Phytoconstituents, Proximate and Mineral Investigations of the Ethanol Extracts of the Bark and Leaves of *Ficus sur* Forssk.

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Abstract
Qualitative phytochemical screening and nutritional compositions of the leaves and bark of *Ficus sur* Forssk. (*Moraceae*), a Nigerian plant with medicinal potentials, was carried out using standard methods. The phytochemical screening revealed the presence of tannins, alkaloids, flavonoids, phenols, steroids, cardenolides and quinones in varying concentrations in the bark and leaves. Anthraquinones were detected in moderate concentrations in the leaves only whereas saponins were not detected in either the leaves or bark. The bark revealed higher contents of alkaloids and tannins than the leaves. Proximate analysis results showed a high carbohydrate but low lipid contents in both leaves and bark of *F. sur*. The mineral analyses of the leaves and bark, respectively, showed a high concentration of magnesium (93.70 ± 0.50; 93.85 ± 0.50), iron (16.05 ± 0.30; 18.95 ± 0.73), manganese (7.98 ± 0.50; 7.43 ± 0.47) and potassium (9.84 ± 0.35; 7.96 ± 0.25), amongst others. Most of the other results obtained from the analyses of the ethanolic extracts of the leaves and bark exhibited similar trends; revealing the nutritional and pharmacological potentials of the *Ficus sur* plant thereby supporting its ethnobotanical use in the management of diarrhoea, diabetes and rheumatism.

Keywords: *Ficus sur*, medicinal plant, mineral content, phytochemical, proximate analysis

Introduction

Nigeria is rich and biodiverse; the forests are replete with different species of the *Ficus* plant. *Ficus* is a genus of about 800 species of woody trees, shrubs, vines, epiphytes and hemi-epiphytes in the family *Moraceae*. They are found in the savanna and rainforest; beside rivers and streams (Odunbaku *et al.*, 2008). Amongst the *Ficus* species are: *Ficus sur*, *Ficus goliath*, *Ficus elastic*, *Ficus exasperata*, *Ficus carica*, *Ficus benjamin*, *Ficus altissima* and *Ficus lingua*, etc.

Ficus sur Forssk. (*Moraceae*) is commonly known as “broom cluster fig” or “bush fig” and as “dûllúú, fárín sháurèè, haguguwa or garica” (Hausa) in northern Nigeria (Blench and Dendo, 2007). In Nigeria, it grows to 6–9 m, with a girth of 1–2 m, spherical crown and often low-branching. The bark produces white sap on wounding and the foliage leaves are about 2.5–15 cm long (Burkill, 1985).

Various parts of the *F. sur* plant, such as: the bark, leaves, tender shoots, fruits, seeds and latex have been reported to possess medicinal properties (Burkill, 1985). They are used to treat diarrhoea and anaemia as well as sexually transmitted diseases, amongst others (Irvine, 1961). In addition, they can be used as laxatives. *Ficus sur* contains many antioxidants and possess antimicrobial properties. The aqueous leaf extract showed antibacterial activities against *Staphylococcus aureus* and *Escherichia coli* but no activity was observed against *Salmonella typhimurium* (Ramde-Tiendrebeogo *et al.*, 2012). The fruits of *F. sur* also find uses in animal husbandry (Diba *et al.*, 2015).

Feleke and Brehane (2005) have reported isolating pentacyclic triterpenoids from the latex of *Ficus sur*. They are good sources of flavonoids and polyphenols and some bioactive compounds, such as: arabinose, β-amyrins, β-carotenes, glycosides, β-sitosterol and xanthotoxol (Gilani, 2005). The dried seeds are made up of 30% of a fixed oil containing the fatty acids: oleic (18.99%), linoleic (33.72%), linolenic (32.95%), palmitic (5.23%), stearic (2.18%) and arachidic (1.05%) acids. The oil is edible and can be used as a lubricant (Vaya, 2006).

The *Ficus sur* plant remains largely underexploited. Consequently, this investigation on the comparative study of the phytochemical, proximate and mineral compositions of the ethanolic extracts of the bark and leaves of *Ficus sur* Forssk. has been undertaken with a view to providing a rational basis for the plant’s use in alternative/traditional medicine.

Materials and Methods

Plant Collection and Preparation

The leaves and bark of *Ficus sur* were collected from Maiduguri (11^o 50’42” N and 13^o 9’36” E) in Northern Nigeria. The plant was authenticated and deposited at Herbarium of the Botany Department, University of Lagos (Voucher no LUH 5795). The plant samples were air-dried, away from direct sunlight, pulverised and stored until use.

Extraction of Plant Materials

100 g of the pulverised leaf and bark samples were extracted using absolute ethanol (250 mL x 2) for 72 hours. The individual extracts were filtered and concentrated *in vacuo* at 40 ^{o}C. The yields of the crude extracts obtained were 5.3% w/w. and 4.2% w/w. for the bark and leaves of *F. sur*, respectively.

Phytochemical Screening of Extracts

The crude ethanol extracts of the leaves and bark of *F. sur* (*Moraceae*) were screened for their phytochemical composition, such as: alkaloids, saponins, tannins, steroids, phenols, flavonoids, cardenolids, quinones and anthraquinones, according to the methods adopted by Asekun *et al.* (2013).

Proximate and Mineral Analyses

The analyses for the proximate contents of the dried powder of the leaves and bark of *F. sur* were carried out using methods described by the Association of Official Analytical Chemists (AOAC, 1999). The samples were analysed for moisture content, carbohydrates, crude fibres, crude proteins, total ash and crude fats (lipids). The nitrogen value, which is the precursor for determining the proteins of a substance, was determined by the micro-Kjeldahl method (Miller and Houghton, 1945). The nitrogen value was converted to protein by multiplying with a factor of 6.25. All the proximate values were reported in percentages.

The mineral constituents were determined by the aqua-regia method of digesting the samples in a mixture of nitric acid and hydrochloric acid (1:3). The minerals investigated were sodium (Na), magnesium (Mg), aluminium (Al), potassium (K), calcium (Ca), copper (Cu), iron (Fe), zinc (Zn) and nickel (Ni), using the Atomic Absorption Spectrophotometer (Analyst 200 Model) and adopting methods used by Shah *et al.* (2009).

Results

The phytochemical screening revealed the presence of tannins, alkaloids, flavonoids, phenols, cardenolides, steroids and anthraquinones in varying concentrations in the bark and leaves of *F. sur* (Table 1).

Table 1: Phytochemical Composition of *Ficus sur*

Phytochemicals	Bark	Leaves
Tannins	++	+
Flavonoids	+	+
Alkaloids	++	+
Phenols	+	+
Steroids	+	+
Saponins	ND	ND
Quinones	+	+
Cardenolids	+	+
Anthraquinones	ND	+

++ = high concentration
+ = moderate concentration
ND = Not Detected

The proximate analysis showed that both the bark and leaves were rich in carbohydrates at 57.26% and 58.70%, respectively (Table 2). The ash (20.44%; 16.65%) and protein (9.37%; 14.40%) contents for the bark and leaves, respectively, were also significant. The ash content was higher in the bark than the leaves while the latter gave a higher protein content than the bark of the plant. The lipids and moisture content were detected in small quantities.

The elemental analysis results for the bark and leaves of *F. sur* are shown in Table 3. The mineral contents of the plant parts examined were similar, to a large extent. The magnesium content was high in both the bark (93.85 mg/g) and leaves (93.70 mg/g). Other results for the bark and leaves, respectively, included: iron (18.95 mg/g; 16.05 mg/g), sodium (16.44 mg/g; 18.44 mg/g) and zinc (6.02 mg/g; 6.80 mg/g).

Discussion

The phytochemical analyses of the ethanol extracts of *Ficus sur* revealed the presence of tannins, alkaloids, flavonoids, phenols, steroids, cardenolides and quinones in varying concentrations in its bark and leaves. Anthraquinones were detected in moderate concentrations in the leaves only whereas saponins were not detected in either the leaves or bark. Nonetheless, the bark revealed higher contents of alkaloids and tannins than the leaves (Table 1).

It is noteworthy that whilst alkaloids were observed in high and moderate concentrations (see Table 1) in the ethanolic extracts of the bark and leaves, respectively, the methanolic extracts of the *Ficus sur* plant did not show the presence of alkaloids. Conversely, the methanol extracts gave positive results for saponins, which were undetected in the ethanol extracts of the bark and leaves (Solomon-Wisdom *et al.*, 2011). Similarly, Adebayo *et al*. (2017) did not observe the presence of anthraquinones in neither bark nor leaves whereas in this study, anthraquinones were detected in moderate concentrations in the leaves. The foregoing

Table 2: Proximate Composition of *Ficus sur*

Plant Part	Ash (%)	Fibre (Crude) (%)	Lipid (Crude) (%)	Moisture (%)	Protein (Crude) (%)	Carbohydrate (Total) (%)
Bark	20.44 ± 0.44	6.50 ± 0.39	1.63 ± 0.25	4.93 ± 0.35	9.37 ± 0.35	57.26 ± 0.34
Leaves	16.65 ± 0.45	4.35 ± 0.45	1.80 ± 0.20	4.03 ± 0.25	14.40 ± 0.28	58.70 ± 0.45

*Mean values of three determinations = mean ± standard deviation (SD)

results point to the fact that solvents play a crucial role in phytochemical analyses. Poor to zero yields of extracts have been reported due to solvent effect.

The report of Uzoekwe and Mohammed (2015) on their investigation on the ethanol extracts of *Ficus capensis* Thunb. (a synonym of *Ficus sur* Forssk.) revealed contrasting results in the phytochemical, proximate and mineral contents analyses of the leaves and bark. For instance, saponins and alkaloids were detected and undetected, respectively, contrary to the results from *Ficus sur*. Additionally, anthraquinones were not found in the bark and leaves of *F. capensis*.

The presence of important phytochemicals, such as: alkaloids, flavonoids and phenols, in the bark and leaves of the *Ficus sur* plant is pertinent as these groups of secondary metabolites are medically beneficial and impact useful potentials to the body. Flavonoids and other phenolic compounds are potent water-soluble antioxidants and free-radical scavengers that prevent oxidative cell damage and have strong anti-cancer properties (Del-Rio *et al.*, 1997; Cowan, 1999; Okwu, 2004). Alkaloids, on the other hand, have marked physiological effects on animals (Edeoga and Eriata, 2001). They also act as anti-poisons, antioxidants and stimulants (Cordell *et al.*, 2001). Tannins have been reported to be responsible for a decrease in feed intake and feed efficiency, net metabolisable energy, protein digestibility and growth rates in experimental animals (Shills *et al.*, 2006).

The proximate results of *Ficus sur* (Table 2**)** showed a higher protein content in the leaves (14.40%) than in the bark (9.37%). The protein content was higher in comparison to other Nigerian leafy vegetables, such as *Corchorous olitorius* (1.3%) and *Talinum triangulare* (2%), as reported by Obahiagbon and Erhabor (2010), though it was lower than that of the leaves of *Ficus exasperata* (16.85%), accoding to Ajayi *et al.* (2012), and 17.47% of *Ficus capensis* (Uzoekwe and Mohammed, 2015). The health benefits of proteins include the involvement of its essential and non-essential amino acids as building blocks for protein synthesis; not only for the growth of infants and children but also for the constant replacement or turnover of the adult body proteins (Lehninger, 1990).

The crude lipids content was higher in the leaves (1.80 ± 0.20%) than in the bark (1.63 ± 0.25%). This is comparable to the percentage crude fat reported by Uzoekwe and Mohammed (2015) for the leaves (1.8%) and bark (2%) of *Ficus capensis* Thunb. Although *F. capensis* showed a higher fat content in the bark than its leaves, the leaves contained the same percentage of crude lipids as *F. sur* leaves. The lipids content of the leaves of *F. sur* was higher than that of *T. triangulare* (Obahiagbon and Erhabor, 2010) but lower than that of the *F. exasperata* leaves (Ajayi *et al.*, 2012). Lipids are essential carbon sources for the biosynthesis of cholesterol and other steroids. The provision of fatty acids by plants is also well known and documented (Lehninger, 1990).

The fibre content of *Ficus sur* was higher in its bark (6.50%) than the leaves (4.35%). However, the leaves' crude fibre was higher in comparison to that of *C. olitorius* (1.2%) and *T. triangulare* (2.0%), as reported by Obahiagbon and Erhabor (2010), but lower than those of *F. exasperata* (8.26%) and *F. asperifolia* (20.27%), according to Nkafamiya *et al.* (2010). Fibres lower body cholesterol and therefore reduce the risks of cardiovascular diseases and diabetes (Rankin *et al*., 1976).

The high carbohydrate content detected in the bark (58.70%) and leaves (57.26%) of *F. sur* indicates that the plant is probably a good source of carbohydrates. In the tropics where carbohydrates contribute up to 80% of the daily calorific need (Burton and Foster, 1998), the *Ficus sur* plant would be useful in the human diet.

Table 3: Mineral Compositions of *Ficus Sur*

Minerals	Concentration (mg/g)	
	Bark	**Leaves**
Magnesium	93.85 ± 0.59	93.70 ± 0.50
Iron	18.95 ± 0.73	16.05 ± 0.30
Manganese	7.43 ± 0.47	7.98 ± 0.50
Copper	0.22 ± 0.01	0.20 ± 0.01
Calcium	0.04 ± 0.01	0.01 ± 0.01
Potassium	7.96 ± 0.25	9.84 ± 0.35
Sodium	16.44 ± 0.30	18.44 ± 0.20
Zinc	6.02 ± 0.20	6.80 ± .025
Nickel	0.014 ± 0.01	0.004 ± 0.01

*Mean values of three determinations = mean ± standard deviation (SD)

Equally notable are the ash and moisture contents, which were both respectively higher for the bark (20.44%; 4.93%) than the leaves (16.65%; 4.03%). The percentage ash for the bark and leaves of *F. sur* were about double the values reported for the bark (10.95%) and leaves (11%) of *F. capensis* (Uzoekwe and Mohammed, 2015). The high ash contents observed in the proximate analysis of the ethanol extracts of the bark and leaves of *F. sur* was corroborated by the high and varied mineral composition analyses results obtained (see Table 3).

The results for the elemental analysis of the bark and leaves of *F. sur* recorded higher concentrations of Mg, Fe, Cu, Ca and Ni for the bark whereas the compositions of Mn, K, Na and Zn were higher in the leaves. Uzoekwe and Mohammed (2015) have reported the absence of sodium and potassium in the leaves and manganese in the bark of *Ficus capensis*.

The magnesium content in the bark (93,850 ppm) and leaves (93,700 ppm) of the *Ficus sur* plant was very high compared to that of *Ficus exaperata* leaves (186.2 ppm) and *Corchorous olitorius* leaves (187.2 ppm), as reported by Ajayi *et al.* (2012) and Obahiagbon and Erhabor (2010), respectively. Magnesium is needed in the human diet because it is an active component of several enzymetic systems in which thiamin pyrophosphate (TPP), for example, is a co-factor (McDowell, 1992).

The iron content was also higher in the bark of *F. sur* (18,950 ppm) than its leaves (16,050 ppm). However, Ajayi *et al.* (2012) reported a much lower iron content in the leaves of *F. exasperata* (168.2 ppm). Iron performs several functions in the body. Therefore, it is desirable in herbs for the maintenance of good health. Iron also helps in blood formation and the transfer of oxygen and carbon dioxide from one tissue to another (McDonald *et al.*, 2011).

The concentration of potassium, which was higher in the leaves (9,840 ppm) than the bark (7,960 ppm) of *F. sur* was much lower when compared to the concentration (40,000 ppm) found in *Vernonia amygdalina* (Obahiagbon and Erhabor, 2010). Potassium helps to maintain osmotic pressure and regulate acid–base equilibria. It plays an important role in nerve and muscle excitability and it is also involved in carbohydrate metabolism (McDonald *et al.*, 2011).

The zinc content in the leaves of *F. sur* (6,800 ppm) was similar to that of the bark (6,020 ppm). It was also very high compared to the zinc reported in the leaves of *F. exasperata* (66.30 ppm) by Ajayi *et al.* (2012). Zinc plays a vital role in gene expression as well as in the regulation of cellular growth. It is a co-factor in several enzymes responsible for the metabolism of carbohydrates, proteins and nucleic acid (Gafar and Itodo, 2002).

Calcium is an important component of the skeleton and teeth as well as an essential constituent of living cells and tissue fluids. It is essential for the activities of enzyme systems necessary for the transmission of nerve impulses and the contractile properties of muscles. Calcium is also concerned with the coagulation of blood and occurs in the plasma. It is the most abundant mineral element in the animal body (McDonald *et al.*, 2011). The concentration of calcium was relatively low in the *F. sur* plant. It was higher in the bark (40 ppm) than the leaves (10 ppm); unlike in *F, capensis* where the converse was the case (Uzoekwe and Mohammed, 2015).

The values obtained for sodium gave a converse scenario to that of calcium as the leaves of *F. sur* recorded a higher concentration (18,440 ppm) than that of the bark (16,440 ppm). The leaves of *Ficus sur* also contained more sodium than the leaves of *Telfairia occidentalis* (10,000 ppm) (Obahiagbon and Erhabor, 2010) and *Ficus exasperata* (16.7 ppm) (Ajayi *et al.*, 2012). Sodium plays a role in the transmission of nerve impulses and in the absorption of sugars and amino acids from the digestive tract. It also helps in the production of osmotic pressure and regulates fluid exchange between the cell and the surrounding tissues in the body (Long *et al.*, 2007).

Conclusion

The results of the phytochemical, proximate and mineral compositions obtained in this study have revealed the nutritional and pharmacological potentials of the bark and leaves of *Ficus sur* Forssk. The presence of these components in the plant ought to, therefore, justify its use, in alternative/traditional medicine; in the management of heart diseases and sexually transmitted diseases as well as hypertension, anaemia and diarrhoea. In addition, its further investigation should bode well for research and the development of new drugs.

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