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Phytochemical, Proximate Analysis, Vitamin and Mineral Composition of Aqueous Extract of *Ficus capensis* leaves in South Eastern Nigeria

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ABSTRACT

The phytochemical, proximate, vitamin and mineral composition of the aqueous extract of the leaves of *Ficus capensis* collected from Ikwuano Local Government Area (LGA) in Abia State was investigated. The parameters investigated were determined using standard biochemical methods. Phytochemical studies carried out on aqueous extract of *Ficus capensis* leaves showed high levels of flavonoids, terpenoids, tannins and alkaloids while glycosides, saponins, steroids were in trace amount. The proximate analysis of the leaves revealed that *Ficus capensis* leaves is a poor source of lipid (1.83%) and fiber (4.77%) but has very high moisture content (104.53%) and carbohydrate (73.77%), moderate amount of ash (6.65%) and protein (6.31%). This composition shows that the sample could be a good source of carbohydrate and moisture. The result also showed that the leaves contain a variety of vitamins (A, B-complex, C , E, D, K and carotenoid) with β-carotenoid (6.55±0.009%) having the highest concentration and Vitamin A (6.06 ± 0.004) while the B-Vitamins and Vitamin E are in moderate amount. The mineral content showed the presence of zinc, calcium, magnesium, phosphorus, potassium and iron content. This indicates the tendency of *Ficus capensis* to be able to control osmotic balance, essential for bone formation, lower blood pressure and also act a source of antioxidant vitamins and minerals. The presence of these phytochemicals, minerals and vitamins in this leafy vegetable supports the use of the leaves of *Ficus capensis* both for food and ethno medicine purposes in many parts of Nigeria.

INTRODUCTION

The therapeutic use of natural products from indigenous plants for ethnomedicinal and nutritional purposes has grown tremendous interest among scientists to search for bioactive components (Oktay *et al*., 2003; Wangensteen *et al*., 2004) that are beneficial to man. Recently, the interest in natural products from plants and their use has increased tremendously even in areas where conventional medicines are very much available. Medicinal plants are sources of raw materials for pharmaceutical drug formulation (WHO, 2014). A significant percentage of medicinal plants used by the rural populace in Africa are affordable when compared to the high cost of conventional drugs. In the rural communities, people depend mostly on traditional medicine which also recognizes their socio-cultural and religious background which orthodox medicine neglects (Adesina, 2014). Medicinal plants contain numerous biologically active compounds such as nutrients and phytochemicals which have physiological actions on the human body (Olowokudejo *et al*., 2008) and these inherent active ingredients are used to treat various ailments (Okigbo *et al*., 2008). A majority of the world's population in developing countries still relies on herbal medicines to meet their health needs (Uzoekwe and Mohammed, 2015). Presently, in Nigeria, vegetables are the cheapest and readily available sources of proteins, vitamins and minerals (Thompson and Kelly, 1990) and therefore could also benefit the populace with their medicinal properties.

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Ficus capensis commonly called "bush fig tree" belongs to the family Moraceae. In Nigeria, it is locally referred to as Akokoro (Igbo) Opoto (Yoruba) and Uwaraya (Hausa) (Otitoju *et al*., 2014). Its leaves are broad, greenish and produce fruits all year round (Arnold and Dewett, 1993) and have been regarded as an underutilized plant. The leaves of *Ficus capensis* are used as vegetable both in soup and yam pottage in various parts of Nigeria (South East) (Otitoju *et al*., 2014). Traditionally, *Ficus capensis* has been used for the treatment of dysentery and wound dressing (Igoli *et al*., 2005). It is also used to treat circumcision wounds, leprosy and epilepsy, rickets, infertility, gonorrhea, edema and respiratory disorders (Olowokudejo *et al*., 2008) and abortion (Owolabi *et al*., 2009). Apart from its traditional uses, scientific investigations have reported its; blood-boosting effect (Otitoju *et al*., 2014; Njoku-oji *et al*., 2016), anti-sickling (Umeokoli *et al*.,2013; Mpiana *et al*., 2008) antibacterial (Oyeleke *et al*.,2008), anti-abortifacient (Owolabi *et al*., 2009), immune-stimulatory (Daikwo *et al*., 2012), antidiarrhoea (Owolabi, 2013), antioxidant (Ramde-Tiendrebeogo *et al*., 2012) and pro-fertility in treating azoospermia (Gelfand *et al*.,1985; Akomolafe *et al*. ,2016).

To the best of our knowledge, no documented reports on the vitamin and mineral content, nutritive and phytochemical composition of the leaves of this plant harvested from Ikwuano Local Government Area (LGA) in Abia State has been published. In order to ascertain the nutritive value of the vegetable species and thereby stimulate interest in its utilization beyond the traditional localities. Therefore, it is important to validate scientific documentation on the leaves of the plant harvested from Abia State in Nigeria for the presence of essential minerals, vitamins, phytochemical and proximate composition so as to promote and scientifically validate its health and ethnomedicinal benefit.

MATERIALS AND METHODS

Collection and preparation of plant extract

The fresh leaves of *Ficus capensis* was collected from a local farm in Umudike in Ikwuano Local Government Area of Abia State. The leaves were identified in the Department of Forestry and Environmental Management in Michael Okpara University of Agriculture Umudike in Abia State. The leaves were air dried at room temperature to a constant weight. The dried leaves were then pulverized to powder using an electric grinding machine (Panasonic MX-337N). The powdered material was stored in air-tight containers. Five hundred grams (500g) of the powdered leaf sample was extracted using 1500ml of distilled water for 48hrs with continuous stirring. The mixture was filtered using Whatman paper No1. The filtrate was evaporated to dryness using a water bath to obtain 30% yield.

Phytochemical analyses

Alkaloids, glycoside, terpenoids were determined using the method described by Harborne, (1973). The alkaline picrate method was employed for the determination of cyanogenic glycosides (Onwuka, 2005). The percentage composition of tannins and steroids in the plants was determined with some modifications while saponin content was determined using the method of AOAC (1990). Determination of flavonoid content was done by the method described by Bohnr and Kocipai (1994).

Proximate Analyses

The parameters determined for proximate analyses include ash, moisture, crude protein, fat, fiber and carbohydrate. All of these were carried out using the methods described by (AOAC, 2010).

Vitamin composition

The amount of vitamin A, E, C, B_{12} in the sample was determined using the method described by (Achikanu *et al*, 2013; AOAC, 2010.) Vitamin B_1 and B_3 were determined using the method described by Okwu and Ndu, (2006) while Vitamin B_2, K, folate were determined using the methods described by Okwu and Josiah (2006). The method described by Oulai *et al* (2014) was used in the determination of β-carotene..

Mineral Analyses

The atomic absorption spectrophotometer (AAS) was used for the analyses of the following metals: Mg, Zn, Fe, Cd, Cu, Pb, Ca, Ni, and P while the flame photometer was used in the analyses of K and Na. Using AAS, the ash solutions of the plant samples were prepared by weighing 5g of each of the powdered plant samples, these were ashed at 550°C in muffle furnace for 5 hrs, and the residues dissolved in 100 ml of deionized 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 were injected and the concentrations obtained from the AAS. Using the flame photometer, the diluents of sample was aspirated into the Jenway Digital flame photometer using the filter corresponding to each mineral element. All of these were carried out using the method described by (Oshodi, 1992).

Statistical Analysis

Data was analyzed using SPSS Version 20.0. Results were expressed as Mean ± SD of three replicates determinations.

RESULTS AND DISCUSSION

Table 1 shows the quantitative phytochemical analysis of *Ficus capensis* leaves. The leaves contain copious presence of flavonoids (1367.42 ± 0.005), terpenoids (1280.39 ± 0.003), tannins (687.64 ± 0.006), alkaloids (422.12 ± 0.006) while saponins (0.27 ± 0.004), steroids (0.476 ± 0.004), glycosides (11.39 ± 0.003) and hydrogen cyanide (0.55 ± 0.008) are in trace amount respectively. The presence of tannins (687.64mg/100g) in the leaves of *Ficus capensis* confers the leaves to be a good source for the treatment of wounds emanating from varicose ulcers and hemorrhoids (Njoku and Akumufula, 2007). Plants that contain

tannins are used as astringents, against diarrhea, as diuretics, against stomach and duodenal tumours (Saxena *et al.,* 2013). Flavonoids in plants possess medicinal benefits which includes antioxidant and anti-inflammatory activities (Saxena *et al*., 2012). They have the ability to scavenge hydroxyl radicals, super oxide anions and lipid peroxy radicals (Okwu, 2004; Okwu and Josiah, 2006), therefore supports its antioxidant activity. The flavonoid content of the leaves of *Ficus capensis* therefore supports its use for protection against diseases such as cancer, inflammation and atherosclerosis (Onyeka and Nwambekwe, 2007).

Table 1: Phytochemical composition of *Ficus capensis* leaves.

Phytochemical constituent	Value
Flavonoids (mg/100g)	1367.42 ± 0.005
Alkaloids (mg/100g)	422.12 ± 0.006
Saponins (mg/100g)	0.27 ± 0.004
Steroids (mg/100g)	0.48 ± 0.004
Glycosides (mg/100g)	11.39 ± 0.003
Terpenoids (mg/100g)	1280.39 ± 0.003
Tannins (mg/100g)	687.64+0.006
Hydrogen cyanide (mg/1g)	0.55 ± 0.008

Results are expressed as Mean ± Standard deviation (SD).

The presence of alkaloids (422.12mg/100g) in the leaves of *Ficus capensis* supports the findings by Oyeleke *et al.,* (2008), that the antibacterial activity of this plant may be attributed to the presence of alkaloids. Alkaloids have been reported to possess various pharmacological activities including antihypertensive effects, antiarrhythmic effect, antimalarial and anticancer activity **(**Saxena *et al.*, 2013). Pure isolated alkaloids and their synthetic compounds have been used in medicine as an analgesic, antispasmodic and bactericidal agents (Stary, 1998; Okwu, 2004). Saponins from fruits and vegetables are important dietary supplements and are known to exhibit antimicrobial activities and protect plants from microbial pathogens (Sczkowski *et al*., 1988). They could be beneficial in modulating blood lipids, lower cancer risks and improve blood glucose response as well as possess antioxidant activity (Igidi and Edene, 2014). Leafy vegetables such as *Ficus capensis* leaves are thus said to possess antimicrobial property attributed to saponins and other phytochemicals present. This is in agreement with reports on the antimicrobial potentials of *Ficus capensis* obtained from other localities in Nigeria (Ogundare and Akinyemi, 2013; Igwe *et al*., 2016).

The presence of terpenoids in the leaves of *Ficus capensis* supports its use in the treatment and management of cancer, ulcers and malaria. Plants produce volatile terpenes either to attract specific insects for pollination or otherwise to expel certain preys which consume these plants as food (Degenhardt *et al*, 2003). In addition, terpenoids possess medicinal properties such as anticarcinogenic, antimalarial, anti-ulcer, antimicrobial or diuretic activity (Dudareva *et al*, 2004). So therefore, leaves of Ficus capensis could be used in ethnomedicine in the management of various ailments due to the presence of these terpenes.

The value obtained for hydrogen cyanide (HCN) in *Ficus capensis* leaves is 0.55mg/1g and is less than the 36mg/100g considered lethal dose for man (Mgbagwu, *et al* 2010). Thus, its leaves can be said to be safe both for human and animal consumption as its HCN levels is within permissible limits. HCN is a poisonous chemical asphyxiant, which stops the tissue from utilizing oxygen (Brown *et al*., 2001). Processing methods such as boiling and soaking of vegetables for a period of time can significantly reduce the HCN levels (Siddhuraju, *et al*, 1996).

Plant extracts containing cyanogenic glycosides could be used as flavoring agents in pharmaceutical preparations (Sarker and Nahar, 2007). Therefore, the presence of glycoside (11.39mg/100g) in the leaves of *Ficus capensis* supports its pharmacological use as a flavouring agent and in the management of cancer. This report contradicts reports by Oyeleke *et al*., (2008) which reported that its leaves contain no glycosides. Plant steroids are phytoconstituents that have found therapeutic applications as arrow poisons or cardiac drugs (Firn, 2010).Trace amounts of steroid content (0.48mg/100g) in the leaves could be useful in promoting nitrogen retention in osteoporosis and in animals with wasting illness (Maurya *et al.*, 2008; Madziga *et al.*, 2010). The proximate compositions determined in the plant leaves are summarized in table 2.

Table 2: Proximate composition of *Ficus capensis* leaves.

Components	Value (%)
Moisture	104.53 ± 0.003
Ash	6.65 ± 0.004
Fat	1.83 ± 0.004
Proteins	6.31 ± 0.007
Fiber	4.77 ± 0.007
Carbohydrate	73.77 ± 0.002

Results are expressed as Mean ± Standard deviation.

It shows that the plant has a high moisture content (104.53 ± 0.003) and carbohydrate (73.77 ± 0.002), moderate concentration of protein (6.31 ± 0.007) and ash (6.65 ± 0.004), and low concentration of fat (1.83 ± 0.004) and fiber (4.77 ± 0.007). The moisture content (104.53%) of the leaves shows that plant is a good source of water from vegetables for the cells of the body (Okeke *et al*, 2008). The estimated carbohydrate content in the leaves of *Ficus capensis* (73.77) was high and carbohydrates are known to produce energy required for the body because they are essential nutrient required for adequate diet (Emebu and Anyika, 2011) and supplies energy to cells such as brain, muscle and blood (Ejelonu *et al*., 2011). The low content of fat (1.83mg/100g) is below the range (8.3%-27.0%) reported for some leafy vegetables consumed in Nigeria (Sena *et al*., 1998). Leafy vegetables are poor sources of lipids (Ifon and Bassir, 1980; Ejoh *et al*., 1996), therefore the increase in the consumption of vegetables would naturally lower fat intake. The protein content of the leaves was found to be moderately available (6.31%). Protein is vital for various body functions such as body development, maintenance of fluid balance, formation of hormones, enzymes and sustaining strong immune function (Emebu and Anyika, 2011). Fresh green leafy vegetables with low protein content have been reported (Ifon and Bashir, 1989; Oboh and Masodje, 2009) and the protein in these leaves are in the form of enzymes, instead of being a storage pool as found in grains and nuts (Wills *et al*., 1998). Crude fiber

content of this plant could aid in the absorption of trace elements in the gut and therefore increases intestinal bowel movement (Abolaji *et al.,* 2007). Consuming vegetables in our diet could aid in managing constipation problems (Olowokudejo *et al.,* 2008). Dietary fibers also lower cholesterol, triglycerides and protect against cancer and digestive disorders (Selvendran, 1984). The moderate amount of ash content in the leaves of *Ficus capensis* provides a measure of total amount of mineral matter in a plant. Measuring ash content is important because mineral matter may be the cause of a pharmacological effect (Okeke, 1998).

Table 3: Vitamin content of Ficus capensis leaves.

Components	Concentration
Vitamin E (mg/100g)	0.35 ± 0.004
Vitamin C (mg/100g)	0.26 ± 0.002
Vitamin A (µg)	6.06 ± 0.004
Vitamin B_1 (mg/100g)	0.46 ± 0.003
Vitamin B_2 (mg/100g)	0.68 ± 0.002
Vitamin B_3 (mg/100g)	0.36 ± 0.003
Vitamin B_6 (mg/100g)	0.29 ± 0.006
Vitamin B_7 (mg/100g)	0.15 ± 0.005
Vitamin B_9 (mg/100g)	0.24 ± 0.005
Vitamin D (mg/100g)	0.13 ± 0.005
Vitamin B_{12} (mg/100g)	0.37 ± 0.003
Vitamin K (mg/100g)	0.14 ± 0.003
Carotenoid (mg/100g)	6.55 ± 0.009

Results are expressed as Mean ± Standard Deviation of three replicates values

The result in table 3 shows the presence of carotenoid and Vitamin A while the B-Vitamins, Vitamin E, Vitamin C are in moderate amounts. Although vitamins C, vitamin E, niacin (B_3), thiamine (B_1), riboflavin (B_2), pyridoxine (B_6), biotin (B_7), folic acid (B_9), vitamin B_{12}, vitamin D and vitamin K were in trace amount in the leaves, they have very essential roles to play in the human health. Vitamin C and E are very important antioxidants which protect the cell membranes from oxidative stress/damage caused by free radicals (Guyton and Hall, 2006). *Ficus capensis leaves* contain ascorbic acid and flavonoids, both of which are effective antioxidants. Vitamin C possesses an antioxidant property and required for maintenance of normal connective tissues, wound healing and also facilitates the absorption of dietary iron from the intestine (Button, 2004).

This justifies the antioxidant activity of the leaves as reported by Oyeleke *et al*., (2008). Deficiencies of these vitamins predispose the red cell membranes to damage leading to haemolysis (Adesina, 2006). Riboflavin and niacin are necessary for oxidative phosphorylation and for coenzyme formation respectively (Adesina, 2006). The leaves of *Ficus capensis* contains moderate amount of vitamin A and therefore essential for clear vision.

The mineral compositions of *Ficus capensis* leaves are shown in table 4. It contains considerable amount of Zinc (2.84 ± 0.005), Iron (1.89 ± 0.004), Calcium (1.86 ± 0.003), Magnesium (1.92 ± 0.004) and Potassium (0.72 ± 0.006). Pathak and Kapil, (2004) reported that zinc is vital in protein synthesis, cellular differentiation and replication, immunity and sexual functions. Calcium is reported to be essential for blood clotting, bone and teeth formation and as a co-factor in some enzyme catalysis **(**Robert *et al.,* 2003). In humans, magnesium is required in the plasma and extracellular fluid, where it helps maintain osmotic equilibrium (Thomas and Krishnakumari, 2015).

It can also prevent some heart disorders and lower blood pressure in humans. Iron facilitates the oxidation of biomolecules to control obesity, which predisposes an individual to various diseases. It is also essential for hemoglobin formation (Thomas and Krishnakumari, 2015) and plays a role in energy transfer within the plant and also an essential constituent of certain enzymes and proteins. This justifies the use of *Ficus capensis* in folklore medicine as a blood tonic because of its blood boosting effect (Njoku-oji *et al*., 2016).

Moderate quantities of sodium and potassium were present in the leaves of *Ficus capensis* and these are principal cations of extracellular and intra-cellular fluids and aid in maintaining electrolyte balance in the body (Robert *et al.,* 2003). Potassium is essential and is required in large amounts for proper growth and plant reproduction. Phosphorous maintain blood sugar levels and normal heart contraction (Linder, 1991).

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 (Johns and Duquette, 1991). Minerals found to be present in trace quantities are cadmium, nickel and lead. Cadmium and lead in high amounts are not ideal and not desirable for the functioning of the body. The research forms a basis for further isolation and characterization on the bioactive constituents present in the leaves of this plant due to its therapeutic properties.

Table 4: Mineral content of *Ficus capensis* leaves.

Mineral components	Concentration
Sodium (%)	0.17 ± 0.004
Zinc (mg/100g)	2.84 ± 0.005
Lead (mg/kg)	0.03 ± 0.003
Copper (mg/kg)	0.34 ± 0.003
Cadmium (mg/kg)	0.14 ± 0.002
Nickel (mg/kg)	0.01 ± 0.003
Iron (mg/100g)	1.89 ± 0.04
Phosphorus (mg/100g)	0.16 ± 0.004
Calcium (%)	1.86 ± 0.003
Magnesium (%)	1.92 ± 0.004
Potassium (%)	0.72 ± 0.006

Results are expressed as Mean ± Standard Deviation.

CONCLUSION

The present study shows the presence of phytochemicals, vitamins, minerals and nutrients in Ficus capensis leaves which may therefore justify both its nutritional and ethnomedicinal benefits to human health. The study further revealed low level of toxicants such as glycosides and hydrogen cyanide, with high levels of flavonoid, tannin, alkaloid. The leaves also showed a high level of moisture and carbohydrate. Leaves of *Ficus capensis* seem to have good nutritive, vitamin and suitable mineral element value necessary to maintain good health.

AUTHOR'S CONTRIBUTION

This work was carried out in collaboration among all authors. Authors ANK and OC designed the study, wrote the protocol and wrote the first draft of the manuscript. Author EAC managed the literature searches, statistical analyses of the study and editing of the manuscript. OJC managed the literature searches and the experimental process. All authors read and approved the final manuscript.

DECLARATION OF CONFLICTING INTERESTS

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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