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Phytonutrients and Mineral Analysis of *Cymbopogan citratus* Leaves

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Abstract Phytochemicals and mineral elements in medicinal plants have possible role in human health and nutrition. Their therapeutic products have been available and applied in the treatments of diseases throughout history. The current study investigated the availability of some phytonutrients and mineral elements present in Cymbopogan*citratus* leaves. Various methods were employed in identifying, detecting and quantifying the phytonutrients. The minerals; calcium, sodium, potassium, zinc, chromium and copper were estimated by the used of an atomic absorption spectrophotometer. The results obtained for phytonutrients quantification showed significant differences ($p < 0.05$) in their mean values. Statistical analysis of the elements reveals significant differences ($p < 0.05$) between the mean values Na, K and Ca with no preference ($p > 0.05$) in the mean values of Cu, Zn and Cr. Analysis of lemongrass leaves revealed various nutrients in various levels with potential to act as a source of useful drugs and also to improve the health. Further research should be carried out to isolate, purify and possibly characterize the active constituents responsible for its efficacy.

Keywords Nutrients, Medicinal plants, Tea

Introduction

Worldwide, phytomedicine and herbal medicine are culturally accepted and ubiquitously practiced. Recent attention has been paid to evaluate the phytochemistry of *C. citratus.* Lemongrass (*Cymbopogon citratus*) of family, Poaceae, is an aromatic perennial grass with rhizomes and densely tufted fibrous root plant widely distributed worldwide and most especially in tropical and subtropical countries [1-3]. Several reports have linked its origin to Asia (Indochina, Indonesia and Malaysia), Africa and the America. The plant could grow up to 6-inch-high and its bulb-like stems consist of terete and glabrous linearly vented sheathed leaves with narrow base and acute apex. The leaf height is about 10 cm in length and 2 cm in width [4]. When squeezed, the leaves usually produce yellow or amber coloured, aromatic essential oil [5].

Traditionally, tea made from lemongrass is popular among countries of South America, Asia and West Africa [4]. *C. citratus* has been used over many years to make caffeine-free tea and as an herbal drink, suggesting that it may be a healthier alternative to caffeine-containing tea products [6]. Akande *et al.* [7] found that, in comparison to other tea brands consumed among Nigerians (Lipton tea, Nescafe, green tea, and Top tea); *C. citratus* tea was a good source of antioxidants such as flavonoids, and therefore a nutritionally acceptable and medicinally valuable beverage.

C. citratus is added to non-alcoholic beverages and baked food, and used as a flavoring and preservative in confections and cuisines [8]. Lemongrass also enjoyed wide application in folk medicine [9]. It is used in herbal medicine for a wide range of applications based on its antibacterial [10], antifungals [11], antiprotozoal [12], anti-carcinogenic [13], anti-inflammatories [14], antioxidants [15], cardioprotective [16], antitussive, antiseptic, and anti-rheumatic activities. It has also been used to inhibit platelet aggregation [17], treat diabetes [18], dyslipidemia, gastrointestinal disturbances [8], blood purifiers [5], malaria [19], flu, fever, and pneumonia [20], as well as in aromatherapy.

In cosmetics, its essential oils are used as fragrance in the manufacture of perfumes, soaps, detergents, and creams [8]. The medicinal value of plants lies in some chemical substances that produce a definite physiological action in human body. The most important of these bioactive constituents are alkaloids, tannins, flavonoids, phlobotannins, saponins and cardiac glycoside [21]. The present study is designed to determine the chemical constituents of *Cymbopogon citratus*leaves.

Materials and Methods

Collection and preparation of the plant materials

Whole plant of *Cymbopogon citratus*of the *poaceae*family was collected from Hotoro, Tarauni Local Government Area of Kano State, Nigeria. The plant was authenticated in the herbarium unit of the Department of Biological science, Bayero University Kano. Apparently, a healthy leaf of the plant was removed from plant stalk, rinsed with clean water and shade dried to a constant weight. The dried plant sample was ground to fine powder with grinding machine, packaged in glass jars and stored at 4˚C until analysis.

Sterilization of materials

All the equipment was sterilized according to the methods described by Cheesbrough [22] and Jawetz *et al* [23]. The glass wares were surface sterilized (to remove surface contaminants) with 70% ethanol and thoroughly rinsed with sterile distilled water. They were placed in racks to dry and were packed into the autoclave for sterilization at a temperature of 121 ºC for 15 minutes at 15 psi.

Phytochemical screening

Chemical tests for the screening and identification of bioactive chemical constituents in the medicinal plant under study were carried out in extracts using the standard procedures as described by Sofowora [24].

Quantitative Phytochemical Analysis

Determination of alkaloids [25]

Five grams of ground sample was weighed into a 250 ml beaker, and 200 ml of 20% acetic acid in ethanol was added and was covered to stand for 4 hrs. This was filtered and the extract was concentrated using a water bath to evaporate one-quarter of the original volume. The concentrated ammonium solution was added drop-wise to the extract until the precipitation was completed. The entire solution was allowed to settle and the precipitate was collected by filtration, after which it was weighed.

Determination of saponins [26]

Twenty grams of the ground plant sample was dispersed in 200 ml of 20% ethanol. The suspension was heated over a hot water bath for 4 h with continuous stirring at about 55 ˚C. The mixture was filtered and the residue re-extracted with another 200 ml of 20% ethanol. The combined extracts were reduced to 40 ml over water bath at about 90 ˚C. The concentrate was transferred into a 250 ml separating funnel and 20 ml of diethyl ether was added and shaken vigorously. The aqueous layer was recovered while the ether layer was discarded. The purification process was repeated. 60 ml of normal butanol extracts were washed twice with 10 ml of 5% aqueous sodium chloride. The

remaining solution was heated in a water bath. After evaporation the sample were dried in the oven into a constant weight. The saponin content was calculated in percentage.

Determination of Flavonoids [27]

Five grams of the ground plant sample was weighed in a 250 ml titration flask, and 100 ml of the 80% aqueous methanol was added at room temperature and shaken for 4 hrs in an electric shaker. The entire solution was filtered through What man filter paper no. 1 (125 mm) and again, this process was repeated. The filtrate as a whole was later transferred into a crucible and evaporated to dryness over a water bath and weighed.

Determination of Tannins [28]

100 ml of distilled water was added to two grams of the sample. The solution was kept in water bath at 90 ˚C for one hour. The mixture was filtered by using Whatman's paper No. 1 and the residue was re-extracted again. The two filtrates were collected together and allowed to cooldown. Distilled water was added to the filtrates up to 500 ml. One hundred ml of the solution transferred to a beaker, and then 10 ml of 40% formaldehyde and 5ml of concentrated sulpheric acid were added respectively. The whole mixture was refluxed for 30 minutes and was left to cool down. The mixture was filtered and the precipitate dried and weighed.

Statistical analysis

Statistical analysis was performed using the statistical package for social sciences (SPSS), version 20.0. Data obtained were analysed using descriptive statistics and reported as the mean ± standard deviation (SD).

Mineral Element Analysis

Mineral element was estimated by the used of an atomic absorption spectrophotometer. The sample solutions in the sample bottles were analyzed for the concentration of the individual elements. Each element has specific cathode discharge lamp and this lamp was used to determine a particular element. Discharge lamp emits radiation at a wavelength specific for each element being assayed. This specificity can be obtained only from a pure sample of the element that is excited electrically to produce an arc spectrum on that element. Atomic Absorption Spectrophotometer was used for the determination of calcium, sodium, potassium, zinc, chromium and copper using the methods of AOAC [29].

Results and Discussion

Results

The qualitative test for the detection of some phytochemical's compositions in *C. citratus* leaves indicates the presence of alkaloid, flavonoid, saponin, tannin and absence of anthraquinone.The quantitative analysis of the phytochemicals presented in table 1 indicates the 100 g of the *C. citratus* leaves to has flavonoids with highest concentration of 27.10 ± 0.15 g, followed by alkaloid (3.30 ± 0.06 g), saponin (0.30 ± 0.06 g) with tannins as having the least concentration of 0.02 ± 0.00 g. Significant differences ($p < 0.05$) were observed in mean value of all the phytochemicals present in 100 g of the extracts.

Table 1: Results of quantitative analysis of phytochemicals present in *C. citratus* leaves

Phytochemicals	Composition (g/100 g)
Alkaloid	3.30 ± 0.06^{a}
Flavonoid	27.10 ± 0.15^{b}
Saponin	0.30 ± 0.06^{c}
Tannin	0.02 ± 0.00^{d}

Values are expressed as Mean ± S.D of 3 replicates, values with same superscripts within same column are considered not significantly different ($p > 0.05$).

The mineral analysis of *C. citratus* leaves reveals various major and trace elements like Na, K, Ca, Cu, Zn and Cr (Table 2). The analysis shows 100g of sample to has sodium with the highest concentration of 6.63 ± 0.034 mg, followed by potassium (2.55 ± 0.015 mg), calcium (1.00 ± 0.002 mg), copper and zinc contains the same concentration of 0.08 ± 0.002 mg, with chromium as having the least concentration of 0.05 ± 0.010 mg. Statistical analysis reveals significant differences ($p < 0.05$) between the mean values Na, K and Ca; while no significant differences ($p > 0.05$) were observed in the mean values of Cu, Zn and Cr.

Table 2: Results of mineral element analysis of *C. citratus* leaves.

Mineral Elements	Symbol	Quantity (mg/100 g)
Sodium	Na	6.63 ± 0.034^{a}
Potassium	K	2.55 ± 0.015^{b}
Calcium	Ca	1.00 ± 0.002^{c}
Copper	Cu	0.08 ± 0.002^{d}
Zinc	Zn	0.08 ± 0.002^{d}
Chromium	Cr	0.05 ± 0.010^{d}

Values are expressed as Mean ± S.D of 3 replicates, values with same superscripts within same column are considered not significantly different ($p > 0.05$).

Discussion

Cymbopogan citratus is an economically important aromatic perennial plant of poaceae family that has been used to extract essential oils and has extensive therapeutics in number of countries [8]. Qualitative analysis of the plant leaves indicates the presence of flavonoids, alkaloids, tannin, saponin as some active phytonutrients as shown in Table 1.

The medicinal value of plants lies in some chemical substances that have a definite physiological action on the human body. Different phytochemicals have been found to possess a wide range of activities, which may help in protection against chronic diseases. For example, alkaloids protect against chronic diseases. Saponins protect against hypercholesterolemia and antibiotic properties. Steroids and triterpenoids show the analgesic properties. The steroids and saponins were responsible for central nervous system activities [30].

Ozor and Igbokwe [31] and Salman *et al.* [32] reported the importance of alkaloids, saponins and tannins in various antibiotics used in treating common pathogenic strains. The alkaloid content of lemon grass leaves 3.298 ± 0.06 g/100g has been found to be higher than what obtained by Krishnaiah *et al.* [33] in *A. Indica extracts* (0.52 ± 0.12 g/100g) and *H.rosa - sinensis* (0.51 ± 0.16 g/100g); and with what obtained by Amin *et al.* [30] in *Taraxacum officinale* leaves (0.5 ± 0.03 g/100g). Alkaloids been ammonia derivative are widely exploited as pharmaceutics, stimulant and narcotics. Plant derived alcohol are used in clinical as muscle relaxant, morphine and codeine, antibiotics, sanguinarine and berberine and sedative scopolamine [34].

The flavonoid content of *Cymbopogan citratus* leave found to 27.10 ± 0.15 g/100g, compared with *M. oleifera, I. cylindrical* and *Taraxacum officinale* leaves having 0.51 ± 0.18, 0.32 ± 0.16 and 1.2 ± 0.21 g/100g respectively, much less than the concerned plant [30]. Flavonoids are potent water-soluble antioxidants and free radical scavengers, which prevent oxidative cell damage [35]. The higher contents of flavonoids justify the use of lemon grass as medicinal plant. The diuretic and antibacterial activity of plant extracts containing flavonoids have been documented [36]. The alkaloids contained in plants are used in medicine as anaesthetic agents [37].

On the other hand, Saponin having a concentration of 0.30 ± 0.06 g/100g is found to be lower than what obtained in *Salamun incanum* (bitter garden egg) with a level of 19.90 ± 0.67 g/100g by Auta *et al.* [38]. Saponin is having soap like properties i.e. produce foam [39]. Saponin are also important therapeutically as they are shown to have hypolipidemic and anticancer activity and also used in the production of sex hormones such as progesterone derived from diosgenin [40]. The presence of saponins in plants have been reported to be responsible for the tonic and stimulating activities observed in Chinese and Japanese medical herbs [41].

However, tannins having the least concentration of 0.02 ± 0.00 g/100g were also found to be low in *Pteris biaurita* with a level of 0.62 ± 0.67 g/100g [42]. Tannins are soluble in water and alcohol and have characteristics feature of tan i.e. convert things to leather [39]. Tannins are used as antiseptic due to the presence of phenolic group, and used as healing agents in a number of diseases [43]. Tannins is known to show curative activity against several bacteria and it is not surprising that this plant extracts are used traditionally by herbalist to cure bacteria related ill-health. Tannins with its protein precipitating and vasoconstriction effect could be advantageous in preventing ulcer development [44].

The results obtained in this study thus suggest that the identified phytochemical compounds may be the bioactive constituents responsible for the efficacy of the leaves of the plants studied. The presence of some of these compounds have been confirmed to have antimicrobial activity [45], hence it could be inferred that the plant extracts could be a source for the industrial manufacture of drugs useful in the chemotherapy of some microbial infections [31].

The quantitative analysis of the mineral element shows that *C. citratus* leaves contains mineral elements which are extensively essential in the body. The calcium level in the leaves studied compares favorably with the value reported in some green leafy vegetables consumed in Nigeria and some wild edible leaves grown in Eastern Anatolia, Turkey [46-47]. Calcium is minerals present in largest quantity in the structure of the body and in the bone [48]. Calcium ions are needed in several metabolic process such as blood coagulation, muscle contraction, enzyme activation, nerves transmission, hormone function and membrane transport.

Potassium is one of the most important intracellular cations. Potassium with the concentration of 2.55±0.015 mg/100g differ significantly ($p < 0.05$) with what was obtained in *Talinum triangulare* (water leaf) with a concentration of 3.00 mg/100g by Mohammad [49]. It is imperative to know that potassium and calcium rich vegetables in daily diet ensure the 20 to 25% of the daily requirement for potassium and calcium that aid strong bones and health teeth [50]. Therefore, the use of *C. citratus* leaf will help to boast the extracellular potassium, which is important in transmission of nerves impulse, muscle contraction and the maintenance of blood pressure.

Chromium concentration of 0.05 ± 0.01 mg/100g was found to be lower than what was obtained in *Solanum incanum* (Bitter garden egg) 1.60 mg/100g by Auta *et al.* [38]. Chromium functions in the control of glucose and lipid metabolism. Chromium is potentiator for insulin; insulin resistance may be consequence of chromium deficiency. Supplementation of chromium containing compounds like the lemon grass leaves will improve glucose tolerant [51].

The concentration of Copper (0.08 ± 0.002 mg/100g), was found to be lower with what is obtained in *Solanum incanum* (bitter garden egg) with a concentration of 2.10 mg/100g [38]. Copper was found to play metabolic role as an integral component of many metalloenzymes, including ceruloplasmin, superroxidase dismutase, dopamine β-hydroxylase, ascorbic oxidase and tyrosinase. The major function of copper metalloenzymes involved oxidation – reduction reaction. Most known copper containing enzymes bind and react directly with molecular oxygen [52]. The use of lemon grass in supplementation or as medicinal plant will boast the metabolic efficiency of copper.

Zinc is required for growth and wellbeing in animals. The present study reveals Zn to has concentration of 0.08 ± 0.002 mg/100g, which in turn lower than what was obtained by Agbogidi and Akpomorine [53] in *Vernomiaamygdalina* (Bitter leaf) with a level of 5.00 mg/100g. Several researchers reveal that supplementation of lemon grass leave enhanced growth and help to boast metabolic activities in zinc containing enzymes.

The results of sodium content in *C. citratus* leaves is lower than those reported for sodium in some vegetables obtained by Mohammad [49]. Sodium is the principle extracellular cation and is used for acid base balance and osmoregulation in intermodular fluid [6]. It is also important for the active transportation of substance through the cellular membrane.

Conclusion

The mineral and phytochemical analysis revealed various nutrients present in lemongrass leaves in various levels with potential to act as a source of useful drugs and also to improve the health status of the consumers. The

continued traditional medicinal use of these plants is therefore encouraged while it is suggested that further work should be carried out to isolate, purify and possibly characterize the active constituents responsible for this activity.

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