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Evaluation of Some Vitamins and Macro-Nutrients Composition of Ethanolic Extract of *Tecoma stans* and *Costus afer* Leaves

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Authors' contributions

This work was carried out in collaboration between all authors. Author IPE designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors IPE and EOU managed the analyses of the study. Author DA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aim: This study aims to determine the presence of some vitamins and minerals in both *T. stans* and *C. afer* leaves.
Materials and Methods: Composition of some vitamins and minerals of ethanolic extract of *T. stans* and *C. afer* leaves were evaluated and collected at Malabo Campus, University of Calabar, Calabar and from Eman-Uruan local government area, Akwa Ibom State, Nigeria respectively.
The parameters investigated were determined using standard biochemical methods.
Results: The leaves contained a variety of vitamins (A, D, E, B complex and C) with vitamin E-(276.33.±3.28 mg/100 g) for *Tecoma stans* and (265.67±5.49 mg/100 g)for *Costus afer*. *T. stans* recorded higher concentration in mg/100 l for the determined vitamins except for vitamin D, whose

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concentration for *C. afer* (0.09±0.01 mg/100 g) was higher than the value (0.07±0.01 mg/100 g) for *T. stans* though it was significant. *T. stans* is significantly different [p=0.05] from *C. afer* for vitamins A and C respectively.
The mineral compositions of *T. stans* and *C. afer* leaves contain considerable amount of Potassium (3.27 ± 0.009 mg/l) and (4.63±0.09 mg/l), Magnesium (26.03 ± 0.009 mg/l) and (89.83±0.91* mg/l), Sodium (5.27 ± 0.078 mg/l) and (16.23±0.12* mg/l), Calcium (25.33 ± 0.88 mg/l) and (82.00±1.53* mg/l), Phosphorus (2.27±0.09 mg/l) and (1.63±0.09* mg/l), respectively. *C. afer* contained significant ($p < 0.05$) higher concentration of Mg, Ca, K and Na compared to *T. stans.* This indicates the tendency of *T. stans* and *C. afer* to be able to control osmotic balance, essential for bone formation, lower blood pressure and also act a source of antioxidant vitamins and minerals.
Conclusion: The presence of these vitamins and minerals in both *T. stans* and *C. afer* leaves in this leafy vegetables supports the use of these leaves for food and ethnomedicinal purposes in Nigeria and parts of the world where they are cultivated.

Keywords: Tecoma stans; Costus afer; antioxidant; vitamins and minerals.

1. INTRODUCTION

In Nigeria, vegetables are the cheapest and readily available sources of proteins, vitamins and minerals [1] and therefore could also benefit the populace with their medicinal properties. Vitamins are a group of substances required for normal cellular function, growth and development.

Costus afer Ker Gawl (Costaceae) is among the 150 species of stout, perennial and rhizomatous genus *Costus* [2]. It can be found in the forest belt of Senegal, South Africa, Guinea, Niger, Sierra Leone and Nigeria [2,3]. The plant is commonly called bush cane, *Ireke omoda* (Yoruba Western part of Nigeria) *Opete* (Igbo Eastern part of Nigeria and *Mbritem* (Ibibio/Efik Southern part of Nigeria). *C. afer* which belongs to the family *Zingiberaceae* is a monocot and a relatively tall, herbaceous, unbranched tropical plant with creeping rhizome. It is commonly found in the moist or shady forest of the west and tropical Africa [4]. *C. afer* is a perennial, rhizomatous herb that can attain a height up to 4 m. It is often planted in a home garden for medicinal purposes [5]. Many scientists have reported on the ethnopharmacological characteristics of medicinal plants. Their finding revealed different properties of these medicinal plants. It is a useful medicinal plant that is highly valued for its anti-diabetic, anti-inflammatory and anti-anthritic properties in the south - east and south - west Nigeria [6]. The effects of *T. stans* and *C.afer* on lipid profile status has been evaluated and shown to have low lipidemic effect on diabetic albino rats [7]. It is also used for other socio- cultural purposes such as wrapping indigenous food items.

T. stans from *Bignoniaceae* family is a semi evergreen ornamental tropical shrub or small tree originally from Latin America which has been cultivated in Nigeria recently. It is found in Nigeria, India and Iran. Its' primary application has been in treating diabetes and digestive problems. Extracts from *T. stans* leaves have been found to inhibit the growth of yeast infection. Flower and leaves have some medicinal value for the treatment of various cancers [8,9], have studied the anticancer activity of *T. stans* and antioxidant constituent. Roman-Ramos et al. [10] have reported that the extracts have antibacterial activity on human pathogenic bacteria.

2. MATERIALS AND METHODS

Several chemicals and analytical grade reagents were purchased and used for this research, and they include ethanol, sodium hydroxide and sodium chloride.

2.1 Collection and Preparation of Plant Materials

Fresh leaves of *T. stans* and *C. afer* were collected at Malabo Campus, University of Calabar, Cross River State and Eman-Uruan, Uruan local government area, Akwa Ibom State, Nigeria, respectively. The leaves were rinsed severally with water to remove dust particle and debris and allowed to completely drain. The dried leaves were crushed into fine powder and stored in clean capped bottles.

2.2 Extraction of Plant Material

500 g of the dried powdered leave of the plant was separately soaked in 80% ethanol for 72

hours with occasional agitation after which they were filtered into clean beakers through chess material and Whatman No 1 filter paper to obtain a homogenous filtrate. The filtrate was concentrated in vacuo at a low- temperature of 37°C – 40°C to about one- tenth of the original volume. The concentrates were allowed in an open water bath (40°C) to evaporate to complete dryness. Evaporation was maintained at 40°C to prevent denaturation of bioactive constituents inherent in the crude extract. A semi- solid dark green coloured concentrate was obtained from the leaves. It was stored in clean capped bottles in a refrigerator for further use.

2.3 Vitamin Compositions

The amount of vitamin A, E, C, B_{12} in the sample was determined using the method described by Achikanu et al. [11], while Vitamin B_1, B_2 and B_3 was determined using the method described by Aslam et al. [12].

2.4 Mineral Analyses

The atomic absorption spectrophotometer (AAS) was used for the analyses of the following metals: Mg, Ca, and P while the flame photometer was used for the analyses of K and Na. Using AAS, the ash solutions of the plant samples were prepared by weighing 5 g of each of the powdered plant samples. These were then kept at 550°C in a muffle furnace for 5 hrs, and the residues ash was dissolved in 100 ml of deionised water. Suitable salts of the metals were used to make their standards, lamps were fixed. The standard minerals solutions were injected to calibrate the AAS using acetylene gas. An aliquot of ash solutions was injected and the concentrations obtained from the AAS. Using the flame photometer, the diluents of the sample was aspirated into the Jenway Digital flame photometer using the filter corresponding to each mineral element.

2.5 Statistical Analysis

The result was analysed for statistical significance by one way ANOVA. All data were expressed as mean ± standard error of the mean, p=0.05 were considered significant.

3. RESULTS

The results of vitamin compositions and macro-nutrients of *T. stans* and *C. afer*.

Table 1. Vitamin compositions in *T. Stans* and *C. afer* (mg/100 g)

Vitamins	*Tecoma stans*	*Costus afer*
Vitamin A	0.61±0.03	0.48±0.02*
Vitamin D	0.07±0.01	0.09±0.01
Vitamin E	276.33±3.28	265.67±5.49
Vitamin B_1	0.64±0.05	0.53±0.03
Vitamin B_2	1.30±0.07	1.28±0.07
Vitamin B_3	0.44±0.04	0.43±0.03
Vitamin B_6	0.61±0.03	0.55±0.04
Vitamin B_{12}	0.09±0.01	0.07±0.00
Vitamin C	3.96±0.18	3.27±0.09*

*Values are expressed as mean ± S.E.M of triplicate determination. * implies significantly different.*
T. stans is significantly different (P=.05) from C. Afer for vitamins A and C

4. DISCUSSION

The qualitative and quantitative value of vitamins (Fat/water soluble) and minerals elements (k, Mg, Na, Ca, and P) were obtained for both *T. stans* and *C. afer*. Vitamins A, D, E, B, B_3, B_6, B_{12} and C were found in both *T. stans* and *C. afer*. Vitamin A and C in *C. afer* were significantly lower than that of *T. stans* respectively. Vitamin E and C were higher in *T. stans* than in *C. afer*. Vitamin E and C act as antioxidants and stabilises polyunsaturated fatty acids, and they also act to inhibit damages of the lung from oxidants such as O_3 and NO_3 present in the air. Their antioxidative property is due to the presence of phenolic – OH group at C -6 in the chroman nucleus [13]. Yeh et al. [14] however observed a mixed and yet to be proven role of Vitamin E and glucose control due to reasons stated above i.e its potent lipophilic antioxidants activity and its influence on protein glycation, lipid oxidation and insulin secretion and sensitivity. Ekpe et al. [7] also observed the hypolipidemic effect of Ts and Ca which could be a result of the roles of Vitamin E and C in these plants. Vitamin E also affects non- oxidative glucose metabolism although the mechanism of this action is not yet known [14]. Vitamins and organic compounds are natural components of plant foods. They are essential for normal health and growth but cannot be synthesised by the host and thus obtained exclusively from the diet of which they are present in extremely small concentration. Concentration of vitamin B_3 was 0.01 mg/100 g, which was lower in *C. afer* than in *T. stans* while vitamin B_6 content is higher in *T. stans* than in *C. afer*. Vitamin B_3, B_6 are essential co-factors in a lot of biochemical reactions and play a role in glucose, lipid and amino acid metabolism with

Table 2. Mineral contents of *T. stans* and *C. afer* (mg/l)

	Potassium	Magnesium	Sodium	Calcium	Phosphorus
Tecoma stans	3.27±0.09	26.03±0.07	5.27±0.78	25.33±0.88	2.27±0.09
Costus afer	463±0.09*	89.83±0.97*	16.23±0.12*	82.00±1.53*	1.63±0.09*

*Values are expressed as mean ± S.E.M of triplicate determination. * implies significantly different. C. Afer is significantly different (P=.05) from T. stans for all the determined minerals except for phosphorus, which is higher in T. stans*

distinct effect. Deficiency of vitamin B_6 is associated with glucose intolerance, but supplementation, however, has not improved glycaemic control. There has been the unconfirmed use of vitamin B_{12} in the treatment of peripheral neuropathy a complication in diabetes [15]. Vitamin B_3 is thought to have a positive effect on patients with newly diagnosed diabetes. It tends to support the preservation of Beta cells from autoimmune destruction by maintaining intracellular levels of NAD^+ while inhibiting polymerase which is involved in DNA repair [16]. From the foregoing, the presence of those vitamins in both plants renders them as assets in providing required nutrients for normal maintenance of good health. The qualitative and quantitative presence of selected minerals elements (K, Mg, Na, Ca, and P) were found in the leaves of *T. stans* and *C. afer*. All minerals assayed in this study were higher in *C. afer* than *T. stans* except for Phosphorus where the reverse was obtained, while Mg, Na and Ca were much higher in *C. afer* than in *T. stans*. Most antioxidant enzymes or defence system of the body makes use of mineral elements as co-factors.

The mineral compositions of *T. stans* and *C. afer* leaves are shown in Table 2. It contains considerable amount of Potassium (3.27 ± 0.009) and (4.63±0.09), Magnesium (26.03 ± 0.009) and (89.83±0.91*), Sodium (5.27 ± 0.078) and (16.23±0.12*), Calcium (25.33 ± 0.88) and (82.00±1.53*), Phosphorus (2.27±0.09) and (1.63±0.09*), respectively. Calcium is reported to be essential for blood clotting, bone and teeth formation and as a co-factor in some enzyme catalysis [17]. In humans, magnesium is required in the plasma and extracellular fluid, where it helps to maintain osmotic equilibrium [1]. It can also prevent some heart disorders and lower blood pressure in humans. This justifies the use of *T. stans* and *C. afer* leaves in folklore medicine as a blood tonic because of its blood-boosting effect [17]. Moderate quantities of sodium and potassium were present in the leaves of *T. stans* and *C. Afer,* and these are principal cations of extracellular and intracellular fluids and aid in maintaining electrolyte balance in the body [17]. Potassium is essential and is required in large amounts for proper growth and plant reproduction. Phosphorous maintain blood sugar levels and normal heart contraction. It is also important for normal cell growth and repair, bone growth and kidney function. It plays an important role in maintaining the body's acid-alkaline balance [18].

5. CONCLUSION

The present study shows the presence of vitamins, minerals and nutrients in *T. stans* and *C. afer* leaves which may, therefore, justify its nutritional benefits to human health. Leaves of *T. stans* and *C. afer* seem to have good nutritive, vitamin and mineral element values necessary to maintain good health.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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