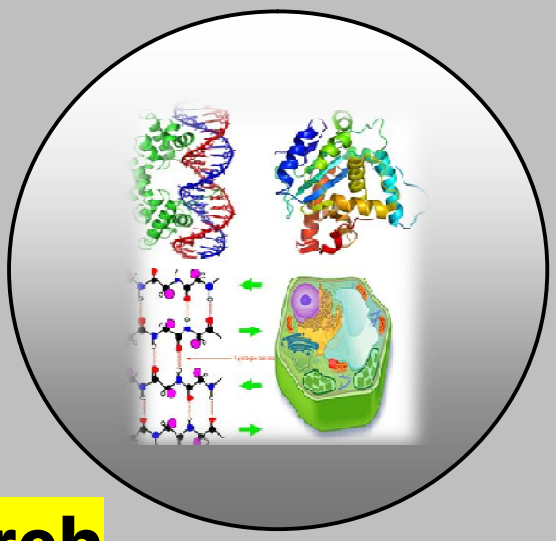

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RESEARCH PAPER

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Minerals, Vitamins And Phytochemical Profile Of *Sida acuta* (Broom Weed): Indices for the Evaluation of Safety and Antioxidant Potentials of the Medicinal Plant

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ABSTRACT

Sida acuta, commonly known as broom weed, is a species of flowering plant commonly found in virtually every part of Nigeria and perhaps many parts of the world. This herb has been reasonably quoted as having useful medicinal properties but appears to be neglected in this part of the world. This work was carried out to determine its mineral, vitamin, phytochemical and antinutrient properties as a means of assessing its safety and antioxidant potentials. Standard phytochemical methods were appropriately used for phytochemical (and antinutrient) determinations. Vitamins were suitably assayed by titration and colorimetric methods while atomic absorption spectrometer (AAS) was used for analysis of minerals. Phytochemicals/antinutrients were present in concentrations (%) ranging from 0.005 ± 0.002 (oxalates) to 68.00 ± 2.30 (tannins). The vitamin concentrations (mg/100g) were 0.33 ± 0.06, 0.48 ± 0.03, 0.51 ± 0.05, 0.27 ± 0.02, 0.39 ± 0.08, 48.40 ± 3.40, for vitamins A, B_1, B_2, B_3, B_{12}, and C, respectively. Some heavy metals – lead, cadmium, chromium, mercury, as well as arsenic were found only in very low insignificant concentrations. Some essential elements were significantly present, iron (6.20 ± 0.04) and zinc (4.29 ± 0.24340); others, potassium, magnesium, and copper were relatively of insignificant concentrations. The absence of contamination with heavy metals is an indication that Sida acuta is relatively naturally free of any significant concentration of toxic heavy metals. Accumulation of ascorbic acid, elements such as zinc, and secondary metabolites confer on the plant a level of antioxidant capacity.
Keywords: Sida acuta, Phytochemicals, Medicinal, Heavy Metals and Antioxidants.

INTRODUCTION

Seemingly, little attention has been directed to *Sida acuta* Burm. f. (common names: broom-weed, broomgrass, wire weed, teaweed, ironweed, and numerous vernacular names applicable) in this part of the world. Despite the commonality of this shrub-like weed in our immediate environment, South-East of Nigeria, and indeed the whole of Nigeria, it appears not to attract any significant positive attention comparative to other widely accepted 'medicinal plants'. It is usually a disdain sight on any agricultural site apparently due to the stubborn nature of the 'weed'. It is common to see arrays of broomweed adorning the edges of our highways with the wave of its brilliant yellow flowers when in blossom. The multiplicity of vernacular names applicable to the plant in different regions of the world is evident of its global spread.

Sida acuta, despite its popularity as a weed, is evidently not just a weed. It has values and potentials that have significantly enlisted it among the medicinal plants of the world and research reports indicate strong pharmacological activities. Damintoti et al (2006) reported that *Sida acuta* is traditionally used in the treatment of malaria, diarrhoea and many other diseases. *Sida acuta* application in the therapeutic management of disturbing conditions such as asthma, renal inflammation, colds, fever, headache, ulcers and worm infections in regions around Central America has been reported (Caceres, 1987). *Sida acuta* has also been found applicable for the treatment of snake bite (Otero et al. 2000, a and b) with an indication that the ethanol extract of the plant had an effect against the venom of *Bothrox athrox*. At the Eke Main Market park in Awka, Anambra State of Nigeria, there was a display of selected freshly harvested medicinal plants, among which was *Sida acuta*. When the 'herbal expert' was asked the use of this one (pointing at *Sida acuta*) he quickly replied 'for the treatment of rheumatism'. He was apparently on a sponsored free public enlightenment on the effectiveness of local herbs for the treatment and management of various illnesses. From the point of view of chemical constituents several alkaloids and steroidal compounds with varying potentials have been isolated from *Sida acuta* (Cao and Qi, 1993; Jang et al., 2003). Cryptolepine alkaloid was identified as the major alkaloid of the plant responsible for its antimalarial properties (Banzouzi et al., 2004; Karou et al., 2003). The antimicrobial activity of alkaloids in *Sida acuta* against several test microorganisms was confirmed (Damintoti et al, 2006).

MATERIAL AND METHODS

Collection of plant materials and processing

Large quantity of *Sida acuta* leaves were harvested fresh from a locality in Awka, Nigeria. It was air dried under shade for five days and then pulverized using manual blender. The powdered sample was stored at room temperature and later used for all analyses.

Analysis of Minerals

Analyses were carried out to quantitatively identify the presence of certain minerals in the plant. Determination of the concentrations of various elements was done by means of the Varian Atomic Absorption Spectrophotometer (FS 240).

Some pharmacologically important metallic elements including lead, mercury, arsenic, cadmium, iron, etc, were determined. Wet digestion of sample with HNO_3/ $HClO_4$/ H_2SO_4 mixture was done according to method of Adrian (1973).

Analysis of Vitamins

The analysis of vitamin A was done by the colorimetric method of Kirk and Sawyer (1991) with absorbance read by means of a spectrophotometer (JENWAY 60610) at 325nm. Ascorbic acid (vitamin C) analysis was done by the titration method reported by (Kirk and Sawyer 1991). The B – complex vitamins, including thiamine (vitamin B_1), riboflavin (vitamin B_2), and cobalamine (vitamin B_{12}) were colorimetrically determined with absorbance read at 261nm, 242nm, and 361nm, respectively, while niacin (vitamin B_3), was assayed by titration according to the guidelines of the British Pharmacopoeia (1993).

Phytochemicals/antinutrients

The sample was analyzed for secondary metabolites including alkaloids, flavonoids, cardiac glycosides, saponins, tannins, and the common antinutrient, oxalate.

Alkaloids and saponins were determined according to the methods of Harborne (1973); Obadoni and Ochuko (2001). Flavonoid was determined by repeated extraction with aqueous methanol (80%), at room temperature, as described by Boham and Kocipai (1994). Tannin determination was carried out by the Follins – Dennis titration method as described by Pearson (1974). The determination of cardiac glycosides was done as described by Osagie (1998). The total oxalate content was determined according to the method of Dye (1956) as described by Akpabio (2012).

Statistical Analyses

Data obtained from this study were analysed using the statistical package for social sciences (SPSS) version 18.0 for windows. Analyses of variance (ANOVA) were used to compare means and values were considered significant at $p < 0.05$. Post hoc multiple comparisons for the ANOVA were done using least significant difference (LSD).

RESULTS

Some secondary metabolites with antioxidant (as well as antinutrient) properties were determined. The percentage concentrations of flavonoids, alkaloids, cardiac glycosides, saponin and tannin ranged between 0.20 ± 0.01 for flavonoids to 68.0 ± 2.30 for tannins. Significant concentrations were observed only for alkaloids, tannins and saponins (figure 1).

Concentrations of vitamins A and C were determined, as well as those of the B-complex class including thiamine (vitamin B_1), riboflavin (vitamin B_2), cyanocobalamine (vitamin B_{12}) and niacin (vitamin B_3). The concentrations (mg/100g) of these vitamins ranged between 0.27 ± 0.02

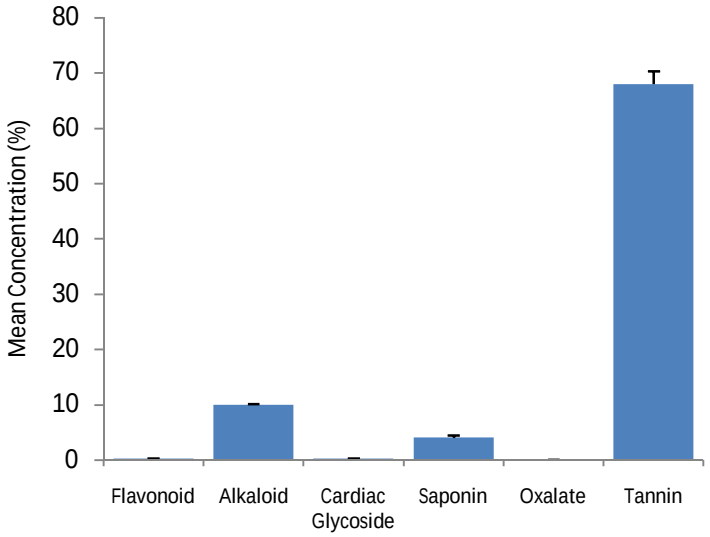

Figure 1: Phytochemical (antinutrient) profile of Sida acuta (Data represented as Mean ± SEM)

to 48.40 ± 3.40. Only ascorbic acid with a value 48.40 ± 3.40 was quantitatively significant (figure 2). Thiamine concentration was 0.48 ± 0.03mg/100g and riboflavin concentration was 0.51 ± 0.05mg/100g while the rest were well below these values.

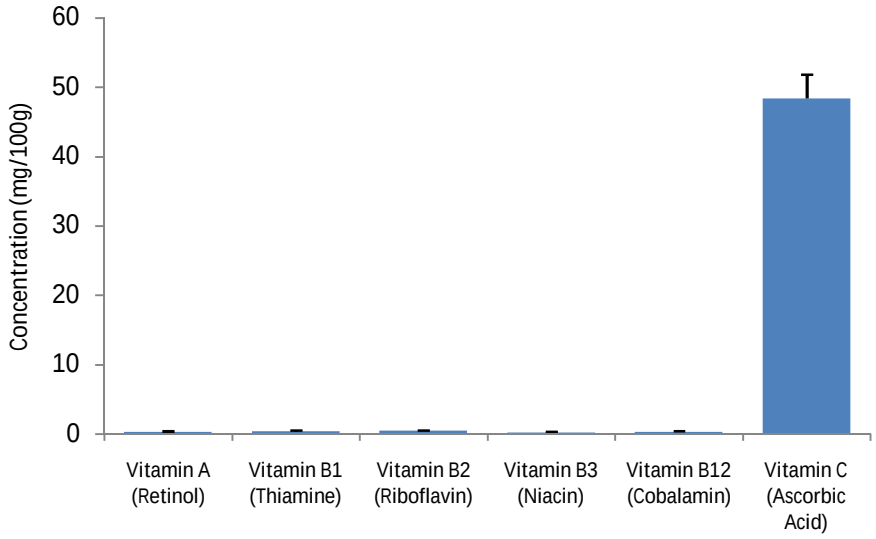

Figure 2. Concentrations of some vitamins in *sida acuta* (Data represented as Mean ± SEM).

The sample was subjected to analysis by atomic absorption spectroscopy to identify quantitatively the possible presence of various minerals that are of pharmacological, toxicological (and perhaps nutritional) importance.

Iron and zinc concentrations (mg/100g) were 6.20 ± 0.04 and 4.29 ± 0.24, respectively. Aluminium, magnesium and arsenic concentrations (mg/100g) were 1.60 ± 0.10, 0.99 ± 0.48810, and 0.84 ± 0.105, respectively. Other elements assayed had insignificant values (figure 3).

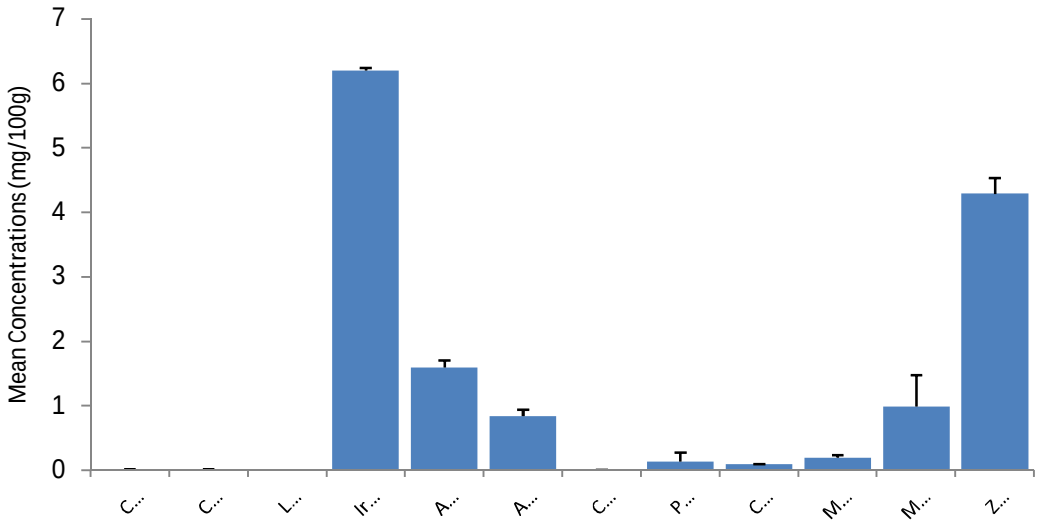

Figure 3. Concentrations of minerals in *Sida acuta* (Data represented as Mean ± SEM)

DISCUSSION

We investigated *Sida acuta* leaf (which is increasingly becoming recognized in the collection of medicinal plants), harvested from Awka, Nigeria, for the presence of heavy metal contaminants and other elements. Lead and chromium were not detected while cadmium, mercury, cobalt and arsenic were detected at very insignificant levels. Aluminium was present at a level below human daily dietary intake but may to the advantage augment the intake in a situation of deficiency. Potassium, a major intracellular cation that significantly affects several physiological processes, was present at very low level. Copper, magnesium and potassium which are essential physiological and biochemical functional elements, were all slightly present. Zinc and iron which play diverse critical biochemical roles were significantly present in *Sida acuta.* Comparatively, high concentrations of Zn, Fe and Mn in selected medicinal plants were reported (Shad et al, 2008) and elevations of Cu, Cr, Zn, and Mn were recorded in another studies (Gajalakshmi et al, 2012). Some of the herbal drugs marketed locally in Pakistan were reported to be toxic and unsafe due to their content of heavy and toxic metals (Bushra et al, 2011). Some workers in Nigeria had reported concentration of Pd, Cd and Zn in some herbal products to be above safe limits established by some international regulatory agencies (Nwoko et al, 2011). Herbs often used for herbal preparations are usually harvested from different environmental backgrounds and in most cases virtually no attention is paid to the influence of the environment on these materials. Furthermore, there is virtually no supervision in the course of processing and production of herbal preparations especially within the localities.

Herbal men and women are simply interested in the efficacy of their preparations without consideration of possible contaminations from sources such as the soil, the environment, water and or other solvents used for preparation and even the vessels engaged for processing. However, reports abound in literature on contaminations of herbal preparations with heavy metals and varieties of other contaminants. Even the world Health Organization (WHO) had expressed concern on the safety and quality of herbal preparations on the basis of contamination from varieties of substances including heavy metals and other elements - lead, cadmium, mercury, chromium, arsenic and many others (WHO, 2007).

The concentration of some vitamins in *Sida acuta* was determined. Our analysis showed that the plant has very low (insignificant) quantities of the B – vitamins as well as vitamin A. Only traces of thiamine, riboflavin and cobalamine were detected. Ascorbic acid was significantly present with a concentration of 48.40 ± 3.40 mg/100g. Vitamins are generally useful to the body with numerous physiological and biochemical functions. Ascorbic acid (vitamin C) deficiency leads to development of scurvy. It promotes intestinal absorption of iron by reducing nonhaeme ferric iron to the ferrous state in the stomach. Ascorbic acid is one of the well recognized nutrient antioxidants and appears to play essential role in protecting nitric oxide from free radical degradation (Hardman et al, 2001).

Some secondary metabolites (phytochemicals) with antioxidant (as well as possible antinutrient) properties were analysed together with oxalate, a common antinutrient compound found in plant. Flavonoid, cardiac glycosides, (and oxalate) were virtually absent whereas tannins, alkaloids, and saponins were significantly present in the order tannin > alkaloid > saponins. These phytochemicals individually possess peculiar structural characteristics responsible for their diverse pharmacological roles. From the overall analyses, *Sida acuta* appears to possess moderate antioxidant capacity. The high content of ascorbic acid, possibly working in synergy with Zn, other elements/intrinsic factors not covered in this work, and some of the other secondary metabolites, may confer on the plant a moderate ability to scavenge free radicals. The near absence of flavonoids, cardiac glycosides and oxalate indicates that leaves of *Sida acuta* do not possess antinutrients to any significant extent. The consideration for antinutrient concentration in medicinal plants is justified by the fact that most herbal preparations are administered orally and consequently the herbal active principles are directly exposed to interaction with dietary nutrients.

CONCLUSION

Herbal preparations are usually carried out without supervision and in many cases, freely marketed. There is hardly any consideration for the possibility of contaminations due to ignorance especially within the local communities. Even in urban centres those who prepare and sell herbal products are more of the uninformed class who only pay attention to the efficacy of their products over certain ailments or infections. They harvest their plant materials from wherever they sight them without consideration of even heavy contamination or pollution of the sites which definitely impacts on their extracts and /or preparations.

The victims are often the consumers of such product who seek remedy for their ailment. Difficult it may seem though, but screening of herbal or medicinal preparations or products to ascertain safety from contamination is a goal worth pursuing in the overall interest of the public. Our investigation has shown that *Sida acuta* is naturally largely free of heavy metals contamination and thus any case of such contamination should be traceable to the natural environment from which the plants were grown and harvested or the course of processing. Furthermore, *Sida acuta* possess moderate antioxidant properties and the seemingly absence of antinutrients is a conviction that it could not likely constitute any major hindrance to the effective utilization of nutrients.

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