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Elemental Composition of *Sacoglottis gabonensis* A Nigerian Alcohol Beverage Additive

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Abstract: Studies on the effects of *Sacoglottis gabonensis* stem bark extract against lipid peroxidation and on the natural antioxidant defenses after phenylhydrazine-induced lipid peroxidation resulted in elemental determination of the bark extract. The data revealed that the bark extract contains copious amounts of core elements required in natural antioxidant defenses against peroxidation reaction as well as absence of heavy metals that elicite free radical formations. The bark extract can, thus, find ready application as an antioxidant as well as function in electrolyte balance controls.

Key words: *Sacoglottis gabonensis,* cadmium, calcium, copper, lead, iron magnesium, manganese, potassium, sodium and zinc

Introduction

There is paucity of information currently on the chemical constituents of plants. However, most data on the elemental and proximate composition of plant tissues and extracts have been derived from edible plants and crops. Such studies include those reports of Calixto and Canellas (1982) on *Ceratonia siliqua,* Aliyu (1995) on *Chochlospermum planchonii,* and on *Acacia azabica.*

The nature of the life sustaining biochemical and physiological processes and activities in the body is such that they routinely generate oxidants such as superoxide anion radical (O_2), hydroxyl radical (HO) and hydrogen peroxide (H_2O_2) which invariably cause damages to tissue cells and macromolecules. Oxidants are so called because they cause oxidation of the substance they react with. Tissue damage results where the chemical substance reacting with an oxidant is a component of a biological macromolecule or a tissue cell. This is because the oxidized moiety can no longer fit into the normal architecture of the macromolecule or tissue cells. The oxidant load of the body and hence the potential for serious tissue damages is high where an individual is exposed to a chemically polluted environment. The mammalian system has inherent defenses against damages by oxidants. The antioxidant defense system protects the body against and or by immediately repairing any damage caused to tissues cells and macromolecules. In addition, in the case of very lethal oxidants, both the oxidant generating and destroying reactions occur within the same cell compartment shielded away from the rest of cell cytoplasm. For instance, the peroxide generating and destroying reactions are confined in specialized cell organelles called peroxisomes. A net damage to tissues is weakened by lack of essential nutrients in an individual's staple diet (Machlin and Bendich, 1987; Halliwell, 1994) or by the presence of chemical inhibitors of antioxidant defense enzyme in food and drinks of individuals. Also, a net damage would occur when an individual's system is chronically exposed to a level of oxidants in excess of the capacity of the antioxidant defense system.

There has been increasing scientific interest in recent years in the level of oxidants in the human environment (especially in the atmosphere and water). This is traceable to the growing numbers of scientific reports implicating chronic exposure to oxidants as an aetiological factor in a number of cases of human diseases such as cardiovascular and respiratory tract diseases (Machlin and Bendich, 1987; Halliwell, 1994). Expectedly, there has been an increasing interest not only in the human nutritional needs for the seven or so micronutrients (Vitamins C and E, Se, Fe, Cu, Zn and Mn). A natural food additive with antioxidant micronutrients and properties would be expected to complement the role of the antioxidant micronutrients and other defense systems in controlling oxidative tissue damages and preventing the allied diseases of chronic exposure to oxidants.

Sacoglottis gabonensis stem bark extract is a traditional palm wine additive commonly used in many communities of tropical rainforest belt of Nigeria. Previous studies done in other laboratories have suggested that the bark extract may possess antioxidant properties (Okoye and Neal, 1988, 1991; Ekong and Ejike, 1974). With the present overwhelming evidences trying to confirm that the bark extract and its active ingredient, bergenin possess antioxidant properties in the mammalian model, the extract and bergenin may find ready application in medical science (notably in nutrition and food science), especially in the control of tissue damages by oxidants and prevention of diseases associated with oxidative damage to tissues. Thus, there is need to study these constituents with a view to understand, what possible roles they may play in various functions in which plants take part and also to know the elemental composition of *S. gabonensis* and the possible roles of these components in various antiperoxidative functions of antioxidant enzymes.

Materials and Methods

Fresh stem bark cuttings of *S. gabonensis* used in this study were purchased from Ekeapara market, Aba and Agburuike Isiugwu, Obioma Ngwa Local government Area of Abia State in the rain forest zone of Nigeria. The samples were kept moist, wrapped in polythene bags and immediately upon return to Jos, Plateau State were botanically identified and confirmed at the Department of Botany, University of Jos, Nigeria. They were stored in the refrigerator pending extraction and use but in all the instances, all the analyses were concluded within two weeks of return from Aba, Abia State.

Four percent aqueous ethanol extract and methanol aqueous stem bark extract (1:10w/v) were prepared essentially as described by Madusolumuo (1993), which is a laboratory adaptation of the method of traditional users in Ngwa land, Abia State, Nigeria. The outer most bark and inner layers of the stem bark cuttings of *S. gabonensis* were scrapped leaving the pinkish middle fibrous layer. This middle fibrous layer was pounded with pestle in mortar into fine fibrous mesh. Half of the mesh was stepped in four percent ethanol (1:10w/v) in a beaker, covered and left overnight at room temperature. The resultant amber solution was filtrate concentrated in vacuum and was used for elemental determination. This portion was reserved for elemental determination. Four percent ethanol and pure methanol were used differently for extraction in order to compare the relative efficacy of each solvent in extracting the elements and inorganic constituents from *S. gabonensis* stem bark. (Madusolumuo, 1993). Elemental quantitation and determination of the minerals were performed using nitric acid and hyperchloric acid (6:1) as a digestion mixture.

Results

Table 1 shows the concentrations (mg/100g bark extract) of the ten elements analyzed, out of which nine were detected in the plant namely cadmium, calcium, copper, iron, magnesium, manganese, potassium sodium and zinc. Lead was not detected, suggesting that the bark extract may not elicit generation of hydroxyl radicals and its associated lesions during lead toxicity. With the exception of sodium and zinc, the levels of the individual elements were higher in methanol extract than in aqueous ethanol extract confirming that methanol though toxic, is a better solvent for extraction than ethanol. However, the differences were statistically significant only in respect of potassium, calcium, sodium, magnesium and manganese.

Table 1: Elemental composition of *S. gabonensis* (mg/100g dry bark wt.) Means ± S.D, n= 3

Elements	Types of extract	
	Aqueous ethanol extract	Methanol extract
Cadmium	0.008± 0.006	0.010± 0.007
Calcium	2.38± 0.01	381.3*± 0.015
Copper	6.63± 0.04	6.99± 0.004
Iron	2.52± 0.004	2.65± 0.002
Lead	ND	ND
Magnesium	21.16± 0.001	23.24*± 0.04
Manganese	4.36± 0.003	4.84*± 0.01
Potassium	514.05± 0.01	870.03*± 0.01
Sodium	37.25± 0.02	30.44± 0.04
Zinc	10.11± 0.04	9.45± 0.032

ND. Not determined, * Significant at P< 0.01

Discussion

Calcium, magnesium, potassium and iron are essential elements (Draper, 1976). Calcium is a cofactor playing important role in the regulation of intermediary metabolism and also as an intracellular regulator of large number of biochemical activities in various subcellular components (Carafoli, 1987). Calcium is involved in control of cell permeability and cell wall structure, ameliorates toxicity or other ions and is involved in mitosis and nitrogen metabolism of plants and as an activator for the control of electrolyte balances in the cells. Potassium plays important role in plant chemistry and aids in transporting iron during oxidative reactions. Iron, manganese, copper and zinc are important components of the three primary antioxidant enzymes involved in inhibiting against peroxidative deteriorations by oxidants and free radicals (Kumar *et al.*, 1988). Iron is a component of catalase which acts on hydrogen peroxide and organic peroxides. Copper and zinc are components of cytosolic superoxide dismutase (CuZn-SOD), whereas the mitochondrial superoxide dismutase (Mn-SOD) contains manganese as a core element all of which disporoprtionate superoxide anion (O_2^-) to hydrogen peroxide (H_2O_2). Manganese also activates certain carboxylases and dehydrogenases (Tietz, 1987) and assists chlorophyll biosynthesis in plants. Zinc is a component of carbonic anhydrase and is involved in the biosynthesis of indole acetic acid. Zinc also plays crucial role in stabilizing biomembranes and inhibits NADPH-dependent lipid peroxidation induced by cytochrome P450 (Bray *et al.*, 1996) It is possible; therefore, that some of the medicinal attributes of *Sacoglottis gabonensis* stem bark may be connected with the high contents of these nutritional metallic or elemental components in it. *S. gabonensis* stem bark extract has been in use in the rainforest belt of Southern Nigeria (Cross River, Akwa Ibom, Rivers, Abia, Imo, Delta and Bayelsa States) among the peasant communities as an additive to palm wine. When used in palm wine, it reduces foaming, prolongs the shelf life and tempers the sweet sugary taste by imparting a bitter taste making it more acceptable. It is also used as a spice for its heating effect in pregnant and nursing mothers among the Ngwa people of Abia State of Nigeria. There had been preliminary reports from indirect evidences to suggest that the bark extract may posses antioxidant properties (Okoye and Neal, 1988, 1991; Ekong and Ejike, 1974; Maduka *et al.,* 1999). Very recently, we have shown by *in vivo* (Maduka *et al.,* 1999a) and *in vitro* evidences (Maduka *et al.,* 1999, Maduka and Okoye, 2000) that the bark extract possesses antioxidant properties against peroxyl radical-induced lysis of mammalian erythrocytes. We have reported in the above studies and publications that the bark extract spared tissue depletion of hematological parameters (red blood cells, packed cell volume) caused by oxidative stress induced by oxidants as well as protected
mammalian erythrocytes against lysis by peroxyl radicals of carbon tetrachloride.

Experimental data show that the bark extract possesses sufficient essential roles associated with it in folkloric local medicine practice. Our findings have shown that *S. gabonensis* possesses essential elements of the primary antioxidant enzymes and hence may find application in ameliorating lipid peroxidations in free radical reactions. Our results also favour conclusion that *S. gabonensis* stem bark extract may be relevant in the management of hypertension and other electrolyte related diseases.

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