International Research Journal of Biological Sciences _____ ISSN 2278-3202
Vol. **3(1),** 17-21, January **(2014)** *Int. Res. J. Biological Sci.*

Minerals, Vitamins and Phytochemical Profile of *Gongronema latifolium*: Indices for Assessement of its Free Radical Scavenging, Nutritional, and Antinutritional Qualities

Enemor V.H.A.[1*], Nnaemeka O.J.[1] and Okonkwo C.J.[2]
[1]Department of Applied Biochemistry, Nnamdi Azikiwe University, Awka, NIGERIA
[2]Department of Human Biochemistry, Nnamdi Azikiwe University, Nnewi Campus, NIGERIA

Available online at: www.isca.in, www.isca.me
Received 24th August 2013, revised 28th September 2013, accepted 3rd November 2013

Abstract

Gongronema latifolium (Utazi) leaf, widely used (especially in the South-East of Nigeria) as spice and vegetable, was analysed to ascertain its potentials for free radical scavenging and nutritional relevance. Various parameters analysed include secondary metabolites (phytochemicals), vitamins and minerals. Appropriate phytochemical methods were used to determine the different phytochemical compounds. Vitamin analyses were carried out by colorimetric and titration methods as appropriate while minerals were determined by means of atomic absorption spectrophotometer (AAS). Alkaloids, flavonoids, cardiac glycosides, and saponins were substantially present while tannins, phytic acid, and oxalate were of insignificant concentrations. Among the vitamins, ascorbic acid was of the highest concentration (15.84 ± 0.12 mg/100g) followed by vitamin A (2.81 ± 0.01 mg/100g). The concentrations of other vitamins were rather insignificant. Heavy metasl were virtually absent from the sample while other essential minerals assayed were reasonably present with magnesium having the highest value of 14.00 ± 0.01ppm followed by manganese, calcium, iron, sodium and potassium with 10.10 ± 0.23ppm, 9.34 ± 0.00ppm, 5.90 ± 0.05ppm, 3.89 ± 0.00ppm, and 2.13 ± 0.01ppm, respectively. The concentrations of the rest were insignificant. Gongronema latifolium thus possess sufficient active principles that confirm it as an important medicinal vegetable with rich free radical scavenging properties. It is also rich in vitamins and nutritionally essential minerals.

Keywords: *Gongronema latifolium*, medicinal, free radical, mineral, vitamin.

Introduction

Gongronema latifolium, commonly known in the Southast of Nigeria as utazi, is a climbing herb that has made name as a special grade vegetable, and is widely trusted to have strong nutritional and medicinal values. It has a very wide spread distribution as it is easily propagated. *Gongronema latifolium* is utilizeable in many different ways in different places to prepare delicacies in homes. In many situations it is part of herbal prescriptions or preparations adminstered by herbalists for treatment and or management of certain health challenges. *Gongronema latifolium* is consumed fresh, cooked or dried and applied as powdery spice. Whichever way, it carries a moderate bitter taste that contributes tremendously to its flavour. Locally, apart from its nutritional flavour, it is believed to carry powerful medicinal qualities useful for amelioration of malaria, diabetes, and hypertension, among others. Locally, bitterness of plant materials is often strongly associated with antimalarial potency and this likely informs the local belief in the antimalarial capacity of the plant. Indeed most plants with antimalarial properties bear characteristic bitter tsate due to the content of some secondary metabolites. Thus *Gongronema latifolium* shares recognition in two principal capacities namely as a popular vegetable and as medicinal plant. Consequently, it has to be investigated thoroughly to identify pharmacologically active principles which form the basis for its supposed medicinal values. On the other hand, it should be screened extensively to ascertain the nutritional compnents to justify its popularity as a special brand vegetable and choice spice. Harnessing all the qualities of this herb may offer solutions to some prevailing clinical and nutritional conditions since it is constantly becoming obvious that the natural vegetational environment around us is so richly endowed with solutions to most of our health challenges and the extent to which we discover it will have enormous implication to resolving these challenges. Research interests were already being directed to *Gongronema latifolium*. It has been reported to have antimicrobial efficacy[1,2]. In line with local beliefs that it cures hypertension, it was reported that *Gongronema latifolium* reduced glucose levels in experimental animals induced with diabetes[3], and similar outcome was also reported by an independent study[4]. The ability of extract of *Gongronema latifolia* to decrease kidney function markers has also been reported in literature[5]. All these reports point to the fact that in line with local beliefs and views, *Gongronema latifolium* apart from serving as a type of vegetable, goes beyond nutritional benefits to express useful pharmacological actions.

In this study, we set to evaluate *Gongronema latifolium* for its content of minerals, vitamins and secondary metabolites to assess its pharmacological properties with regard to antioxidative potentials as well as nutritive qualities.

Materials and Methods

Collection and processing of *Gongronema latifolium* leaves: Fresh leaves of *Gongronema latifolium* were purchased from Eke Main Market in Awka, Anambra State, Nigeria. The bulk was air dried under shade and mechanically pulverized to a very fine texture and used for all analyses in this study.

Secondary metabolites: The sample was analyzed for phytochemicals (secondary metabolites) including alkaloids, flavonoids, cardiac glycosides, saponins, tannins, phytate, and oxalate.

Alkaloids and saponins were determined according to the methods that have been variously described[6,7]. Flavonoid was determined by repeated extraction with aqueous methanol (80%), at room temperature, as described previously[8]. Tannin determination was carried out by the Folin – Dennis titration method as described by Pearson[9]. The determination of cardiac glycosides was done as described by Osagie[10]. The total oxalate content was determined according to the method of Dye[11] as described by Akpabio[12]. Phytic acid (phytate) contents were determined using the method of Young and Greaves[13] as adopted by Lucas and Markakes[14].

Analysis of Vitamins: The analyses of caroteinoids (vitamin A) and tocopherol (vitamin E) were done by colorimetric methods[15] with absorbance read from a spectrophotometer (Jenway 60610) at 325nm for vitamin A and 410nm for vitamin E. Ascorbic acid (vitamin C) analysis was done by the titration method reported by Kirk and Sawyer[15]. 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. Niacin (vitamin B_3) and pyridoxine (vitamin B_6) were assayed by titration according to the guidelines of the British Pharmacopoiea[16].

Determination of Minerals: Analyses were performed to quantitatively identify the presence of certain minerals in the *Gongronema latifolium*. Determination of the concentrations of various elements was done by means of the Varian Atomic Absorption Spectrophotometer (FS 240). Some pharmacologically (or toxicologically) important heavy metallic elements including lead, mercury, arsenic and cadmium, were determined. Others with pharmacological (such as antioxidant properties), clinical, as well as nutritional importance, were also quantitatively assayed. Wet digestion of sample with HNO_3/ $HClO_4$/ H_2SO_4 mixture was done according to the method of Adrian[17].

Results and Discussion

Gongronema latifolia was analysed for the presence of secondary metabolites (pyhtochemicals). The results showed significant percent concentration values for alkaloids, flavonoids, cardiac glycosides, and saponins. Tannins, phytic acid, and oxalate were of insignificant concentrations as evident on figure 1.

Concentrations (mg/100g) of vitamin A, vitamin C, and vitamin E were 2.81 ± 0.01, 15.84 ± 0.12, and 0.54 ± 0.02, respectively. Vitamin B_3 concentration was 0.77 ± 0.01mg / 100g while the rest were merely trace in quantity as can be seen from figure 2.

The concentrations (ppm) of some heavy metals, lead, mercury, cadmium, chromium, cobalt, arsenic were of very low quantities. Some elements with nutritional and clinical importance were appreciably present, including potassium (2.13 ± 0.01ppm), iron (5.90 ± 0.05ppm), magnesium (14.00 ± 0.01ppm), manganese (10.10 ± 0.23ppm), sodium (3.89 ± 0.00ppm), calcium (9.34 ± 0.00ppm). Copper and zinc were 0.84 ± 0.00 ppm and 0.91 ± 0.27 ppm, respectively, while molybdenum and selenium were not detected as shown in figure 3.

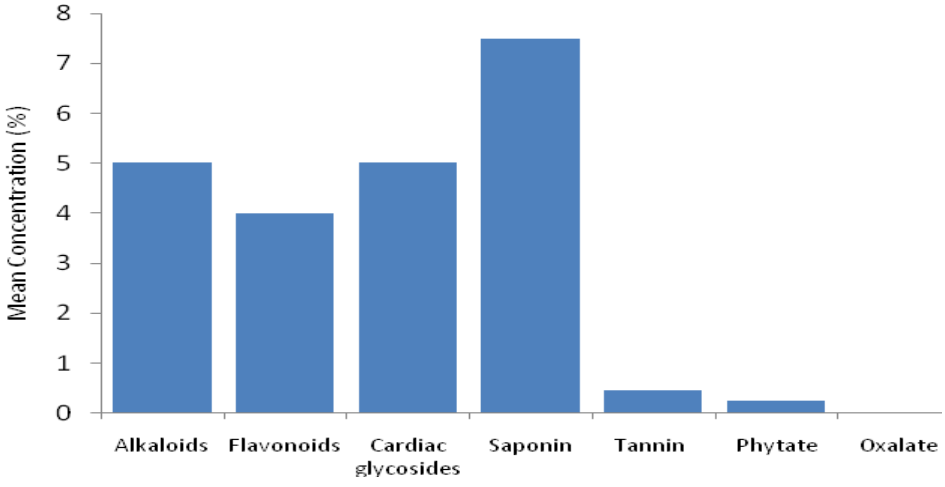

Figure-1
Percent concentration of secondary metabolites in *Gongronema latifolium*

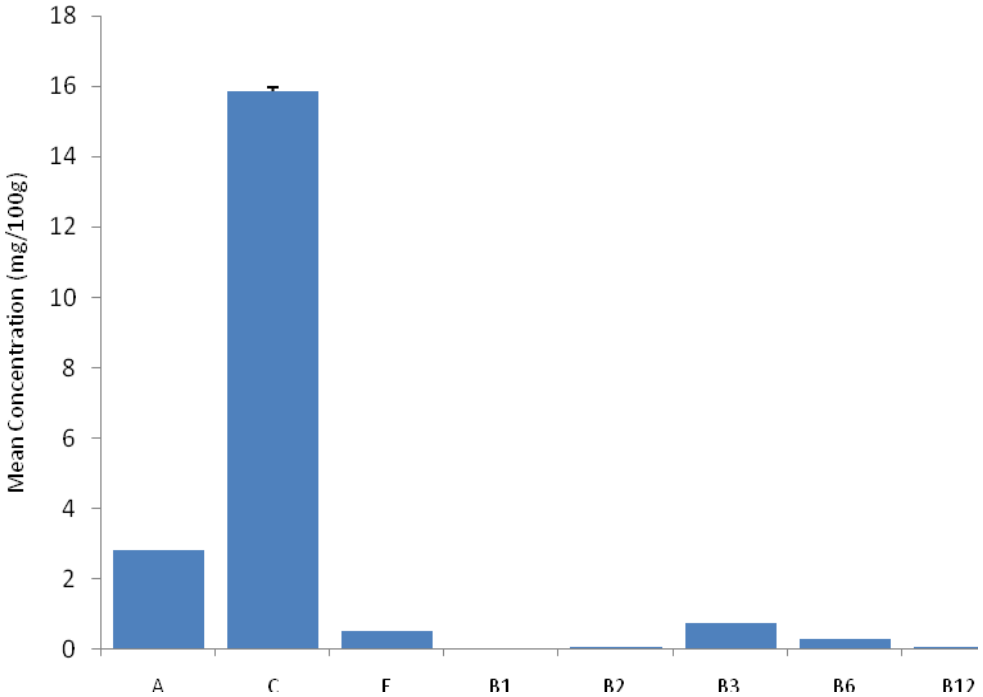

Figure-2
Mean concentration of vitamins in *Gongronema latifolium* (Data represented as mean ± SEM)

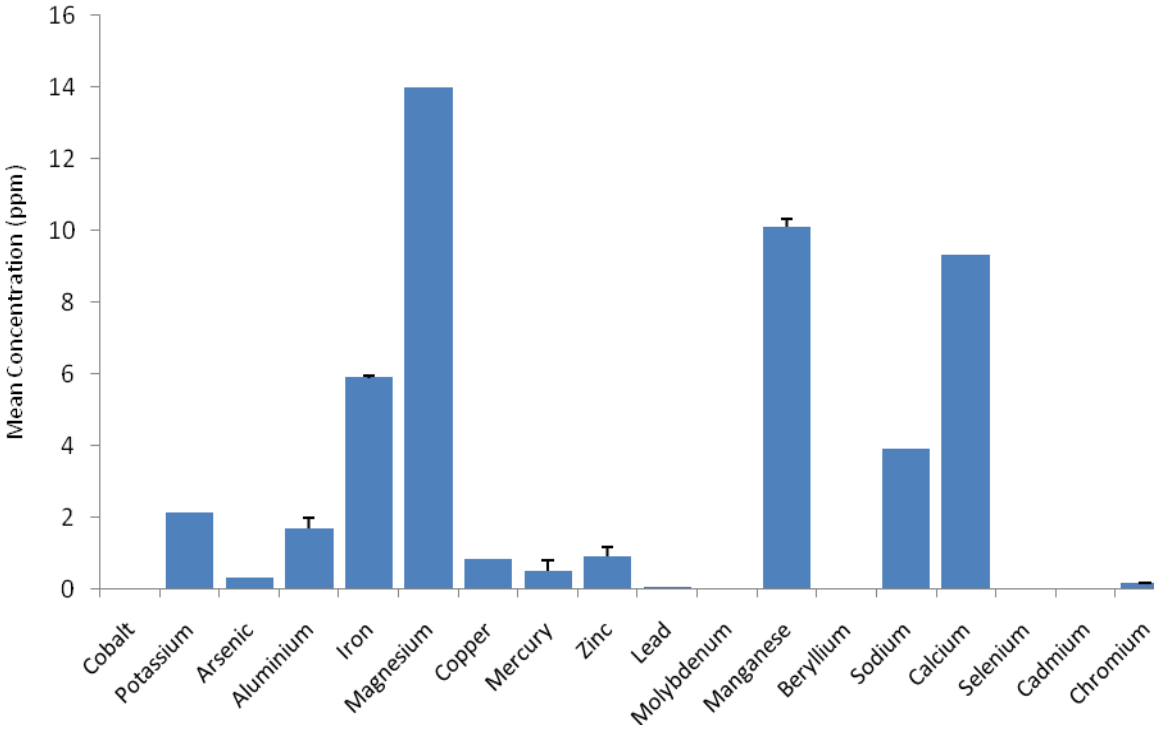

Figure-3
Mean concentration of minerals in *Gongronema latifolium* (Data represented as mean ± SEM)

Our studies have shown *Gongronema latifolium* to be rich in quite a good number of phytochemical components occurring as secondary metabolites. Our discussion in the context of this work will ignore the roles of these compounds within the plant species that produce them and will focus extensively on their implications for the animals, especially man, consuming the plant materials and or their products either as part of the diet or as a medicinal prescription. Alkaloids, cardiac glycosides, saponins, and flavonoids were all present in appreciable quantities while tannins, phytate, and oxalate were of infinitesimal values.

Antinutrients are substances (natural or synthetic) and/or their metabolic products that interfere with nutrient utilization (absorption) and often affect the physiological disposition of animals. The near zero levels of tannins, phytate and oxalate is evident that the leaf of *Gongronema latifolium* is low in antinutrients. While flavonoids may be implicated for their binding to metals such as iron and zinc and decreasing the absorption of such nutrients, the list of their health benefits outweighs their antinutrient activities, at least as very important antioxidants, among others. Alkaloids are wide and varied in structure and function. While it is factual that most alkaloids are physiologically and pharmacologically functionally useful, some have deleterious effects (example they may cause growth depression in animals[18], nevertheless based on the amount taken at any point in time and/or the overall quantity accumulating in the body at any given time. Thus, the total alkaloids in our specimen may have only little or no antinutrient significance. Cardiac glycosides are mostly steroidal glycosides (mainly cardenolides and bufadienolides groups) commonly useful for treatment of heart conditions. Saponins though partly antinutritional have been associated with the beneficial effect of lowering cholesterol and perhaps glucose[18-20]. These activities may be linked to local beliefs that the leaf of *Gongronema latifolium* reduces the intensity of hypertension and diabetes mellitus. Saponins and alkaloids together are most likely responsible for the characteristic mild and appealing bitterness of *Gongronema latifolium.* Generally, a number of phytochemical compounds with antinutritional properties also possess useful effects.

Our result largely suggests that *Gongronema latifolium* has strong antioxidant potentials. Antioxidant phytochemicals are effective free radical scanvengers[21]. Flavonoids, significantly present in *G. latifolium* is a major phytochemical antioxidant involved in scavenging of free radicals. They diminish the chances of atherosclerosis as well as pharmacologically acting in various other capacities in controlling different types of health challenges[21]. Ascorbic acid (vitamin C) has been reported as a major natural antioxidant capable of scavenging reactive oxygen species and also possesses anticarcinogenic properties[22,23]. *G. latifolium* has a high concentration of vitamin C and therefore a good antioxidant vegetable. Vitamin A (as caroteinoids), which is also recognized for antioxidant activity, is also fairly concentrated in *G. latifolia*. Low concentration of vitamin E was recorded. Vitamin E is also a well known antioxidant that can mitigate lipid oxidation and thus helps to reduce the occurrence of atherosclerosis which predisposes to increased risk of heart disease. Besides their roles as antioxidants, these vitamins have several other pharmacological, biochemical and physiological roles. *G. latifolium* has significant accumulation of manganese and small quantities of copper and zinc, all of which have been linked with roles as antioxidants. Vegetables and fruits are desirable as rich sources of vitamins and minerals. *G. latifolium* has an accumulation of such minerals and vitamins that strike an acceptable nutritional balance as expressed in figures 2 and 3.

Conclusion

From the foregoing, we conclude that *Gongronema latifolia* has a high concentration of nutritionally important minerals and vitamins and as such its use as vegetable is encouraged. It also contains substances that are of great pharmacological and /or biochemical values. Its antioxidant potentials are tremendously high and consumption of the herb can enormously promote healthy living.

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