Nutritional Profile and Phytochemical Composition of *Ficus capensis* Stem collected from Agbani, Enugu, South East Nigeria.

ABSTRACT

Ficus capensis commonly called bush fig tree belongs to the family Moraceae and have been used for different medicinal purposes. Thisstudy aimed at determining the Proximate, Phytochemical, Vitamin and Mineral Compositions of *Ficus capensis* stem. The analyses were done using standard biochemical methods. The results of Proximate composition showed that the stem contained moisture (21.94 ± 0.10 %), Crude Fat (2.45 ± 0.21 %), Crude protein (15.24 ± 0.05 %), Crude Fiber (32.55 ± 0.06 %), Carbohydrate (18.79 ± 0.34 %) and Ash (9.04 ± 0.12 %). The Total energy value was 158 KCal/100g. The phytochemical analysis revealed the presence of Tannin (1.32 ± 0.01 mg/g), Alkaloid (0.55 ± 0.00 mg/g), Saponin (2.17 ± 0.00 mg/g), Glycoside (1.13 ± 0.00 mg/g), Terpenoids (0.10 ± 0.00 mg/g), Flavonoids (2.42 ± 0.02 mg/g), Steroids (0.54 ± 0.00 mg/) and Phenol (0.97 ± 0.00 mg/g). The result also revealed that the stem contained vitamins A (0.57 ± 0.02 mg/g), β-carotene (1.27 ± 0.02 mg/g), B_1 (0.89 ± 0.02 mg/g), B_2 (1.14 ± 0.01 mg/g), B_3 (0.96 ± 0.01 mg/g), B_6 (0.85 ± 0.01 mg/g) and B_9 (1.28 ± 0.04 mg/g), C (0.81 ± 0.01 mg/g), D (0.26 ± 0.01 mg/g), E (0.85 ± 0.02 mg/g) and K (1.10 ± 0.02 mg/g). The Mineral composition include Calcium (34.01 mg/kg), Phosphorus (0.57 mg/kg), Chloride (2.56 mg/kg), Potassium (21.40 mg/kg), Sulphur (0.26 mg/kg), Iron (0.89 mg/kg), Manganese (0.07 mg/kg), Copper (0.28 mg/kg), Zinc (0.07 mg/kg), Cobalt (0.02 mg/kg) and Selenium (0.52 mg/kg). These results have shown that stem of *Ficus capensis* is a potential source of nutrients and bioactive compounds which are found useful in nutrition and therapy.

Keywords: *Ficus capensis*, Mineral, Stem, Proximate, Phytochemical, Vitamin

1. INTRODUCTION

The world at large depends on the use of plants for their nutritional and therapeutic needs. Plants contain compounds that have therapeutic properties and are equally nutritionally important due to their high contents of proteins, fibres, essential fatty acids and minerals [1,2]. All these are necessary in the maintenance of balanced nutritional diets[3]. And so, imbalance or deficiency of these nutrientscould cause adverse effect on the physiology of the

bodysuch as cardiac musclemass, decreased muscle functions, delayed wound healing process, altered gastrointestinal functions and impaired immunity[4,5]. Medicinal plants are also used as sources of raw materials for formulation of drugs. The potency of medicinal plants for therapeutic purposes is often based on their organic constituents such as saponins, flavonoids, tannins, alkaloids and essential oils. Mineral nutrients are usually present in plants in low concentrations which are unstable in time and space caused by environmental factors like physicochemical properties, climate and weather [6]. Recently, there have been reports that prolonged ingestion or overdose of the medicinal plants leading to chronic accumulation of different elements caused various health problems[2]. In view of this, determination of the elemental composition of the medicinal plants is very important since some essential metals induce toxic effects when their intake is in high concentration. Furthermore,even at very small amount, the non-essential metals are toxic[1].

Ficus capensis commonly called bush fig tree is one of the numerous plants used in folklore medicine. It is locally called in Nigeria Opoto (Yoruba), Akokoro (Igbo), Rima bichehi (Fulani), Obada (Edo) and Uwaraya (Hausa) [7]. It belongs to the family Moraceae. The leaves of the plant are used for numerous medicinal purposes. In Nigeria, the decoction is used in treating diarrhoea[8], dysentery, oedema, epilepsy and rickets in infants[9]. It is used to treat colds, sore throats, wounds and to stimulate lactation [10]. The fruits and seeds are eaten raw as supplements by local populations of Africa. Studies have reported its blood-boosting effect [7, 11], anti-sickling [12] antibacterial [13], anti-abortifacient [9], immune-stimulatory [14], antidiarrhoea[15], antioxidant [16] and pro-fertility in treating azoospermia [17]. With the increase interest in medicinal plants and the quest of getting a replacement for the high cost of synthetic drugs in order to sustain individual's well-being and health as well as the bio-prospecting of new plant-derived drugs, this study was therefore aimed at the evaluation of the various proximate, phytochemical, vitamin and mineral contents of the stem of*Ficus capensis.*

2. MATERIALS AND METHODS

2.1 Sample collection and Identification

The stem which bears the leaves of *Ficus capensis* was collected at Agbani, Enugu state, Nigeria. It was identified and authenticated by Prof. Eze C.S of the Biology section,

Department of Applied Biology and Biotechnology, Enugu State University of Science and Technology (ESUT).

2.2 Sample Preparation

The stem of *Ficus capensis* wascut out from the tree. The leaves were removed and then the stem was thoroughly washed, cut into small pieces and air dried at room temperature for two(2) weeks. The dried stems were ground into powder using manual grinding machine. It was stored in airtight container and kept in the refrigerator until required.

2.3 Proximate analysis

The proximate compositions were analyzed using the respective procedure according to the methods of AOAC [18].The carbohydrate content was determined by difference [19] as % Carbohydrate = 100–(% moisture + %crude fiber + %ash + % crude fat + % crude protein).The calorific value(total energy content) was determined by multiplying the values of crude protein, crude fat and total carbohydrates by their respective Atwater factors; 4, 9 and 4. The sum of the products is expressed in kilocalories per 100 g sample as reported by Onyeike and Ehirim[19] thus:

Total energy (Kcal) = 4 x (Protein + carbohydrate) + 9 x (lipid).

2.4 Phytochemical Analysis

The Phytochemical analysis was done using ethanol extract of *Ficus capensis* stem. The powered sample (approximately 250 g) was soaked in 80% ethanol (1500ml). The mixture was stirred, covered and allowed to stand for 24 hours. The mixture was then filtered into a conical flask using Whatman No 1 filter paper.The filtrate was then evaporated and concentrated in a water bath at 50 ºC.

2.4.1 Qualitative Phytochemical Analysis

Tannin, Alkaloids, Flavonoids and phenols were evaluated using the method of Trease and Evans [20] while Saponin, Terpernoids, Steroids and glycosides were evaluated using the method of Sofowara[21].

2.4.2 Quantitative Phytochemical Analysis

Alkaloid, terpenoid, glycoside and phenol were determined according to the method of Harborne [22]. Saponin was determined using the method of Obdoni and Ochuko [23]. Tannin was determined using the method of van-Burden and Robinson [24]. Flavonoid was determined using the method of Bohn and Kocipal-Abyassan[25]. Steroid was determined according to the method of Okeke and Elekwa[26].

2.5 Vitamin Analysis

The vitamin contents (Vitamins A, β-carotene, B_1, B_2, B_3, B_6, B_9, C, D, E and K) of Ficus capensis stem were determined using the method of AOAC [18].

2.6 Mineral Analysis

The following minerals were determined: Calcium, Phosphorous, Magnesium, Chloride, Potassium, Sulphur, Iron, Manganese, Copper, Zinc, Cobalt and Selenium. The mineral analyses were carried outaccording to the method of AOAC [18]using X-ray fluorescence which is a non-destructive analytical technique used to determine the elemental composition of materials.

2.7 Statistical Analysis

Data obtained from this study were processed using SPSS version 25 (SPSS Inc., Chicago, Illinois, USA) and presented as mean (n = 2) ± standard deviation.

3. RESULTS

3.1 Proximate Compositions

The result of the proximate analysis is presented in Table 1. The result revealed that the plant has the highest content of crude fiber (32.55 ± 0.06%) followed by moisture(21.94 ± 0.10%) while the fat content was the lowest (2.45 ± 0.21%). The energy value was low.

Table 1: Proximate Composition of *Ficus capensis* stem

Parameter	Composition
Moisture (%)	21.94 ± 0.10
Crude Fat (%)	2.45 ± 0.21
Crude Protein (%)	15.24 ± 0.05
Crude Fibre (%)	32.55 ± 0.06
Ash (%)	9.04 ± 0.12
Carbohydrate (%)	18.79 ± 0.34
Energy (Kcal/ 100g)	158.43 ± 0.75

Values are Mean ± Standard deviation of duplicate readings

3.2 Phytochemical Composition

The result of the phytochemical analysis (Table 2) showed that Alkaloids and steroids were slightly present, Tannins, Glycosides, Terpenoids and Phenols were moderately present while

Saponin and Flavonoids were highly present with Flavonoids being the highest in concentration.

Table 2: **Phytochemical Composition of *Ficus capensis* stem**

Phytochemical	Qualitative Composition	Quantitative Composition(mg/g)
Tannins	++	1.32 ± 0.01
Alkaloid	+	0.55 ±0.00
Saponin	+++	2.17 ±0.00
Glycoside	++	1.13 ±0.00
Terpenoids	++	0.10 ±0.00
Flavonoids	+++	2.42 ±0.02
Steroids	+	0.54 ±0.00
Phenol	+	0.97 ±0.00

+ = slightly present; ++ = moderately present; +++ = highly present. Values are Mean ± Standard deviation of duplicate readings.

3.3 Vitamin Composition

The result of the Vitamin analysis (Table 3) revealed the presence of vitamins A, β-carotene, B_1, B_2, B_3, B_6, B_9, C, D, E and K. Vitamin B_9 (1.28 ± 0.04 mg/g) was the highest in concentration while Vitamin D was the lowest (0.26 ± 0.01 mg/g).

Table 3: Vitamin Composition of *Ficus capensis* stem

Vitamins	Composition (mg/g)
A	0.57 ± 0.02
β-carotene	1.27 ± 0.02
B1	0.89 ± 0.02
B2	1.14 ± 0.01
B3	0.96 ± 0.01
B6	0.85 ±0.01
B9	1.28 ± 0.04
C	0.81 ± 0.01
D	0.26 ± 0.01
E	0.85 ± 0.02
K	1.10 ± 0.02

Values are Mean ± Standard deviation of duplicate readings.

3.4 Mineral Composition of *Ficus capensis* stem

The result of the Mineral analysis is shown in Table 4. Calcium was the highest in composition (34.01 mg/kg) followed by Potassium (21.40 mg/kg). Magnesium was absent.

Table 4: Mineral Composition of *Ficus capensis* stem

Minerals	Concentration (mg/kg)
Calcium	34.01
Phosphorous	0.57
Magnesium	0.00
Chloride	2.56
Potassium	21.40
Sulphur	0.26
Iron	0.89
Manganese	0.07
Copper	0.28
Zinc	0.07
Cobalt	0.02
Selenium	0.52

4. DISCUSSIONS

4.1 Proximate Composition

The result of the proximate analysis of *Ficus capensis* stem revealed the proximate compositions in the order; crude fiber > moisture > carbohydrate > crude protein > ash > crude fat. A crude fiber content (32.55%) obtained in this study is higher than that of Mgbemena*et al.*[27], who reported a crude fiber content of 9.25%. The value is however lower than that of the stem of *H. odoratissimum*(43.56%) reported by Afuape*et al*[28]. The high fiber content suggests that the fiber of the stem can be used as ropes, fishing nets, composite reinforcement and twines [29]. Crude fiber helps in the absorption and digestion of fat and glucose, however, it causes decrease in nutrient usage and gastro-

intestinaldisturbances [30]. This is because of its high cellulose and low lignin content, making it difficult to be digested in humans[31]. The moisture content of *Ficus capensis* stem in this study was 21.94%. This is higher than the moisture content (2.67% and 8.24%) reported by Achikanu and Ani [32] on the stem bark of *Cissus populnea*and Mgbemena*et al*, [27] on the stem of *Ficus capensis* respectively. Moisture content in a sample is an indication of the shelf life.Thus, sample with low moisture tend tolast longer when stored compared to those with high moisture content. The high moisture content of *Ficus capensis* in this study shows that the stem has a short shelf life and may be prone to microbial spoilage. The carbohydrate content was low (18.79%). This is comparable to that (15.67%) obtained by Afuape*et al* [28] on the stem of *H. odoratissimum*.It is however lower than that (56.69%) obtained by Mgbemena*et al*[27]. Carbohydrate is the main energy source and the low value obtained in this study shows that the stem of *Ficus capensis* may not be an adequate source of energy. The calorific value was equally low (158.43 Kcal/100g). This value is close to that (169.81 Kcal/100g) obtained by Williams *et al*[33]for stem bark of *Maeruaangolensis.* The low energy value is less than the required energy value as an average person requires 2000-3000kcal per day [34]. Protein is important in maintaining body fluid, the synthesis of enzymes and hormones and in the sustenance of a strong immune response [35]. The crude protein content (15.24%) of *Ficus capensis* stem in this study was moderate and higher than those (6.31%, 4.70%) of the leaves of *Ficus capensis* and *Urena lobata* stem as reported by Achi *et al*[35] and Njoku *et al*[36] respectively. Nevertheless, this value is still low when compared with the normal protein value of higher than 20% in the diet [37]. Ash content is indicates the level of mineral content of theplant [38]. The ash content of 9.04% obtained in this study compared favourably with the reports for other plants stems such as *Urena lobata* (7.26%), *H. odoratissimum* (10%), and *Prosopis aficana*(11.52%) as reported by Njoku *et al*[36]Afuape*et al*[28] and Alagbe[39] respectively.

4.2 Phytochemical Composition

The result of the phytochemical analysis of *Ficus capensis* stem showed the presence of Tannins, Alkaloids, Saponin, Glycosides, Terpenoids, Flavonoids, Steroids and Phenol which are in line with that reported by Mgbemena*et al*[27]. The composition of Tannins (1.32 ± 0.01 mg/g) in this study was lower than that (1.987 ± 0.01 mg/g) of stem bark of *Cissus populnea* as reported by Achikanu and Ani [32]. The presence of tannins in the stem of *Ficus capensis* showsthat the stem could be used for the treatment of wounds arising from hemorrhoids and varicose ulcers [40]. Flavonoids in plants are beneficial medicinally with

anti-inflammatory and antioxidant abilities[41]. Therefore, the flavonoid content of the stem of *Ficus capensis* supports the use of the plant for protection against diseases such as atherosclerosis, cancer and inflammation [42]. Alkaloids found in the stem of *Ficus capensis*is in line with that reported by Oyeleke *et al.*[13] and Saxena *et al.*[43], which attributes the antibacterial activity as well as other pharmacological effects of this plant to the presence of alkaloids. Saponins found in vegetables and fruits are essential dietary supplements, they possess antimicrobial activities and protect plants from microbial pathogens [44]. They are antioxidants and aid in the modulation of blood lipids, lowering the risk of cancer and improvement of blood glucose response[45].Terpenoids are useful in themanagement and treatment of malaria, ulcer andcancer; also possess antimicrobial and diureticactivity[46].In addition, terpenoids possess medicinal properties such as anticarcinogenic, antimalarial, anti-ulcer, antimicrobial or diuretic activity [47].Therefore, the presence of glycoside in the stem of *Ficus capensis* shows that it could be pharmacologically useful. Plant steroids possess therapeutic ability, they are used in the treatment of cardiovascular complications[48].Trace amounts of steroid content (0.54 mg/g) found in the stemof *Ficus capensis* could be useful therapeutically.

4.3 Vitamin Composition

The values of the vitamin content obtained in this study on the stem of *Ficus capensis* are higher than those of the leaves as reported by Achi *et al*[35]. The high level of these vitamins could depict that the stem of *Ficus capensis* is an excellent source of vitamins. Vitamin B_9 was the highest in concentration (1.28 ± 0.04 mg/g). The B vitamins are commonly known for their functions as coenzymes foroptimal activities of metabolic enzymes that are requiredfor the generation of energy. They help in stabilizing appetite, formation of red blood cells, maintenance of healthy skin and nervoussystem [49]. Beta carotene was the second in composition. It is a precursor of vitamin A and is very important in strengthening the immune system. Vitamin C and E were also found in the study. They are very significant antioxidants which protect the cell membranes from oxidative stress/damage caused by free radicals [50]. Vitamin C is required for wound healing, maintenance of normal connective tissues, promotes the absorption of dietary iron from the intestine and prevents development of scurvy [51]. Vitamin E aids in the normal functioning of the muscles and red blood cell development [52]. Vitamin D known as sunshine vitamin was the least in concentration. Vitamin D is responsible for increased uptake of intestinal calcium, phosphate and magnesium [53].

4.4 Mineral Composition

Adequate dietary intake of minerals play important rolesin maintaining proper body functions and good healthwhile insufficient consumption in the diet has been linkedto vulnerable immune system hence susceptibility toinfectious diseases [4]. The result of the mineral analysis in this study showed that the stem of *Ficus capensis* contains considerable amounts of the minerals analyzed. The concentration of the macro minerals in the stem of *Ficuscapensis*were in the order Ca >K> Cl >Ph> S. Magnesium was absent. This contradicts that, reported by Mgbemena*et al*[27] who reported the presence of Magnesium in the stem of *Ficus capensis*. The trace minerals were in the order Fe> Se > Cu > Zn >Mn> Co. Calcium was the highest of all the minerals in concentration (34.01 mg/kg). This could suggest that stem of *Ficus capensis* is anexcellent source of Calcium. The value obtained although might be insufficient to meetthe daily requirement of 1300 mg/day [54] but could go a long way in contributing to the amount required.Calcium is found in the skeleton and teeth of animals and also as an essential constituent of living cells and tissue fluids. It is also essential for the activities of enzyme systems necessary for the transmission of nerve impulses and the contractile properties of muscles. Potassium is one of the principalminerals of intra-cellular and extracellular fluids that helpin maintaining fluid balance in the body and regulate bloodpressure. Besides this role, potassium has also beenreported to play crucial role in the utilization of iron,regulate acid–base balance in the body and improve musclefunctions and nerve actions [4]. Phosphorus plays vital role as energy intermediate, in synthesisand the overall architecture of DNA and RNA[55]. Although phosphorus plays a crucialrole in metabolism and growth, its low concentration in plants has been found useful for the improvement of the bioactive ingredient and free radical scavenging capacity in medicinalplants[56]. The importance of lower phosphorus in potential dietary strategies, as oneof the therapeutic targets for the management of chronic kidney diseases, mineral andbone disorders, has been reported [57]; thus, the stem of *Ficus capensis*could be functional in themanagement of chronic kidney diseases.This studyrevealed that the stem of *Ficus capensis* contains iron (0.89 mg/kg). Iron is important in theformation of blood and also acts as an essential componentof hemoglobin, a protein which enables red blood cells totransport oxygen throughout the body. The iron found in the stem of *Ficus capensis*could suggest additional health benefit against anemia,dysfunctional immune system and other diseases associatedwith iron deficiency [58]. This supports the usage of *Ficus capensis* in traditional treatment of anemia [11]. However, caution should be observed since concentrationof iron above daily recommended value could causestomach upset, constipation

and blackened stools [58].Minimum daily requirement depends on age, sex, physiological status, and iron bioavailability and range from about 10 to 50 mg/day[59] but the established provisional maximum tolerable daily intake (PMTDI) of 0.8 mg/kg is applicable to iron from all sources[60].Manganese is an important cofactor of many metabolicenzymes that are essential for the metabolism of carbohydrate,proteins and fat[61]. Theamount (0.070 mg/kg) obtained from the stem of *Ficus capensis* is sufficient to meet human recommendeddaily dose of 2 to 9 mg/day [62]. Zinc is an essential element for plants and animals, but only a small increase in its level may cause interference with physiological processes[63]. Zinc plays role in cellular differentiation and replication, protein synthesis, sexual functions and immunity[64]. The Zinc content (0.074 mg/kg) ofthe stem of *Ficus capensis* was found to be within the limit given by FAO/WHO of 99.40mg/kg. Selenium is important in nutrition, a part of selenoproteins that have important function in synthesis of DNA, metabolism of thyroid hormone, reproduction, protection from infection and oxidative damage [65]. However, high selenium level is highly toxic as 0.45 milligram is the recommended maximum daily intake[66]. The result obtained from this study shows that the Selenium content (0.51 mg/kg) of stem of *Ficus capensis* is a little above the tolerable upper intake level and so excessive consumption may expose one to health risks from selenium. Cobalt has so many benefits; a key component of Cobalamin (vitamin B_{12}) [67]. The smallest amount of cobalt found in soils significantly boosts the health of grazing animals, a daily uptake of 0.20 mg/kg a day is recommended as this the only way they can obtain vitamin B_{12}[68]. Cobalt is classified as a heavy metal and heavy metals are toxic due to solubility in water[69]. High concentration of cobalt causes dermatitis, cardiovascular and lung diseases. The average daily intake of cobalt is estimated to be 5 to 40 µg per day (0.04mg)[70]. The result from this study showed that Cobalt content of stem of *Ficus capensis* was 0.02 mg/kg. This value is within the estimated daily intake.

5. CONCLUSION

The results obtained from this study showed that nutrients, phytochemicals and minerals are found in the stem of*Ficus capensis*. The proximate composition revealed that the stem of *Ficus capensis* is rich in crude fiber and moisture. The analysis of the vitamin content showed that the stem contains considerable amounts of vitamins which are essential in maintaining body functions and act as antioxidant agents. Mineral composition analysis showed that the stem is a good source of essential minerals.These results suggest that the stem of *Ficus capensis* in addition to the leaves which are conventionally used as vegetables could also be

integrated as a functional food into the diet. The findings have provided basis on the therapeutic proof for the inclusion of the stem of this plant in ethno-medicinal use in the treatment of numerous humanailments and various oxidative stress-related diseases. Further study to assess the biological function of thestem is currently in progress.

REFERENCES

1. Jabeen S, Shah MT, Khan S, Hayat MQ. Determination of major and trace elements in ten important folk therapeutic plants of Haripur basin. Pak J Med Plant Res. 2010;4(7):559-66.
2. Ghani A, Ali Z, Ishtiaq M, Maqbool M, Parveen S. Estimation of macro and micro nutrients in some important medicinal plants of Soon Valley, District Khushab, Pakistan. Afr J Biotechnol. 2012;11(78):14386-91.
3. Muhammad S, Amusa NA. Important food crops and medicinal plants in North Western Nigeria. Res J Agric Biol Sci. 2005;1(3):254-60.
4. Bello MO, Asubonteng K, Sodamade A, Adeniyi S. Nutrient potentials of two lesser known leafy vegetables (Vitex doniana L. and Sesamum indicum L.). Int. Food Res J. 2014;21(5):1993-9.
5. Khomdram S, Barthakur S, Devi GS. Biochemical and molecular analysis of wild endemic fruits of the Manipur region of India. Int J Fruit Sci. 2014;14:253-66.
6. Maathuis FJM, Diatloff E. Roles and functions of plant mineral nutrients. In: Maathuis FJM, ed. Plant Mineral Nutrients: Methods and Protocols. Methods in Molecular Biology. 2013;953:1-21.
7. Otitoju GTO, Nwamarah JU, Otitoju O, Iyeghe LU. Nutrient composition of some lesser known green leafy vegetables in Nsukka L.G.A of Enugu State. J Biodivers Environ Sci. 2014;4(4):233-9.
8. Igoli JO, Ogaji OG, Tor-Aryiin A, Igoli NP. Traditional medicinal practices amongst the Igede people of Nigeria. Part 11. Afr J Tradit Complement Altern Med. 2005;2(2):134-52.
9. Owolabi OJ, Nworgu ZA, Falodun A, Ayinde BA, Nwako CN. Evaluation of tocolytic activity of ethanol extract of the stem bark of Ficus capensis Thunb. (Moraceae). Acta Pol Pharm Drug Res. 2009;66(3):293-6.
10. Ochulayi PO, Anekwe GE. Lipid composition of medicinal plants: Portulaca oleracea and Ficus thonningii. Afr J Food Sci. 2013;7(5):76-9.
11. Njoku-Oji NN, Nwike CV, Dimkpa U, Ifegwu NO, Anike LC, Maduka SO, Sobanke OA, Uchefuna RC. Hematological changes following oral administration of aqueous leaf extract of Ficus capensis in albino rats. Int Blood Res Rev. 2016;5(1):1-7.
12. Umeokoli BO, Onyegbule FA, Gugu TH, Igboeme SO. Evaluation of the erythropoietic and anti-sickling properties of Ficus capensis leaf extract in the treatment of anaemia. Planta Med. 2013;79(Suppl 1):PE29.
13. Oyeleke SB, Dauda BEN, Boye OA. Antibacterial activity of Ficus capensis. Afr J Biotechnol. 2008;7(10):1414-7.
14. Daikwo OA, Tende JA, Okey SM, Eze ED, Isa AS. The effect of aqueous extract of leaf of Ficus capensis Thunb (Moraceae) on in-vivo leukocyte mobilization in Wistar rats. Br J PharmacolToxicol. 2012;3(3):110-4.

15. Owolabi OJ. Active ileum relaxant fractions from the leaves of Ficus capensis Thunb (Moraceae). Niger J Pharm Sci. 2013;12(1):1-7
16. Ramde-Tiendrebeogo A, Tibiri A, Hilou A, Lomp OM, Millogo-Kone H, Nacoulma OG, Guissou IP. Antioxidative and antibacterial activities of phenolic compounds from Ficus sur Forssk and Ficus sycomorus L. (Moraceae): Potential for sickle cell disease treatment in Burkina Faso. Int J Biol Chem Sci. 2012;6(1):328-36.
17. Akomolafe SF, Oboh G, Oyeleye SI, Boligon AA. Aqueous extract from Ficus capensis leaves inhibits key enzymes linked to erectile dysfunction and prevents oxidative stress in rats' penile tissue. NFS J. 2016;4:15-21.
18. AOAC. Official Methods of Analysis, 18th ed. AOAC International, Washington, DC, 2005.
19. Onyeike EN, Ehirim FC. Chemical and sensory evaluation of melon fungus (Pleurotus tuber-regium) and melon fungus cake. J Biochem Mol Biol. 2001;16(1):77-81.
20. Trease, G.E. Evans MC. (1989). Textbook on Pharmacognosy (13th Edn). Bailiere Tandal and Caussel, London. Pp. 144-148
21. Sofowora A. Screening plants for bioactive agents. In: Medicinal Plants and Traditional Medicines in Africa. 2nd ed. Ibadan: Spectrum Books Ltd.; 1993. p. 81-93.
22. Harborne JB. Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis. London: Chapman and Hall Ltd; 1973. p. 49-188.
23. Obdoni BO, Ochuko PO. Phytochemical studies and comparative efficacy of the crude extract of some haemostatic plants in Edo and Delta States of Nigeria. Glob J Pure Appl Sci. 2001;8(2):203-8.
24. Van Burden TP, Robinson WC. Formation of complexes between protein and tannic acid. J Agric Food Chem. 1981;29(1):77.
25. Bohn BA, Kocipai-Abyazan R. Flavonoids and condensed tannins from leaves of Hawaiian Vaccinium vaticulatum and V. calycinium. Pac Sci. 1994;48(4):458-63.
26. Okeke CU, Elekwa I. Phytochemical study of the extract of Gongronemalatifolium Benth. J Health Vis Sci. 2003;5(1):47-55.
27. Mgbemena NM, Akoh OU, Obodo GA, Nwakwue K. Determination of the phytochemicals, minerals, proximate and antibacterial constituents of the leaf, stem, root and seed of Ficus capensis (bush fig). J Chem Soc Niger. 2022;47(1):179-89.
28. Afuape AO, Afolayan AJ, Buwa-Komoreng LV. Proximate, vitamins, minerals and anti-nutritive constituents of the leaf and stem of Helichrysum odoratissimum (L.) Sweet: a folk medicinal plant in South Africa. Int J Plant Biol. 2022;13:463-72.
29. Njoku CE, Alaneme KK, Omotonyinbo JA, Daramola MO. Characterization of Urena lobata fibers after alkaline treatment for use in polymer composites. J Nat Fibers. 2020;19(2):485-96.
30. Oladiji AT, Mih FO. Proximate composition, mineral and phytochemical constituents of Eleusine coracana (finger millet). Afr J Biotechnol. 2005;4(12):1440-1.
31. Mann A, Otori AA. Determination of chemical composition, minerals and antinutritional factors of two wild seeds from Nupe land, North Central Nigeria. Am J Chem Appl. 2014;1(1):20-6.
32. Achikanu CE, Ani ON. Nutritional and phytochemical content of Cissus populnea (Okoho) stem bark. Asian J Res Biochem. 2020;7(3):8-15.

33. Williams ET, Nachana'a T, Attama C. Phytochemical screening, elemental and proximate analysis of Maeruaangolensis (Capparaceae) stem bark. Int J Biochem Res Rev. 2019;27(4):1-10.
34. Meda NT. Antioxidant activity of phenolic and flavonoid fractions of Cleome gynandra and Maeruaangolensis of Burkina Faso. J Appl Pharm Sci. 2013;3(2):036-42.
35. Achi NK, Onyeabo C, Ekeleme-Egedigwe CA, Onyeanula JC. Phytochemical, proximate analysis, vitamin and mineral composition of aqueous extract of Ficus capensis leaves in South Eastern Nigeria. J Appl Pharm Sci. 2017;7:117-22.
36. Njoku CE, Alaneme KK, Omotoyinbo JA, Ekeleme AC, Ugwu EI, Ikele US. Phytochemical, proximate and mineral analyses of Urena lobata stems from Imo State Nigeria. IOP Conf Ser Mater Sci Eng. 2021;1107:012183.
37. National Research Council. Committee on Dietary Allowances. Recommended Dietary Allowances, 10th ed. National Academy of Science Press, Washington, DC, USA, 1989, p. 453.
38. Chuku OS, Chuku EC. Comparative assessment of the proximate composition of the stem, leaf and the rhizome of Costusafer. IOSR J Agric Vet Sci. 2018;11:59-62.
39. Alagbe JO. Proximate, phytochemical and vitamin compositions of Prosopis africana stem bark. Eur J Agric Rural Educ. 2020;1-7.
40. Njoku PC, Akumufula MI. Phytochemical and nutrient evaluation of Spondias mombin leaves. Pak J Nutr. 2007;6(6):613-5.
41. Saxena M, Saxena J, Pradhan A. Flavonoids and phenolic acids as antioxidants in plants and human health. Int J Pharm Sci Rev Res. 2012;16(2):130-4.
42. Onyeka EU, Nwambekwe IO. Phytochemical profile of some green leafy vegetables in South East, Nigeria. Niger Food J. 2007;25(1):67-72.
43. Saxena M, Saxena J, Nema R, Singh D, Gupta A. Phytochemistry of medicinal plants. J PharmacognPhytochem. 2013;2(1):168-82.
44. Sczkowski CP, Kalinowska M, Wojciechowski Z. The 3-O-glucosylation of steroidal saponins and alkaloids in eggplant (Solanum melongena): evidence for two separate glycosyl transferases. Phytochemistry. 1998;48:1151-9.
45. Igidi OJ, Edene CE. Proximate and phytochemical compositions of Napoleonavogelii Hook fruit. Int J Eng Sci. 2014;3(6):46-51.
46. Ghasemzadeh A, Ghasemzadeh N. Flavonoids and phenolic acids: role and biochemical activity in plants and humans. J Med Plants Res. 2011;5(31):6697-703.
47. Dudareva N, Pichersky E, Gershenzon J. Biochemistry of plant volatiles. Plant Physiol. 2004;135:1893-902.
48. Firn R. Nature's Chemicals. Oxford: Oxford University Press; 2010. p. 74-5.
49. Princewill-Ogbonna IL, Ogbonna PC, Ogujiofor IB. Proximate composition, vitamin, mineral and biologically active compounds levels in leaves of Mangifera indica (Mango), Persea americana (Avocado pea), and Annona muricata (Sour sop). J Appl Sci Environ Manage. 2019;23(1):65-74.
50. Guyton AC, Hall JE. Textbook of Medical Physiology. 11th ed. Philadelphia: Elsevier; 2006. pp. 113-115.
51. Button KC. Prescription for Nutritional Healing. 4th ed. Vol. 5. Penguin Putnam; 2004. pp. 478-479.

52. Onwuka GI. Food Analysis and Instrumentation: Theory and Practice. 1st ed. Surulere, Lagos, Nigeria: Naphtali Prints; 2005. pp. 140-160.
53. Holick MF. Sunlight and vitamin D for bone health and prevention of autoimmune diseases, cancers, and cardiovascular disease. Am J Clin Nutr 2004;80(6):1678S-88S.
54. United States Food and Drug Administration. Vitamins and Minerals Chart 5. Interactive Nutrition Facts Label. 2020. Available from:www.fda.gov/nutritioneducation.
55. Vance CP, Uhde-Stone C, Allan DL. Phosphorus acquisition and use: critical adaptations by plants for securing a nonrenewable resource. New Phytol 2003;157(3):423-447.
56. Añuli NA, Ekwutosi OT, Udodi NC, Ijeoma EKC, Chisom OV. Assessment of Proximate, Phytochemical and Selected Mineral Content of Acanthus montanus Leaf. Asian J BiotechnolBioresour Technol 2020;6:45-54.
57. Abbey L, Asiedu S. An Overview of Nutritional and Anti-nutritional Factors in Green Leafy Vegetables. Horticult Int J 2017;1(2):58-65.
58. Trowbridge FL, Martorell R. Forging effective strategies to combat iron deficiency. J Nutr 2002;132(8):875-880.
59. Piskin E, Cianciosi D, Gulec S, Tomas M, Capanoglu E. Iron Absorption: Factors, Limitations, and Improvement Methods. *ACS Omega*. 2022;7(24):20441-20456.
60. Joint FAO/WHO Expert Committee on Food Additives. 64th Meeting. Codex Standard 193-1995. Rome: Food and Agriculture Organization of the United Nations/World Health Organization; 2005. p. 47.
61. Pandey G, Jain GC, Mathur N. Therapeutic potential of metals in managing diabetes mellitus: a review. J Mol Pathophysiol 2012;1(1):63-76.
62. World Health Organization. Assessing Human Health Risks of Chemicals: Derivation of Guidance Values for Health-Based Exposure Limits. Environmental Health Criteria 170. Geneva: WHO; 1994.
63. Elbagermi MA, Edwards HGM, Alajtal AI. Monitoring of heavy metal content in fruits and vegetables collected from production and market sites in the Misurata area of Libya. ISRN Analytical Chemistry;2012:1-5.
64. Pathak P, Kapil U. Role of trace elements zinc, copper and magnesium during pregnancy and its outcome. Indian J Pediatr 2004;71(11):1003-5.
65. Sunde RA. Selenium. In: Ross AC, Caballero B, Cousins RJ, Tucker KL, Ziegler TR, editors. Modern Nutrition in Health and Disease. 11th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2012. p. 225-237.
66. Emsley J. Nature's Building Blocks. New ed. Oxford: Oxford University Press; 2011.
67. Prasad MNV. Heavy Metal Stress in Plants. 2nd edition. Springer; 2004. ISBN: 978-3-540-40131-5. pp. 484-487.
68. Schwarz FJ, Kirchgessner M, Stangl GI. Cobalt requirement of beef cattle - feed intake and growth at different levels of cobalt supply. J Anim Physiol Anim Nutr 2000;83(3):121-128.
69. Oladeji SO, Saeed MD. Assessment of cobalt levels in wastewater, soil and vegetable samples grown along Kubanni stream channels in Zaria, Kaduna State, Nigeria. Afr J Environ Sci Technol 2015;9(10):765-775.

70. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Cobalt. Atlanta (GA): Public Health Service, US Department of Health and Human Services; 1992.