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Research Article

Phytochemical Screening and Microbial Inhibitory Activities of *Ficus Capensis*

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ABSTRACT: *Ficus* plant components have application in traditional medicine because of the myriad uses they have been subjected to. The ease of application is based on the secondary metabolites this plant contains. The challenges faced by modern medicine especially in the complete cure of microbially-associated diseases through abrupt and unpredictable genetic mutations in the presence of conventional drugs informed the investigation of the microbial inhibitory activities of the stem, root and leaf parts of *F. capensis* against test disease causing microorganisms. The phenolic, alkaloid and tannin phytochemical fractions were highest in *F. capensis* bark extract (180, 165 and 155 µg/ml respectively) followed by that contained in the stem extract (100, 90 and 85 µg/ml respectively). While *Streptococcus faecalis* and *Pseudomonas mirabilis* were resistant to many different antibiotics (87.5%), they were effectively inhibited by all concentrations of ethanolic *F. capensis* extracts. The minimum inhibitory concentration of ethanolic extracts ranged from 25% leaf and stem extract concentration respectively (4mm) against *S. faecalis* and (2mm) against *P.mirabilis*. All test isolates were 100% susceptible to ethanol extract growth inhibition..

Keywords: *Ficus capensis*; phytochemical; inhibitory activities.

INTRODUCTION

Ficus plants belong to the mulberry family, *Moraceae*. *Ficus capensis*, also known as the cape fig and is a native of tropical Africa and the Cape Islands. The plant is a deciduous tree with spreading roots and branches and broad green leaves. The name 'fig' is derived from the hollow, pear-shaped inflorescence called "Syconia". *F. capensis* produces fleshy fruits all year round in a single or branched raceme along the trunk and the main braches. These fruits, though inedible to humans are eaten by many animals.

Many of the world's population are versed in the use of the available plants and herbs in their environment in the treatment of different diseases (Hansch *et al.*, 1990; Shellard, 1987). In Nigeria, and other parts of the world, the plant along with many others in this family is important in the traditional treatment of many diseases and ailments. The plant extracts have been reported in the treatment of diarrhea, dysentery, sexually transmitted disease causing microorganisms, chest ailments, tuberculosis, leprosy, convulsions, pain, in anaemia and wound (Irvine, 1961; Amos *et al*., 2001; Ahmadu *et al*., 2007, Oyeleke *et al.*, 2008; Sandabe and Kwari, 2000; Wakeel *et al.*, 2004) among many others.

The relevance of this plant in traditional medicine is as a result of the secondary metabolites such as phytates, phenols, saponins, tannins, alkaloids, terpenoids and flavonoids which they have been screened to contain. Also referred to as phytochemicals, they are reported to possess inhibitory activities against the growth and disease inducing activities of some pathogenic microorganisms (Hassan, 2005; Oyeleke *et al*., 2008; Sandabe *et al*., 2006; Solomon-Wisdom *et al.*, 2011 Stary, 1998; Udobi *et al*., 2008).

Despite the breakthroughs in disease management and medicine, disease causing microorganisms continually undergo genetic variations which permit them to survive and resist treatment especially with antibiotics. Hence, even in this modern age the search

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for newer sources of antimicrobial agents in disease management continues to be important. This study therefore aims at investigating the phytochemical composition and microbial inhibitory activities of *Ficus capensis* on selected disease causing microorganisms compared with that of established antibiotics.

MATERIALS AND METHODS

Sample collection and processing

Fresh leaf, stem and bark samples of *Ficus capensis* were purchased from local herb vendors at Bode herbal market in Ibadan, Nigeria. Identification was carried out at the herbarium, Department of Botany, University of Ibadan. The samples were air-dried, pulverized separately in a warring blender and packaged in sample bags for subsequent determinations.

Extraction and Phytochemical Screening of *F. capensis* samples.

Uniform weights (500g) of pulverized *F. capensis* plant parts were subjected to a 1L solvent extraction using ethanol and a soxhlet extractor. Aqueous extraction was done by immersing the samples in distilled water. Extracts were concentrated on a rotary evaporator to a dark brown thickened fluid. Bioactive components present in the plant samples such as phytates, phenols, saponins, tannins, alkaloids, terpenoids and flavonoids were quantitatively and qualitatively screened for according to Trease and Evans, (1989).

Microorganisms and Culture Conditions

The test isolates: *Escherichia coli, Pseudomonas aeruginosa, Shigella dysenteriae, Proteus mirabilis, Klebsiella pneumonia, Streptococcus faecalis, Staphylococcus aureus* and *Candida albicans* obtained from urine, wound and stool were retrieved from laboratory stock, sub-cultured unto fresh nutrient agar plates and incubated at 37^{o}C for 24 hours.

Determination of Inhibitory Activities of the Extracts

In-vitro antimicrobial screening of all extracts at different concentrations was carried out against the test isolates. A fresh inoculum size of 10^{6}cfu ml^{-1} for each test isolate was mixed with 20 ml agar medium, poured into a plate and allowed to set. Using an agar (nutrient and potato dextrose) well diffusion method, the antimicrobial activities of the different *F. capensis* extracts was determined by introducing 100µl of the ethanol and aqueous extracts into 5mm diameter wells with an approximate volume of 0.24m^{3}. Absolute ethanol and distilled water were used as controls while Cotrimoxazole, Ofloxacin, Amoxycillin, Tetracycline, Augumentin, Nitrofurantoin, Nalidixine and Gentamycin were antibiotics used to compare the efficacy of the extracts. Plates were incubated for 24-48 hours after which inhibition of the growth of the test organisms was observed for and the zone of inhibition around each well was measured in millimeters.

Determination of minimum inhibitory concentration

To determine the minimum inhibitory concentration, 100µl of increasing concentrations of *F. capensis* extracts (125µg/ml; 250µg/ml; 375µg/ml and 500µg/ml) were tested against the microbial isolates.

RESULTS

Quantitatively, the highest presence of tannins was recorded in the bark while the phytates were most abundant in the leaf. Saponins were highest in the leaves, reduced gradually in the stem and were found to be least in the bark (Table 1). Alkaloids and phenolics were highest in the bark while their quantity was least in the leaf. Terpenoids and flavonoids were highest in the leaf samples.

Table 1:
Qualitative determination of bioactive components in the leaf, stem and bark of *Ficus capensis*

Bioactive component	Leaf extract	Stem extract	Bark extract
Tannins	+++	+++	+++++
Phytates	++	+	+
Saponins	++++	++	+
Alkaloids	++	+++	+++++
Terpenoids	+++	+	+
Flavonoids	++	+	+
Phenolics	+++	++++	+++++

Key: + Present ++ Higher presence
- Absent

Increase in the number of sign showed how much was present qualitatively.

The quantitative amount of bioactive components is shown in Figure 1. Each powdered *F. capensis* extract was enlisted at different concentrations (0.125mg/ml; 0.25mg/ml; 0.375mg/ml and 0.5g/ml) to test for antimicrobial activity potentials (Table 2). The results revealed that the highest inhibitions came from ethanol extracts. The bark extracts had the highest inhibitions on *P. aeruginosa, C. albicans* and *S. aureus.* Ethanol extracts from the leaf had the greatest inhibition on *S.*

faecalis, E. coli and *S. dysentariae.* In both cases the inhibition reduced as the concentration of the extract reduced. Water extracts from the leaf and bark demonstrated half of the inhibitory potentials of the ethanol extracts. No inhibition was recorded by either extracts at 0.125g/ml concentration in *P. aeruginosa*, *S. aureus, K. pneumoniae* and *S. dysentariae.* The water extract from the stem was totally without activity against *S. faecalis, S. aureus* and *K. aeruginosa.* The minimum inhibitory concentration was recorded from the leaf and stem ethanol fractions against *S. faecalis* and *P. mirabilis.* A concentration of 125µg/ml leaf and stem ethanolic extract respectively was found to effect an inhibition on *S. faecalis* and *P. mirabilis* respectively.

Table 3 shows the response of test isolates to some antibiotics. All isolates were resistant to cotrimoxazole except *S. dysentariae* which showed an inhibitory zone of 23mm. *K. pneumonia, P. mirabilis, S. aureus* and *S. faecalis* were all resistant to Tetracycline amoxicillin and nitrosofuranide. *P. mirabilis* and *S. faecalis* had the greatest resistance to the range of antibiotics tested against being succeptible to only one antibiotic each.

Table 3 shows the sensitivity of the test isolates to some commercial antibiotics. *S. faecalis* was resistant to all antibiotics except nalidixine while all concentrations of the ethanolic extracts had inhibition against it (Table 2). *S. dysentariae* was also highly resistant to most of the antibiotics and recorded a very high inhibition with the leaf ethanolic extract (16mm). All extracts at 25% to 100% concentration inhibited the bacterium's growth around the well. The highest concentration of the ethanol extracts recorded high inhibition against *K. pneumoniae* while the bacterium proved resistant to 6 antibiotics. A hundred percent concentration of the *F. capensis* leaf ethanol extract recorded an inhibition of 18mm on *E. coli* which was more than the value that was recorded with nitrofurantoin and gentamicin. Inhibition of *P. aeruginosa* by 100% bark ethanol extract (18mm) was higher than that recorded from 5 antibiotics against the same bacterium.

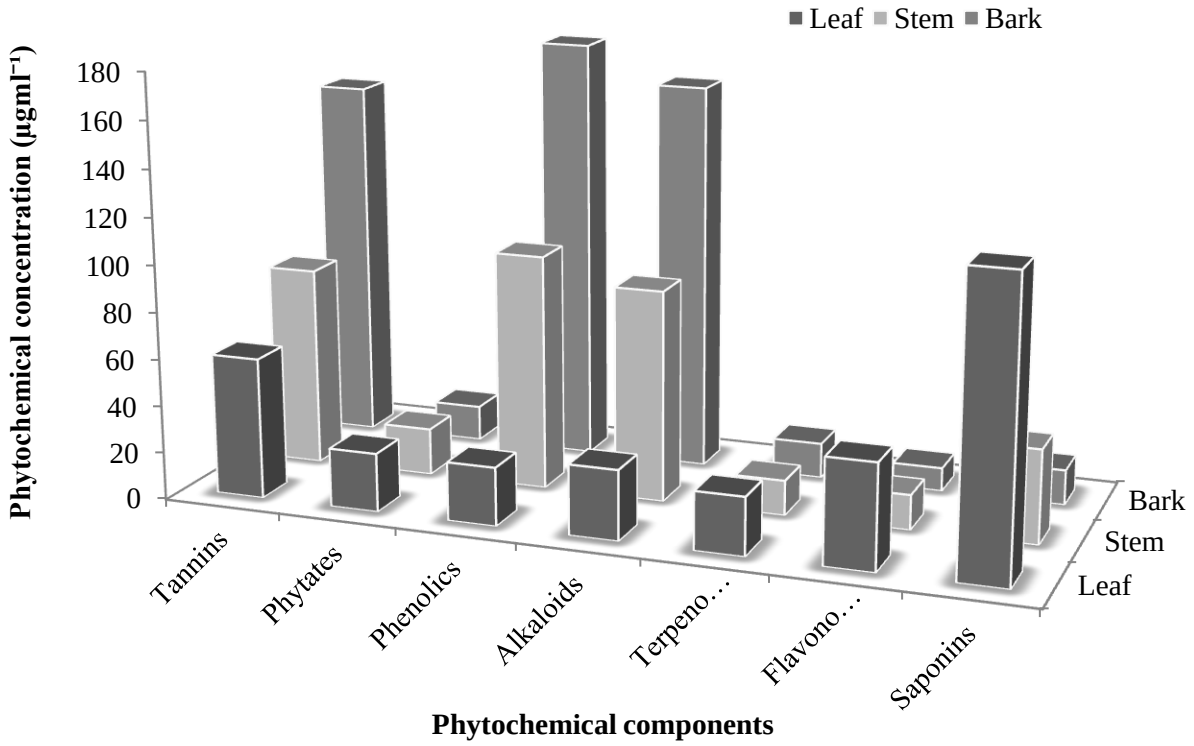


Figure 1:
Quantitative determination of the bioactive components of *Ficus capensis* plant parts

Table 2:

Inhibitory activities of *Ficus capensis* extracts on selected isolates

Test Isolates	Extract concentration (%)	Water control	Ethanol control	Zone of inhibition (mm)					
				LEE	SEE	BEE	LWE	SWE	BWE
S. faecalis	100	-	1	13	10	11	8	-	8
	75			8	8	8	2	-	6
	50			8	6	5	-	-	-
	25			4	-	-	-	-	-
P. mirabilis	100	-	1	8	8	5	4	2	5
	75			3	6	2	4	-	3
	50			-	6	-	-	-	-
	25			-	2	-	-	-	-
P. aeruginosa	100	-	2	14	13	18	6	4	5
	75			9	11	6	4	2	-
	50			4	-	-	-	-	-
	25			-	-	-	-	-	-
S. aureus	100	-	1	8	10	12	5	-	2
	75			8	4	3	2	-	-
	50			5	-	3	-	-	-
	25			-	-	-	-	-	-
E. coli	100	-	2	18	15	16	10	8	7
	75			12	12	11	7	8	5
	50			9	8	7	-	-	2
	25			-	4	-	-	-	-
K. pneumoniae	100	-	2	12	12	12	5	-	7
	75			-	7	9	-	-	2
	50			-	-	4	-	-	-
	25			-	-	-	-	-	-
S. dysenteriae	100	-	1	16	12	8	10	8	4
	75			10	10	6	4	7	4
	50			6	9	6	-	-	-
	25			-	-	-	-	-	-

Keys: LEE (leaf ethanolic extract); SEE (stem ethanolic extract); BEE (bark ethanolic extract); LWE (leaf water extract) SWE (stem water extract); BWE (bark water extract)

Table 3:
Sensitivity of test isolates to some antibiotics

Test isolates	**OFL**	**AUG**	**TET**	**AMX**	**COT**	**NIT**	**GEN**	**NAL**	**% Resistance**
S. faecalis	R	R	R	R	R	R	R	20	87.5
P. mirabilis	11	R	R	R	R	R	R	R	87.5
P. aeruginosa	19	18	20	12	R	12	R	R	37.5
S. aureus	17	R	R	R	R	R	18	R	75
E. coli	R	R	19	R	R	14	16	23	50
K. pneumonia	R	20	R	R	R	R	17	R	75
S. dysenteriae	R	R	10	R	23	R	R	R	75

KEYS:
OFL- Ofloxacin; AUG- Augumentin; TET-Tetracycline; AMX- Amoxycillin; COT-Cotrimoxazole; NIT-Nitrofurantoin
GEN Gentamycin NAL Nalidixine

Both *F. capensis* plant extracts (100% water and ethanol) had the best inhibition on *P. mirabilis.* This was also much higher than that recorded with the use of established antibiotics of which seven were unable to inhibit the bacterium growth. The zones of inhibition recorded by ofloxacin and gentamycin against *S. aureus* were 17 and 18mm respectively. The extracts also recorded inhibition even at 50% concentration while 6 established antibiotics were unable to inhibit the growth of *E. coli*.

DISCUSSION

These results showed the presence of secondary metabolites in *F. capensis* of which tannins, saponins, alkaloids and phenolics were especially found abundant in all plant parts tested. Even though low at times, the phytochemicals were recorded in all plant parts unlike the findings of Solomon-Wisdom *et al.,* 2011 where certain phytochemicals may be found in only one part of the plant and not in the other. Adeshina *et al.,* 2010, reported that the geographical location of the plant influences the amount of phytochemicals present in it. In this work, the presence of the phytochemicals in all plant parts tested showed that the Oyo State environment favoured the presence of the phytochemicals in the plant. The high phytochemical contents observed in this plant will make it a unique material of medicinal drug screening and research. A high quantity of saponins was recorded especially in its leaf sample, corroborated by Solomon-Wisdom *et al.,* 2011, and contrary to the findings of Oyeleke *et al.,* 2008, which also reported the presence of all the phytochemicals identified except saponins however, the flavonoid content recorded from the leaf sample was slightly lower than that recorded by Adeshina *et al.,* 2010.

Considerable antimicrobial activities of the plant extracts were recorded in this work and these would be as a result of the presence of the bioactive compounds in *F. capensis*. Both the leaf and bark extracts had the highest inhibitory activities against test pathogens while the stem had the least. Ebana *et al.* (1991) reported the inhibition of pathogenic bacteria by alkaloids. The growth of all the pathogens tested for in this work was inhibited by the plant extracts. The high tannin content in the bark would make it a suitable choice especially in treatment of wounds and bleedings (Nguyi, 1988). The extracts had superior microbial inhibitory activities when compared with the antibiotics used and may find application in the management and treatment of the diseases caused by these test organisms. That the stem ethanol extract recorded microbial inhibition even at 125µg/ml on *E. coli* suggests a strong possibility of the application of very minimal quantities of *F. capensis* as a chemotherapeutic agent in the treatment of skin infections such as pruritis, boils, burns, surgical wound dressings, etc (Akpendu *et al.,* 1994; Solomon-Wisdom *et al.,* 2011).

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