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Phytochemical, Proximate and Mineral elements Composition of Lemongrass (*Cymbopogon citratus* (DC) Stapf) grown in Ekosodin, Benin City, Nigeria

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ABSTRACT

Qualitative and quantitative determination of chemical and nutritive composition of *Cymbopogon citratus* (DC) Stapf (lemongrass) a medicinal plant in Nigeria was carried out using standard methods namely: proximate analysis, atomic absorption spectrophotometry (AAS) and complexometric titration. The leaves were found to be rich in crude protein (15.86 %). Other_findings were ash value (9.40 %), crude lipid content (6.90%) crude fibre content (1.00 %) carbohydrate content (66.54 %) and moisture content (72.95 %). Biomineral analysis revealed that the grass is a good source of biominerals and this order of concentration was observed: Calcium > Potassium > Magnesium > Phosphorus > Sodium > Iron > Copper. Phytochemical analysis showed the presence of saponins, tannins, alkaloids, flavonoids and cardiac glycosides while anthraquinones and cyanogenic glycosides were below detectable levels. These results support the medicinal and pharmacological activities shown by the plant and unveil the possibility of its use as a source of nutrients for man and livestock.

Keywords: *Cymbopogon citratus*, proximate, inorganic, phytochemical, composition, medicinal plant.

INTRODUCTION

Cymbopogon citratus (DC) Stap*f* commonly known as lemon grass, lemongrass, barbed wire grass, citronella grass, fever grass amongst many others, is a perennial fast growing aromatic grass growing to about 1 m (3 feet) high with thin leaves of about 5 mm wide. It produces a network of roots and rootlets that rapidly exhaust the soil. It is a genus of Asian, African, Australian and Tropical Island plants in the grass family of Poaceae (Bor, 1960; Shah *et al*., 2011). Commercially, lemongrass products can be found in different forms: lemongrass tea, alcohol extract of lemongrass, lemongrass oil and in perfumes. In environments where they are not used for cosmetics, drug or perfumery, such as in the Eastern Cape Province of South Africa, these plants have found a good application as roof thatches and grass brooms (Avoseh *et al*., 2015). Locally, lemongrass is used as a general tonic for the body, useful with respiratory infections, sore throats, laryngitis, headaches and fever, helpful with colitis, indigestion and gastroenteritis, helps with correcting environmental poor air circulation and as an insect repellant, useful in cleaning up oily skin, acne as well as athlete's foot, also alleviates excessive perspiration. Lemon grass is also said to improve the functioning of the liver and reduce hyperglycaemia through effects on the pancreas (Adeneye *et al*., 2007; Avoseh *et al*., 2015). Scientific investigation confirmed its folklore use in suspected type 2 diabetic patients (Adeneye *et al*., 2007). Lemongrass is said to exhibit antibacterial properties and inhibits a host of microorganisms including *Escherichia coli*, *Candida albicans*, *Klebsiella pneumoniae*, *Staphylococcus* aureus among others (Ogunlana *et al*., 1987; Onawunmi and Ogunlana, 1986); antifungal effects with actions against such dematophytes as *Trichophyton mentagrophytes*, T. *rubrum*, *Epidermophyton floccosum* and *Microsporun gypseum*, ringworm fungi (Shadab *et al*., 1992). It is known to be an effective herbicide and insecticide (Ahmad, 1995) because of its naturally occurring antimicrobial effects. Laboratory studies have shown cytoprotective, antioxidant and anti-inflammatory properties *in vitro* (Figueirinha *et al*., 2010; Tiwari *et al*., 2010; Devi *et al*., 2012). Myrcene has been identified as the major analgesic component of the oil. Lemongrass is "generally recognized as safe" (GRAS) in the United States but is not used in pregnancy because of uterine and menstrual flow stimulators (Carlini *et al*, 1986). There is a growing interest in 'natural' medicine from medicinal plants, hence this study aims to carry out phytochemical screening of water extract and proximate and inorganic analysis on lemongrass (*Cybopogon citratus).*

MATERIALS AND METHODS

Chemicals

All chemicals used were of analytical grade obtained from E. Merck Darmstadt, Germany, May and Baker Ltd. Dagenham, England and British Drug House (BDH) Chemicals Ltd., Poole, England.

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Plant Materials

Blades of lemongrass were collected from lemongrass plant growing in a garden at Ekosodin, Benin City, Nigeria and subsequently identified at the Plant Biology and Biotechnology Department of the University of Benin, Benin City, Nigeria.

Sample Preparation

The freshly collected lemongrass blades were_air-dried and further dried at 60 ^{o}C (Gallenkamp, UK) until a constant weight (Mettler, Toledo, Switzerland) was obtained. It was milled (Thomas – Wiley Machine, England) into fine powder and stored at 25 ^{o}C in an air tight container till needed for analysis.

Proximate Analysis

Proximate analysis to determine moisture, crude protein, crude fat, crude fibre and ash contents of lemongrass were carried out in triplicates according to the methods described by the Association of Analytical Chemists (AOAC, 2000).

Carbohydrate content was determined by 'difference' (FAO, 1998) using the following formula:

$$100 - (weight\ in\ grams\ of\ protein + fat + water + ash) in\ 100g\ of\ food.$$

The carbohydrate estimated in this fashion includes fibre (Merril and Watt, 1973).

The caloric value ($kcal/100g$) of the leaves was calculated using the Atwater factors of 4, 9 and 4 for protein, fat and carbohydrate respectively (FAO/WHO/UNU, 1991):

$$Caloric\ value = (\%\ carbohydrate\ x\ 4) + (\%\ crude\ fat\ x\ 9) + (\%\ crude\ protein\ x\ 4)$$

Inorganic Analysis

Standard methods of AOAC (2000) were used to study the inorganic contents of *C. citratus*. Atomic absorption spectrophotometry (AAS) was utilized (model – Solar 969 England) to estimate the elemental constituents Copper, Zinc, Iron and Manganese in the sample. $0.1g$ of the ashed sample was heated for 5 minutes with $10\ cm^3$ Nitric acid, allowed to cool and then made up to $50\ cm^3$ with distilled water. Appropriate working standard solutions were prepared for each element and standard curves obtained for the various inorganic ions by plotting concentration against absorbance. Calcium and Magnesium were determined using the complexometric titration method. Potassium and Sodium were determined using flame emission spectrophotometry (Gallenhamp digital flame analyser, Perkin Elmer Model 703).

Phytochemical Screening

Evidence for the presence of phytochemicals (alkaloids, saponins, tannins, flavonoids, anthraquinones, cardiac glycosides, cyanogenic, glycosides) in the water extract of the leaves of *C. citratus* was obtained by adapting standard phytochemical procedures (Harborne, 1998; Sofowora, 2008).

Statistical Analysis

Results were expressed as Means ± S. E. M. where appropriate and calculated for three independent determinations of each variable.

RESULTS AND DISCUSSION

Proximate composition of *C. citratus* is as presented in Table 1. Lemongrass recorded a high moisture content (72.947) which fell in the 72 – 93% range for leafy vegetables. The amount in individual samples depends on several factors including age, agronomic practices prevailing during cultivation and freshness (Oguntona, 1998).

Table 1: Proximate Composition of *C. citratus* leaves (% $\boldsymbol{dry\ weight}$)

Component	Value (%)
Moisture	72.947 ± 0.028
Ash	9.400 ± 0.230
Lipid	6.900 ± 0.100
Crude Protein	15.862 ± 0.15
Crude Fibre	1.000 ± 0.060
*Carbohydrate	66.000 ± 1.110
Caloric value	391.708 $kcal/100g$

Values are means ± SEM of triplicate determinations.
*Carbohydrate was determined by difference

The ash content of lemongrass (9.40%) is similar to the values reported for some commonly *consumed leafy vegetables in Nigeria Amarantus hybridus, Adarisonia digitata, Vernonia amygdalina*, *Celosia argentea* and *Solanum africana* (Oguntona, 1998). It is however lower than the 20.5% reported for *Talinum* triangulare (Akindahunsi and Salawu, 2005). The ash content is a reflection of the amount of minerals present in the food sample. The crude fat content (6.9 %) observed for *C. citratus* leaves is within the range reported for *Gnetum africanum, Xanthosem sagittifolium, Celosia argentia* and *Solanum africana* but almost half the value of 12 % for *Cochorus olitorius* leaves (Oguntona, 1998). Though leafy vegetables are known to be poor sources of fat, levels of ether extract of dry samples can range from 1 – 30 % (Oguntona, 1998). Crude protein content of 15.8% observed for C. citratus herein (Table 1), is relatively high for leafy vegetables, but compares favourably with *Gnetum* *africanum* (15.2 %). Overall, fresh leafy green vegetables have crude protein content ranging from 1.5 to 1.7%, although when dried samples have been used, the crude protein content can range from 15.0 to 30% (Aletor and Adeogun, 1995; Oguntona, 1998).Crude fibre content (1.00%) of *C. citratus* is the lowest of all the proximate compositions determined in this study (fig 1) but compares favourably with the reported values of 1.0% for *Talinum triangulare* and 1.3% for *solanum nigrum* (Oguntona, 1998).Carbohydrate content of 66.54% observed in this study for *C. citratus* is close in value to the 64.4% reported for *Vernonia amygdalina* (Oguntona, 1998). Leafy vegetables are not good sources of dietary energy since most fall within much lower values than that observed in this study.

C. citratus with a caloric value of $391.708 kcal/100g$ (Table 1) is a good source of energy compared to the energy value of $25 kcal$ for *Talinum traingulare*, and red *Hibiscus sabdariffa* with a value of $276 kcal$ (Oguntona, 1998)

Amongst the minerals analyzed (Table 2) Calcium content was found to be the highest. Calcium has three main functions (Pasternak, 1997): (i) it is required for muscle contraction, (ii) together with phosphate it is the major constituent of bone, (iii) it is required for blood coagulation. Mineral elemental analysis as depicted in Table 2 also indicates that *C. citratus* is a good source of Potassium, Magnesium and Phosphorus but relatively low in iron and copper contents. However, its iron content is comparable to values for iron $0.01g/100g$) for *Manihot utilisima* leaves (Oguntona, 1998). Among the factors influencing the mineral composition of leafy green vegetables, soil fertility (or type and quality of fertilizer used) is perhaps the most important (Schmidt, 1971). The presence of secondary metabolites in plants is characterized by their ability to provide defenses against biotic and abiotic stress. Terpenes, alkaloids and phenolics constitute the largest groups of secondary metabolites. The shikimic pathway is the basis of biosynthesis of phenolics while the terpenes which are comprised of isoprene units arise from the mevalonate pathway. Aspirin from white willow, quinine from the cinchona plant and artemisinin from Artemisia annum are all plant secondary metabolites (Avoseh *et al*., 2015). Phytochemical screening of the leaves (Table 3) showed the presence of saponins, tannins, alkaloids, flavonoids and cardiac glycosides while anthraquinones and cyanogenic glycosides were not detected. The presence of these secondary metabolites support the pharmacological activities of *C citratus.* Seigler (1998*)* reported that saponins have anticarcinogenic properties, immune modulation activities, and cholesterol lowering activity. Flavonoids have been reported to exert multiple biological activities including antibacterial, antiviral, and anti-inflammatory effects, and are said to be strong antioxidants, free radical scavengers and metal chelators (Nakayama *et al.*, 1993). Cardiac glycosides also revealed present in *C. citratus* leaves (Table 3) are a group of triterpenoids. Most are toxic but many have pharmacological activity and they are the active constituents of the major cardiotonic drugs (Evans, 1999).

Table 2: Mineral Composition of Aqueous Leaf Extract of *C. citratus*

Minerals	Concentration (mg/100g)
Sodium, Na	$2.70 \pm 0.21 \times 10^{-2}$
Potassium, K	$38.50 \pm 1.85 \times 10^{-2}$
Phosphorus, P	$11.20 \pm 0.65 \times 10^{-2}$
Calcium, Ca	$40.08 \pm 0.00 \times 10^{-2}$
Magnesium, Mg	$13.77 \pm 0.40 \times 10^{-2}$
Iron , Fe	$7.45 \pm 0.25 \times 10^{-3}$
Copper, Cu	$4.45 \pm 0.46 \times 10^{-3}$

Values are means ± SEM of triplicate determinations

Table 3: Phytochemical Screening of Aqueous Leaf Extract of *C. citratus*

Metabolite	Test	Result
Alkaloids	Dragendoff's	+
	Mayer's	–
	Wagner's	+
	Hager's	+
Saponins	Frothing	+
	H_2SO_4	+
	90% alcohol	+
Tannins	Ferric Chloride	+
Flavonoids	Lead acetate	+
	Na OH	–
	Ferric Chloride	
Anthraquinones	Bontrager's	–
Cardiac glycosides	Salkowski's	+
	Keller-Killiani's	+
Cyanogenic Glycosides	Sodium Picrate	–

Key: $+ = present$ = absent

Tannins reported present in *C. citratus* (table 3) support its use as an antidiabetic agent for type 2 diabetic patients, since tannins have been reported to have hypoglycaemic activity (Oliver-Bever, 1980). *C. citratus* is the single species of *Cymbopogon* which is most exploited for its tannin content (Avoseh et al., 2015). Alkaloids also observed present in this study are often toxic to man and livestock, but many have significant pharmacological activity, hence their wide use in medicine. Some are reported to lower blood sugar, cholesterol and triacylglycerols (Shani *et al*, 1974), metabolites which are usually elevated in diabetes mellitus.

CONCLUSION

This study has clearly demonstrated that *Cymbopogon citratus* DC Strap*f* (lemongrass) contains appreciable quantities of protein, carbohydrate and energy. The study further revealed that, it is a good source of calcium, potassium, magnesium and phosphorus, and the presence of phytochemicals such as tannins supports its folkloric use as an antidiabetic agent and much more.

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