Comparative Phytochemical and Nutritional Profiles of *Ficus capensis* and *Cnidoscolus aconitifolius* Leaves

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**Abstract:** This study investigated the phytochemical, proximate, mineral, vitamin contents of *Ficus capensis* and *Cnidoscolus aconitifolius* leaves. Phytochemical and Proximate analysis were done according to the AOAC methods. Atomic Absorption Spectroscopy (AAS) was used to determine the mineral content while vitamins were determined spectrophotometrically using the standard method of AOAC. The phytochemical analysis revealed the presence of Flavonoids, alkaloids, Tannin, Saponin, Phytate, Haemaglutinin, Oxalate, Cardiac glycosides and Phenol in the leaf extract of *F. capensis* and *C. aconitifolius*. The proximate composition of the dried leaf of *F. capensis* was: moisture (11.35±1.45%), crude protein (10.85±0.31%), crude fibre (12.38±0.71%), crude fat (3.48±0.01%) ash (6.37±0.30%) and carbohydrate (55.57±3.02%). On the other hand, that of *C. aconitifolius* was; moisture (11.35±0.30%), crude protein (10.85±0.52%), crude fibre (12.38±0.02%), crude fat (3.48±0.02%) ash (6.37±0.09%) and carbohydrate (55.57±1.08%). Elemental analyses showed that *C. aconitifolius* had significantly higher (p<0.05) levels of the elements (Cadmium, Arsenic, Fe, Pb, Cu, Na) when compared to *F. capensis*. The leaf of *C. aconitifolius* was significantly higher in vitamins B1, B2, B3, B6, C, E and K (p<0.05) when compared to that of *F. capensis*. However, *F. capensis* leaf had higher vitamins B12 and D contents than *C. aconitifolius*. This study suggests that these two plants can serve as a good source of nutraceutical.

**Keywords:** Phytochemical, proximate, mineral, vitamin, *Ficus capensis*, *Cnidoscolus aconitifolius*

I. INTRODUCTION

The therapeutic use of natural products from indigenous plants for ethnomedical 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.

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. *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) (Otitotoju 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) (Otitotoju 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 (Ololowokudejo et al., 2008) and abortion (Owolabi et al., 2009). Apart from its traditional uses, scientific investigations have reported its; blood-boosting effect (Njoku-oji et al., 2016), anti-sickling (Umeokoli et al., 2013; Mpiana et al., 2008) antioxidant (Oyeleke et al., 2008), anti-abortifacient (Owolabi et al., 2009), immune-stimulatory (Daikwo et al., 2012), antidiarrhoea (Owolabi, 2013), antioxidant (Ramde-Tienda-rebogo et al., 2012) and pro-fertility in treating azoospermia (Gelfand et al., 1985; Akomolafe et al., 2016).

*Cnidoscolus aconitifolius* (CA), locally known in Niger Delta as ‘hospital is too far’ or ‘ogwu obala’, belongs to the family of Euphorbiaceae (McVaugh, 1944). It has succulent stems which exude a milky sap when cut. It is an evergreen, drought deciduous shrubs up to 6m in height with alternate palmate lobed leaves, milky sap and small flowers on dichotomously branched cymes (Awoyinka et al., 2007; Iwuji et al., 2013). It is commonly found in the tropic and sub tropical regions worldwide, including Africa, South of Sahara, North and South America, India, etc. *C. aconitifolius* is commonly known as Chaya or Tree Spinach. It is popular in Mexico and Central America and has been introduced into the United States (mainly South Texas and Florida) for potential uses as a leafy vegetable and/or as a medicinal plant (Brecken, 1979). It
is a large, fast growing leafy perennial shrub that is believed to have originated in the Yucatan Peninsula of Mexico (McVaugh, 1944). It is commonly eaten as vegetable in soup. In fact, levels of leaf nutrients are two to threefold greater than any other land-based leafy green vegetable (Ganiyu, 2005). *C. aconitifolius* leaves have a possible antidiabetic effect (Yang, 1979); antibacterial activities (Ganiyu, 2005; Kuti and Konuru, 2004); and it also ameliorates anaemia and osmotic fragility induced by protein energy malnutrition (Oladinde *et al.*, 2007). Traditionally, leaves of plants have been identified for their nutritional and medicinal values (Oladinde *et al.*, 2007; Oyagbemi *et al.*, 2008; Sofowora, 1993). The aim of this work is to investigate and compare the phytochemical, mineral content, proximate and vitamin constituents of *F. capensis* and *C. aconitifolius*.

**II. MATERIALS AND METHODS**

**Sample Collection and Identification**

The leaves of *Ficus capensis* were collected at Ibeagwa Nike, Enugu East Local Government Area, Enugu State. The leaves of *Cnidoscolus aconitifolius* were collected at Umueze town, Nkanu West Local Government Area, Enugu State. The samples were identified by a botanist in the Department of Botany, Nnamdi Azikiwe University, Awka. The voucher number of *F. capensis* and *C. aconitifolius* is 164 and 168 as deposited at the herbarium of the Department of Botany, Nnamdi Azikiwe University, Awka.

**Preparation of *F. capensis* and *C. aconitifolius* for Phytochemical and Nutritional Analysis**

The leaves were hand-picked, thoroughly washed and air dried at room temperature for four weeks. The dried leaves were ground into powder using Corona manual grinding machine. The sample was then used for the phytochemical, proximate, mineral and vitamin analysis.

**Phytochemical Analysis**

Cardiac Glycosides were determined according to the method of Osagie (1998). Flavonoids was determined by the method of Boham and Kocipai (1994). Alkaloids were determined by the method of Harborne (1993), Tannin was determined by titration (Pearson, 1976). Saponins were determined according to the method of Obadoni and Ochuko (2001). Phytate was determined according to the method of Young and Greaves (1940). Haemaglutinin was determined by AOAC (1984) method. Oxalate was determined by Titration (Harborne, 1993). Phenols was determined according to the method of Harborne (1995).

**Mineral analysis**

The minerals cadmium, arsenic, calcium, nickel, iron, manganese, aluminium, selenium, lead, cobalt, manganese, copper, potassium, silver, mercury and sodium were analysed using Varian AA240 Atomic Absorption Spectrophotometer according to the method of APHA 1995 (American Public Health Association).

**III. RESULTS**

**Phytochemical Analysis**

The result of the phytochemical analysis of *F. capensis* and *C. aconitifolius* revealed that *F. capensis* has high content of flavonoids, phenol, tannin, saponin, alkaloids and haemaglutinin while the phytochemical content of *C. aconitifolius* reveal high content of phenols, haemaglutinin, tannin and alkaloids (Table 1).

<table>
<thead>
<tr>
<th>Phytochemicals</th>
<th><em>F. capensis</em></th>
<th><em>C. aconitofolius</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac glycosides (%)</td>
<td>2.72 ± 0.02</td>
<td>2.94 ± 0.00</td>
</tr>
<tr>
<td>Flavonoids (%)</td>
<td>14.22 ± 0.03</td>
<td>2.562 ± 0.00</td>
</tr>
<tr>
<td>Alkaloids (%)</td>
<td>7.26 ± 0.02</td>
<td>4.10 ± 0.01</td>
</tr>
<tr>
<td>Tannin (%)</td>
<td>11.98 ± 0.03</td>
<td>5.70 ± 0.00</td>
</tr>
<tr>
<td>Saponin (%)</td>
<td>9.40 ± 0.01</td>
<td>5.88 ± 0.00</td>
</tr>
<tr>
<td>Phytate (%)</td>
<td>0.452 ± 0.04</td>
<td>0.5653 ± 0.00</td>
</tr>
<tr>
<td>Haemaglutinin (mg/kg)</td>
<td>8.588 ± 0.02</td>
<td>34.96 ± 0.03</td>
</tr>
<tr>
<td>Oxalate (mg/kg)</td>
<td>0.1056 ± 0.00</td>
<td>0.792 ± 0.01</td>
</tr>
<tr>
<td>Phenol (mg/kg)</td>
<td>22.911 ± 0.04</td>
<td>57.303 ± 0.05</td>
</tr>
</tbody>
</table>
Mineral Content

The result of the mineral analysis of *F. capensis* and *C. aconitifolius* revealed that *F. capensis* has high content of magnesium, calcium, manganese, potassium, selenium and iron. The mineral analysis of *C. aconitifolius* reveal high content of sodium, manganese, potassium, calcium, iron and selenium (Table 2).

### Table 2: Mineral Content of *F. Capensis* and *C. aconitifolius*  

<table>
<thead>
<tr>
<th>MINERALS (PPM)</th>
<th><em>F. capensis</em></th>
<th><em>C. aconitifolius</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium</td>
<td>0.087 ± 0.00</td>
<td>0.225 ± 0.00</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.00 ± 0.00</td>
<td>0.698 ± 0.02</td>
</tr>
<tr>
<td>Calcium</td>
<td>3.124 ± 0.03</td>
<td>3.512 ± 0.04</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.086 ± 0.02</td>
<td>0.000 ± 0.00</td>
</tr>
<tr>
<td>Iron</td>
<td>1.028 ± 0.05</td>
<td>1.345 ± 0.06</td>
</tr>
<tr>
<td>Magnesium</td>
<td>21.36 ± 0.52</td>
<td>22.324 ± 0.53</td>
</tr>
<tr>
<td>Aluminium</td>
<td>0.331 ± 0.00</td>
<td>0.301 ± 0.01</td>
</tr>
<tr>
<td>Selenium</td>
<td>1.786 ± 0.01</td>
<td>1.991 ± 0.03</td>
</tr>
<tr>
<td>Lead</td>
<td>0.008 ± 0.00</td>
<td>0.029 ± 0.00</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.00 ± 0.00</td>
<td>0.013 ± 0.00</td>
</tr>
<tr>
<td>Manganese</td>
<td>2.000 ± 0.01</td>
<td>3.427 ± 0.30</td>
</tr>
<tr>
<td>Copper</td>
<td>0.180 ± 0.03</td>
<td>0.352 ± 0.02</td>
</tr>
<tr>
<td>Potassium</td>
<td>2.555 ± 0.02</td>
<td>2.564 ± 0.50</td>
</tr>
<tr>
<td>Silver</td>
<td>0.221 ± 0.05</td>
<td>0.025 ± 0.05</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.521 ± 0.03</td>
<td>0.163 ± 0.02</td>
</tr>
<tr>
<td>Sodium</td>
<td>2.00 ± 0.40</td>
<td>5.213 ± 0.03</td>
</tr>
</tbody>
</table>

Proximate Analysis

The result of the proximate analysis of *F. capensis* and *C. aconitifolius* revealed that both plants contain virtually the same quantity of macronutrients (Table 3). The macronutrients contained in the leaves of both plant samples include carbohydrate (55.57%), fibre (12%), moisture (11.35%), protein (10.85%), ash (6.37%) and fat (3.48).

### Table 3: Proximate Analysis of *F. Capensis* and *C. aconitifolius*  

<table>
<thead>
<tr>
<th>MACRONUTRIENTS (%)</th>
<th><em>F. capensis</em></th>
<th><em>C. aconitifolius</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash content</td>
<td>6.37 ± 0.30</td>
<td>6.37 ± 0.09</td>
</tr>
<tr>
<td>Moisture content</td>
<td>11.35 ± 1.05</td>
<td>11.35 ± 0.30</td>
</tr>
<tr>
<td>Fibre content</td>
<td>12.38 ± 0.71</td>
<td>12.38 ± 0.02</td>
</tr>
<tr>
<td>Fat content</td>
<td>3.48 ± 0.01</td>
<td>3.48 ± 0.02</td>
</tr>
<tr>
<td>Protein content</td>
<td>10.85 ± 0.31</td>
<td>10.85 ± 0.52</td>
</tr>
<tr>
<td>Carbohydrate Content</td>
<td>55.57 ± 3.02</td>
<td>55.57 ± 1.08</td>
</tr>
</tbody>
</table>

Vitamin Analysis

Comparing the vitamin analysis of *F. capensis* and *C. aconitifolius* reveals that the vitamin C and vitamin B₆ content of *C. aconitifolius* was significantly (p<0.05) compared to that of *F. capensis* leaves. The vitamin B₁, and vitamin B₃ content of *F. capensis* and *C. aconitifolius* leaves are almost the same. The vitamin A, vitamin B₉, vitamin B₁₂, vitamin D and vitamin K content of both plants vary (Table 4).

### Table 4: Vitamin Content of *F. Capensis* and *C. aconitifolius*  

<table>
<thead>
<tr>
<th>Vitamins (mg/kg)</th>
<th><em>F. capensis</em></th>
<th><em>C. aconitifolius</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>14.66 ± 0.20</td>
<td>13.58 ± 0.10</td>
</tr>
<tr>
<td>Vitamin B₁</td>
<td>2.053 ± 0.10</td>
<td>2.143 ± 0.00</td>
</tr>
<tr>
<td>Vitamin B₂</td>
<td>2.011 ± 0.08</td>
<td>2.128 ± 0.00</td>
</tr>
<tr>
<td>Vitamin B₃</td>
<td>1.708 ± 0.00</td>
<td>3.66 ± 0.00</td>
</tr>
<tr>
<td>Vitamin B₄</td>
<td>145.0 ± 0.30</td>
<td>565.0 ± 1.33</td>
</tr>
<tr>
<td>Vitamin B₅</td>
<td>5.55 ± 0.01</td>
<td>4.60 ± 0.00</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>567.7 ± 0.03</td>
<td>814.0 ± 0.62</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>2.29 ± 0.01</td>
<td>1.625 ± 0.00</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>6.25 ± 0.00</td>
<td>6.66 ± 0.03</td>
</tr>
<tr>
<td>Vitamin K</td>
<td>1.389 ± 0.00</td>
<td>3.47 ± 0.01</td>
</tr>
</tbody>
</table>

IV. DISCUSSION

*Ficus capensis* and *Cnidoscolus aconitifolius* are medicinal plants with numerous nutritional importance. From the results, there was high percentage of flavonoids, alkaloids, Tannin and saponin in the ethanol leaf extracts of *F. capensis* when compared to that of *C. aconitifolius*. The high composition of Tannin (11.98±0.03%) 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 and Josiah, 2006), therefore supports its antioxidant activity. The flavonoid content of the leaves of *Ficus capensis* and *C. aconitifolius* therefore supports its use for protection against diseases such as cancer, inflammation and atherosclerosis (Onyeka and Nwambekwe, 2007).

The alkaloid composition (7.26±0.02%) in the leaves of *F. capensis* was higher (p>0.05) when compared to the alkaloid composition (4.10±0.01%) in the leaves of *C. aconitifolius*. This supports the findings by Oyeleke et al., (2008), that the antibacterial activity of these plants 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 (Okwu, 2004). Saponins from fruits and vegetables are important...
dietary supplements and are known to exhibit antimicrobial activities and protect plants from microbial pathogens (Szczykowsk i\textit{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 \textit{F. capensis} and \textit{C. aconitifolius} 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 \textit{F. capensis} obtained from other localities in Nigeria (Ogundare and Akinyemi, 2013; Igwe et al., 2016).

Results of the elemental analysis of the plant leaves of \textit{F. capensis} and \textit{C. aconitifolius} revealed that the leaves contain 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) (Table 2). 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 \textit{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 \textit{F. capensis} and \textit{C. aconitifolius} in folklore medicine as a blood tonic because of its blood boosting effect (Njoku-oji \textit{et al.}, 2016). Moderate quantities of sodium and potassium were present in the leaves of \textit{Ficus capensis} and \textit{C. aconitifolius}, and these are principal cations of extracellular and intra-cellular fluids and aid in maintaining electrolyte balance in the body (Robert \textit{et al.}, 2003). Potassium is essential and is required in large amounts for proper growth and plant reproduction. 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.

The result of the proximate analysis showed that \textit{C. aconitifolius} has high carbohydrate and fibre content (Table 3). Like most leaves, they are low in fat and protein contents as compared to carbohydrate content. The result of the low-fat content may imply they are without any risk of obesity (AOAC, 1990). So daily consumption of \textit{F. capensis} and \textit{C. aconitifolius} may not predispose one to obese-associated diseases like diabetes and hypertension. The low moisture content of \textit{C. aconitifolius} probably may not encourage microbial growth and enzyme activities (Nworah \textit{et al.}, 2012). However, the fresh leaves are succulent green and often preserved by drying.

The estimated carbohydrate content in both leaves 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 \textit{et al.}, 2011). The low content of fat (3.48±0.01%) is below the range (8.3%-27.0%) reported for some leafy vegetables consumed in Nigeria (Sena \textit{et al.}, 1998). Leafy vegetables are poor sources of lipids (Ejoh \textit{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 \textit{et al.}, 1998).

Crude fibre content of these plants could aid in the absorption of trace elements in the gut and therefore increases intestinal bowel movement (Abolaji \textit{et al.}, 2007). Consuming vegetables in our diet could aid in managing constipation problems (Olowokudejo \textit{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 both leaves of \textit{F. capensis} and \textit{C. aconitifolius} 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).

The result in Table 4 shows the presence of Vitamin A while the Vitamins B\textsubscript{1}, B\textsubscript{2}, B\textsubscript{3}, B\textsubscript{4}, Vitamin D, Vitamin E and Vitamin K are in trace amounts, Vitamin B\textsubscript{6}, and Vitamin C are in moderate amounts, 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). \textit{F. capensis} and \textit{C. aconitifolius} 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). 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 \textit{F. capensis} and \textit{C. aconitifolius} contains moderate amount of vitamin A and therefore essential for clear vision.
V. CONCLUSION
This study revealed that *F. capensis* and *C. acontifolius* are important sources of macro and micronutrients. The result of the phytochemical, mineral content, proximate and vitamin analysis shows that the leaves of *F. capensis* and *C. acontifolius* have great nutritional value. In line with the global demands for food, these plants can therefore be incorporated as potential sources of supplements in the formulation of functional foods. Nevertheless, extensive toxicity study on both plants needs to be done to ascertain their safety levels.

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CONFLICT OF INTERESTS
The authors hereby declare no conflict of interests.

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