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Guinea Corn (*Sorghum vulgare*) Leaf, a Potential Source of Nutrients and Phytochemicals

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Abstract The leaf of the Guinea corn plant (*Sorghum vulgare*) was analyzed for the proximate, mineral and antinutritional compositions to determine the distribution of nutrients and antinutrients in the leaf using standard methods. Proximate composition (%) shows carbohydrate (63.76± 3.26) as the most concentrated nutrient and crude fiber (3.07±0.13) as the least concentrated. Calcium (30.33± 9.44mg/100g) was the most abundant mineral in the leaf. Selenium (14.74±4.57mg/100g) and manganese (6.13±0.54) were also present in appreciable quantities. Antinutrients such as phytate (235.63±0.01/100g), tannin (7.60± 1.00%TAE), flavonoid (0.02±0.00) and cyanide (0.01 ± 0.00mg/100g) were present in the leaf. The calculated[ca]/[phytate] molar ratio for the leaf was below the critical value. The foregoing shows *Sorghum vulgare* leaf as an additional source of food nutrients and phytochemicals with antioxidant properties which hold promise as source of food and herbal medicine in the developing world.

Keywords Guinea Corn Leaf, Proximate Composition, Antinutrients, Antioxidant, Phytochemicals

1. Introduction

Guinea corn (*Sorghum vulgare*) is a member of the grass family which can thrive in hot areas with little rainfall providing nutrients for millions of people[1]. The seeds are small, round and have a variety of colours; like brown, black, red and white. Sorghum is an important staple in the diets of Nigerians where it is a principal food crop. It is used for bread making, as source of food for cattle, horses and poultry birds and also in brewing industries[2]

It is an important source of carbohydrate, protein and minerals such as calcium, selenium, manganese and iron in which the bioavailability depends on the level of interactions with various antinutrients[3]. It is also rich in B-complex vitamins. Apart from its use as food, it contains some chemical compounds that are protective against cancer, heart disease, heavy menstrual flow, and tumor growth. It contains no gluten which makes it an excellent nutrient source for individuals with celiac disease[4]. Guinea corn (*Sorghum vulgare*) leaves form an addition to the huge mass of environmental pollutants deriving from the crop harvest. Earlier workers[5] reported the chemical composition of the grains only. The foregoing seeks to evaluate the relative nutrient and antinutrient qualities of the leaf of *Sorghum vulgare*.

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2. Materials and Methods

Guinea corn (*Sorghum vulgare*) leaf was purchased at Ado-Ekiti market, oven dried at 60℃ and powdered using a Philips blender. The powdered sample was stored in air tight container until required for analysis. Moisture content was determined by oven drying method at 110℃ for 4 hours[6]. Ash content of 1.0g powdered sample was determined using a muffle furnace at 550℃. Fat content was determined using the soxhlet extraction method, protein was determined using the Kjeldahl method[7]. In determining the mineral composition, the ash solution was mixed with a drop of trioxonitrate (v) acid and made up to 50ml with deionised water after which it was analysed for calcium, selenium and manganese with the aid of atomic absorption spectrophotometer[8]. Phytate content was determined as follows: 2g of the sample was soaked in 50ml of 2% HCl and filtered. The filtrate was placed in a conical flask and thiocyanate solution was added as indicator after which it was titrated against standard iron II chloride solution. Cyanide composition was determined by soaking 4g of the sample into 40ml of distilled water and 2ml of orthophosphoric acid to set free all the bound hydrocyanic acid. It was later distilled and the resulting distillate was titrated against 0.01M $AgNO_3$[6]. Tannin content was also determined by soaking 0.2g of the sample in 10ml of 70% acetone. The resulting solution was filtered and Lowry reagent and sodium carbonate were added to the filtrate. The absorbance was read at 700nm using a colorimeter[9]. Flavonoid content was determined by mixing 250µl of the

extract with 1250µl water, after which 75µl of 5% $NaNO_2$ solution was added. After five minutes, 150µl of 10% $AlCl_3$ was added, followed by 500µL of IM NaOH and 275µl of water. The absorbance was read at 510nm.

3. Results and Discussion

Table 1 shows the proximate composition (%) of Guinea corn (*Sorghum vulgare*) leaf. The % protein concentration in the leaf (14.42±0.9) is comparable to (10.4% and 15.0%) obtained by Oguntona and Akinyele[5] for Guinea corn grains. This shows that the leaf is also an important source of protein that could replace the grains as animal feed. The moisture content of the Guinea corn leaf (4.95±0.35%) is very low. This is lower than the moisture content of 12% reported for the grain by[10]. Thus the leaf will be less susceptible to microbial attack and enzyme activities which could lead to spoilage than the grain. The fat composition of the leaf (3.07±0.13) is also low and comparable to 3.10% obtained for the grains[11]. Hence, Guinea corn leaf could be found useful in formulation of low fat diet, useful in the prevention of heart related diseases such as high blood pressure, heart attack and arteriosclerosis. The crude fiber (5.02±1.31%) and ash (8.72±0.47%) concentrations of the Guinea corn leaf were higher than those reported for the grains fiber (2.0%) and ash (1.6%)[12]. The high ash concentration suggests that the leaf contains more inorganic nutrients than the grains.

Table 1. Proximate composition (%) of Guinea corn (*Sorghum vulgare*) leaf*

Nutrient	Concentration (%)
Carbohydrate	63.76±3.26
Protein	14.42±0.90
Moisture	4.95±0.35
Crude fiber	5.02±1.31
Fat	3.07±0.13
Ash	8.78±0.47

*values are means of triplicate Determinations ±SD

The antinutrient composition of Guinea corn (*Sorghum vulgare*) leaf is shown on table 2. The phytate concentration (mg/100g) in the leaf (225 ± 0.01mg/100g) is comparable with the range (170 to 380mg/100g) reported for the grains[13]. Phytate can influence the functional and nutritional properties of food depending on its concentration in the food. The cyanide concentration of the leaf (0.01 ±0.00mg/100g) is as low as 0.09mg/100g reported for the grains[6]. At high concentrations, Cyanide acts as antinutrient by inhibiting the electron transport chain[14]. The flavonoid concentration of the leaf (0.02 ± 0.00) is lower than 0.05mg/100g reported for the grains[3]. This shows that the leaf could serve as a source of antioxidant, which could prevent damage caused by free radicals. Guinea corn leaf is a good source of tannin (7.60± 1.00%TA) which could help to control all indications of gastritis, esophagitis and irritating bowel disorders. Tannin and flavonoids are phenolic compounds that serve as defense chemicals, protecting plant from predatory attacks of herbivores, pathogenic fungi and parasitic weeds[15]. They inhibit lipid auto oxidation by acting as radical scavengers[16] based on the redox properties of their hydroxyl groups[17]. Hence, they are essential antioxidants which protect against the propagation of the oxidative chain. They are capable of chelating metal catalysts activating antioxidant enzymes and inhibiting oxidases[18]. Phenolic compounds posses more potent antioxidant potentials than antioxidant vitamins C and E[19]

Table 2. Antinutrient composition of Guinea corn (*Sorghum vulgare*) leaf

Antinutrient	Concentration
Phytate	225.63±0.01mg/100g
Tannin	7.60±1.00%TAE
Cyanide	0.01±0.00mg/100g
Flavonoid	0.02±0.00 (mg/100g)

*values are means of triplicate Determinations±SD. TAE: Tannic Acid Equivalent.

Table 3 shows the mineral composition (mg/100g) and the[ca]/[phytate] molar ratio of Guinea corn (*Sorghum vulgare*) leaf. Calcium (30.33mg/100g) was the most abundant mineral in the leaf followed by selenium and manganese. Hence, the leaf is a better source of calcium than the grain (8.20mg/100g (13)[6] and 15.0mg/100g[6]. Calcium is an important constituent of bones and teeth and it is involved in signal transduction in physiology. The selenium concentration of the leaf (14.74mg/100g) is higher than the (2.50mg/100g) reported for the grain[6]. Selenium, an antioxidant mineral, plays important roles as cofactor in some enzyme catalyzed reactions. The[Ca]/[phytate] molar ratio (2:1) of Guinea corn leaf is below the critical value (6:1). This indicates that the bioavailability of calcium will not be affected by phytate concentration in the leaf. Phytate at high concentration forms stable complexes with divalent mineral ions rendering them unavailable for absorption. Thus, the Guinea corn leaf is a potential source of natural antioxidants .....which can serve as save alternative to synthetic antioxidants such as butylated hydroxyanisole BHA which exhibit toxicological effects along side their free radial scavenging effect[21].

Table 3. Mineral composition (mg/100g) and[Ca]/[phytate] molar ratio of Guinea corn (*Sorghum vulgare*) leaf

Mineral	Concentration (mg/100g)
Calcium	30.33±9.44
Selenium	14.74±4.57
Manganese	6.13±0.54
[ca]/[phytate]	2:1

*values are means of triplicate Determinations ±SD

4. Conclusions

The foregoing revealed that Guinea corn leaf is rich in nutrients, low in fat and the antinutrient concentrations of the leaf are not as high as to result in toxicity and to render minerals unavailable for absorption. Hence, Guinea corn leaf

is a potential source of nutrients and essential antioxidant compounds which could supplement human and animal diets instead of constituting a waste and source of environmental pollution.

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