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Phytochemical analysis of *Ficus thonningii*: A qualitative study

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ABSTRACT

This study assessed the phytochemical contents of the aqueous, ethanol, ethyl acetate and methanol extracts of the fruit, leaves, root, and stem of *Ficus thonningii* at selected concentrations. The contents of alkaloids, tannins, saponins, volatile oils, phenols and flavonoids were determined qualitatively in these extracts at selected concentrations. The results obtained showed that alkaloids are present in the leaves, roots and stem barks of *F. thonningii*. The volatile oil is found in the stem bark, root bark, and fruit (aqueous only) of the plant. Saponin is found to be concentrated in all the extracts of the plant. Phenol is found to be concentrated in the fruit of the plant. Its presence is also confirmed in the leaves (at few concentrations) and present in trace amount in the stem bark. Tannin is found in the fruit, root bark and leaves of *F. thonningii*. Flavonoids are found in all the parts of *F. thonningii*. The variety of phytochemicals confirmed in the fruit, leaves, stem, and root barks of *F. thonningii* show that the plant is pharmacologically active.

KEYWORDS: *Ficus thonningii*, phytochemicals, pharmacological activities

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INTRODUCTION

Ficus thonningii of the family Moraceae, is a multi-stemmed evergreen African medicinal plant that grows 6 to 21-meter-high commonly in upland forests of tropical and subtropical Africa (Cousins & Huffman, 2002) at altitudes of between 1,000–2,500 m and grows best in light, deep and well drained soils (Hines & Eckman, 1993). The is traditionally named Cediya (Hausa), Odan (Yoruba), Tsediya (Nupe) and Okpooma (Idoma) in Nigeria (Maiha *et al.*, 2013). The leaves are alternate, fairly-dark green and sub glossy above whilst paler below (Schmidt *et al.*, 2002). The hairless or finely hairy leaves which are about 4.5-12 cm long are usually rounded or tapering, with a prominent midrib (Hyde & Wursten, 2011). The singly born or paired hairy fruits are round with 10-20 mm diameter and usually yellow or rarely pink when ripe (Schmidt *et al.*, 2002). *Ficus thonningii* is pollinated by wasps that live in the syconium of its fruit, and it can easily be propagated using seeds and cuttings (Danthu *et al.*, 2002).

The *Ficus thonningii* species specifically contains resveratrol glucoside and stilbene glucoside derivatives. Tannins, alkaloids,

terpenoids, saponins, flavonoids and essential oils have also been identified (Bamikole *et al.*, 2004; Greenham *et al.*, 2007; Nduke *et al.*, 2007; Coker *et al.*, 2009; Ahur *et al.*, 2010; Dangarembizi *et al.*, 2013). Other phytoconstituents of the plants include oxalate, phytate (Dangarembizi *et al.*, 2013), lignins, lignans, active carbohydrates and proteins (Ahur *et al.*, 2010).

As shown in Table 1 below, different anatomical parts of the plant have been reportedly used traditionally for medicinal purposes.

According to Dangarembizi *et al.* (2013), various reported pharmacological activities of *Ficus thonningii* include antimicrobial, antiprotozoal, antifungal, anthelmintic, antioxidant, analgesic, anti-inflammatory, cardioprotective, hypoglycemic, antineoplastic, and antidiarrheal properties.

Owing to the paucity of information on the phytochemical contents of *Ficus thonningii*, this research work aims at determining qualitatively the phytochemical contents of the fruit, leaves, root, and stem bark extracts of *Ficus thonningii* at selected concentrations.

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MATERIALS AND METHODS

Chemicals and Reagents

Mercury chloride, potassium iodide, sodium hydroxide, hydrochloric acid (dilute and concentrated), iron (iii) chloride, ethanol, ethylacetate, methanol.

Plant Materials

Ficus thonningii (Figure 1) was collected at Aroje Aba area of Ogbomoso, along Ilorin Express road, Oyo state, Nigeria. The fruit, leaves, root, and stem barks of *Ficus thonningii* were air-dried and grinded; 1gram of each part of the plant was soaked in 20mls of distilled water, 1% volume per volume (v/v), 2%v/v, 3%v/v, 4%v/v and 5%v/v of ethanol, ethyl acetate and methanol separately to obtain the aqueous, ethanol, ethyl acetate and methanol extracts, respectively. The mixtures were left for 24 hours after which they were sieved to obtain the extracts.

Test for Alkaloid

Two drops of Mayer's reagent together with two drops of 2% v/v of Hydrochloric (HCl) acid was added to 1ml of plant extracts. The cream coloration of the mixture indicates the presence of Alkaloid (Obidoa et al., 2010).

Test for Volatile Oil

0.2mls of 1% v/v of sodium hydroxide was added to 1ml of plant extracts. Formation of white precipitate indicates the presence of Volatile oil (Akinyemi & Oyelere, 2019).

Test for Saponin

1ml of distilled water was added to 1mls of plant extracts. Foaming after vigorous shaking for about 20minutes indicates the presence of saponin (Sabri et al., 2012).

Test for Phenol

Two drops of FeCl₃ were added to a mixture of 1ml of distilled and 1ml of plant extracts. The formation of a green precipitate indicates the presence of tannin and bluish green or dark green indicates the presence of phenol (Malliga et al., 2014).



Figure 1: a. *Ficus thonningii* plant; b. *Ficus thonningii* fruits

Test for Flavonoid

Three drops of 20% NaOH were added to the mixture of 1ml of distilled and 1ml of plant extracts. The intense yellow colouration of the mixture indicates the presence of Flavonoid. The disappearance of the yellow colour after the addition of 1mls of dilute HCl acid validates the presence of Flavonoid (Ayoade et al., 2019).

RESULTS AND DISCUSSION

As shown in Table 2, alkaloid is absent at all selected concentrations of *F. thonningii* fruit extracts while volatile oil is found in moderate amounts only in the aqueous extract of *Ficus thonningii* fruit. Saponin, Phenol and Tannin are found in all selected extracts of *Ficus thonningii* fruit at moderate to high concentration. Flavonoid is found in moderate concentration at aqueous and ethyl acetate extracts of *Ficus thonningii* fruit.

According to Table 3, Alkaloid is found to be moderately present at 2% ethanol, 2% ethyl acetate, 1% and 2% methanol extracts of *Ficus thonningii* root bark. The volatile oil was found to be moderately present in aqueous, 1% and 2% ethanol and 3% ethyl acetate extracts of *Ficus thonningii* root bark. Saponin is found to be present in 4% ethanol, 4% ethyl acetate and 4%

Table 1: Ethnomedicine of *Ficus thonningii* plant

Medicinal use	parts used	Reference
Treatment of diarrhea	Leaves, stem, root	Njoronge & Kibunga, 2007
Treatment of gonorrhoea	Leaves	Njoronge & Kibunga, 2007
Treatment of diabetes mellitus	Leaves	Njoronge & Kibunga, 2007
Treating bronchitis and urinary tract infections	Leaves	Cousins & Huffman, 2002
treating stomach pains	Leaves	Nwude & Ibrahim, 1980
Treating gastritis	Leaves	Nwude & Ibrahim, 1980
Treating gastric ulcer	Leaves	Nwude & Ibrahim, 1980
Treating influenza	Stem	Orwa et al., 2009
Treating sore throat	Stem	Orwa et al., 2009
Treating colds	Stem	Orwa et al., 2009
Treatment of arthritis	Stem	Orwa et al., 2009
Rheumatism	Stem	Orwa et al., 2009
Relieve inflammation	Stem	Orwa et al., 2009
Treating ulcer	Stem	Teklehaymanot & Gidday, 2007
Treating skin diseases	Stem	Gelfand et al., 1985
Treating cyst	Stem	Gelfand et al., 1985
Relief for constipation and bowel disorders	Stem	Gelfand et al., 1985
Healing of wound infections	Stem	Usman et al., 2009
Preventing miscarriages	Root	Gelfand et al., 1985
Stopping nose-bleeding	Root	Gelfand et al., 1985
Healing stomach pains	Root	Njoronge & Kibunga, 2007
Treating pneumonia	Root	Teklehaymanot & Gidday, 2007
Treating chest pains	Root	Teklehaymanot & Gidday, 2007

Table 2: Phytochemical screening of *Ficus thonningii* fruit

Extracts	<i>Ficus thonningii</i> (fruit)					
	Alkaloid	Volatile oil	Saponin	Phenol	Tannin	Flavonoid
Aqueous	-	++	++	++	++	++
1% Ethanol	-	-	++	++	++	-
2% Ethanol	-	-	+++	+++	++	-
3% Ethanol	-	-	++	++	++	-
4% Ethanol	-	-	++	++	++	-
5% Ethanol	-	-	++	++	+++	-
1% Ethylacetate	-	-	++	++	++	++
2% Ethylacetate	-	-	+++	++	++	++
3% Ethylacetate	-	-	+++	++	++	++
4% Ethylacetate	-	-	+++	++	++	++
5% Ethylacetate	-	-	+++	++	++	++
1% Methanol	-	-	++	++	++	-
2% Methanol	-	-	++	++	++	-
3% Methanol	-	-	++	++	++	-
4% Methanol	-	-	++	++	++	-
5% Methanol	-	-	++	++	++	-

Table 3: Phytochemical screening of *Ficus thonningii* root bark

Extracts	<i>Ficus thonningii</i> (root bark)					
	Alkaloid	Volatile oil	Saponin	Phenol	Tannin	Flavonoid
Aqueous	-	++	-	-	-	-
1% Ethanol	-	++	-	-	++	-
2% Ethanol	++	++	++	-	++	-
3% Ethanol	-	-	++	-	-	-
4% Ethanol	-	-	+	-	++	++
5% Ethanol	-	-	-	-	-	-
1% Ethylacetate	-	-	++	-	++	-
2% Ethylacetate	++	-	-	-	++	++
3% Ethylacetate	-	++	-	-	-	-
4% Ethylacetate	-	-	+	-	++	-
5% Ethylacetate	-	-	-	-	++	++
1% Methanol	++	-	-	-	++	-
2% Methanol	++	-	-	-	++	++
3% Methanol	-	-	-	-	-	++
4% Methanol	-	-	+	-	-	++
5% Methanol	-	-	-	-	-	-

methanol extracts of *Ficus thonningii* root bark and moderately present in 2% and 3% ethanol and 1% ethyl acetate extracts of *Ficus thonningii* root bark. Tannin is moderately present at 1%, 2% and 4% ethanol extracts, 1% and 2% ethanol extracts and all tested concentrations (except 3%) of ethyl acetate extracts of *Ficus thonningii* root bark. Flavonoid is moderately present at 4% ethanol, 2% and 5% ethyl acetate and 2%, 3% and 4% methanol extracts of *Ficus thonningii* root bark. Phenol is absent at all tested concentrations of the selected extracts of *Ficus thonningii* root bark.

Table 4 shows that Tannin is absent at all selected concentrations of *Ficus thonningii* stem bark extracts. Phenol is present in trace amounts at 1% and 2% ethanol extracts of *Ficus thonningii* stem bark. Flavonoid is present in trace amounts at 3% ethanol and 4% methanol extracts of *Ficus thonningii* stem bark. The volatile oil is present at all selected concentrations (except 1%) of methanol extracts of *Ficus thonningii* stem bark. Alkaloid is present in trace evident in aqueous, 2%, 3% and 5% ethanol, 2% ethylacetate 2% and 5% methanol extracts of *Ficus thonningii*

Table 4: Phytochemical screening of *Ficus thonningii* stem bark

Extracts	<i>Ficus thonningii</i> (Stem bark)					
	Alkaloid	Volatile oil	Saponin	Phenol	Tannin	Flavonoid
Aqueous	+	-	+	-	-	-
1% Ethanol	++	-	++	+	-	-
2% Ethanol	+	-	++	+	-	-
3% Ethanol	+	-	+++	-	-	+
4% Ethanol	+++	-	++	-	-	-
5% Ethanol	+	-	++	-	-	-
1% Ethylacetate	-	-	++	-	-	-
2% Ethylacetate	+	-	+++	-	-	-
3% Ethylacetate	-	-	++	-	-	-
4% Ethylacetate	-	-	++	-	-	-
5% Ethylacetate	-	-	+++	-	-	-
1% Methanol	-	-	++	-	-	-
2% Methanol	+	++	++	-	-	-
3% Methanol	-	++	+++	-	-	-
4% Methanol	-	++	++	-	-	+
5% Methanol	+	+++	+++	-	-	-

stem bark; moderately present in 1% ethanol and highly present in 4% ethanol extracts of *Ficus thonningii* stem bark.

As represented in Table 5, volatile oil was totally absent in *Ficus thonningii* leaves. Alkaloid is present in trace amounts at 5% ethanol extract of *Ficus thonningii* leaves and moderately present at 2% ethyl acetate extract of *Ficus thonningii* leaves. Flavonoid is present in trace amount at 1% ethanol extract of *Ficus thonningii* leaves and 4% ethyl acetate extract of *Ficus thonningii* leaves. Phenol and Tannin are present in moderate and high concentrations at 3% and 4% ethyl acetate extracts of *Ficus thonningii* leaves. Saponin is present in moderate to high concentration at all selected extracts (except aqueous) of *Ficus thonningii* leaves.

Medicinal properties of plants are a function of their phytoconstituents as plants rich in phytochemicals have been proven to exhibit varying pharmacological activities (Tunwagun et al., 2020). Therefore, evaluation of the phytochemicals present in a plant is critical in the development of plant-based drugs. In this study, the phytochemicals present in the fruit, leaves, stem, and root barks of aqueous, ethanol, methanol, and ethyl acetate extracts of *Ficus thonningii* plant is assessed qualitatively at selected concentrations.

The results obtained show the presence of alkaloid, volatile oil, saponin, phenol, tannin, and flavonoid at different quality in the selected extracts of *Ficus thonningii* plant. This observation is in alignment with the report of Dangarembizi et al., (2013). This observation shows that all selected anatomical parts of *Ficus thonningii* plant are of medicinal importance (Dangarembizi et al., 2013). Extracts obtained at all anatomical parts (except fruit) of *Ficus thonningii* plant are found to contain alkaloids. Alkaloids are low-molecular-weight heterocyclic nitrogen-containing alkaline compounds known for several pharmacological effects (Matsuura & Fett-Neto, 2015) such as antimalaria, analgesic, antihypertensive, anticancer properties (Rao et al., 1978; Wink et al., 1998).

The volatile oil is found to be present in varying quality at selected anatomical parts of *Ficus thonningii* plant. However, contrary to the findings of Ogunwande et al., (2008), volatile oil is not found to be present in the leaves of *Ficus thonningii* plant. This discrepancy may be because the specific volatile oil assayed for in the previous studies is not present in this present study. Volatile oils are said to demonstrate antimicrobial, antioxidant (Tunwagun et al., 2020), antibiotic, analgesic, anti-inflammatory, antiseptic, astringent, diuretic, laxative, sedative, vasodilative and vasoconstrictive properties (Haihashemi et al., 2002; Abdollahi et al., 2003).

All anatomical parts of *Ficus thonningii* plant considered in this study is shown to be rich in saponin. Saponins are glucosides with foaming characteristics. They are said to endow plant with different pharmacological properties such as antimicrobial, anti-tumour, anti-insect, hepatoprotective, hemolytic, anti-inflammatory and antihypercholesterolemic activities (Ross & Kassum, 2012).

Comparison of Tables 2, 3, 4 and 5 above shows that phenol is particularly concentrated in the fruit of *Ficus thonningii* plant and totally absent in the root bark extracts of the plant. Phenolics are compounds possessing one or more aromatic rings with one or more hydroxyl groups (Dai & Mumper, 2010). They are known for their antioxidant, anti-inflammatory, anti-proliferative, antioxidant and pro-apoptotic potentials (Manach et al., 2004).

Tannin was found to be concentrated in the fruit and root bark of *Ficus thonningii* and found in the leaves of the plant at few concentrations. Tannins are high molecular weight polyphenols ranging from 500 to 3,000 kDa which react with proteins through hydrogen bonds and/or hydrophobic interactions when in the unoxidized form (Sgarbieri, 1996). They can be hydrolyzed or condensed with the condensed form more studied due to their antimicrobial property (Chung et al., 1984; Akiyama et al., 2001; Lim et al., 2006; Min et al., 2008; Agostini-Costa et al., 2015). Tannins bind to the proteins and adhesins present in mucosal cells with this action being attributed to the phenolic hydroxyl group situated on the surface of this molecule (Jones et al., 1994; Haslam, 1996). They inhibit microbial enzymes by forming a protective cover (Haslam, 1996), which promotes plasma membrane disruption and blockage of substrates required for the microbial growth by forming a tannin-protein and/or polysaccharide complex (Jones et al., 1994; Haslam, 1996; Guimarães-Beelen et al., 2006). Other pharmacological activities of tannin include anti-inflammatory, antiseptic and antioxidant activities (Dolar et al., 2005).

Flavonoids are found in varying qualities in the selected anatomical parts of *Ficus thonningii* plant. Flavonoids are an important class of natural products; particularly, they belong to a class of plant secondary metabolites having a polyphenolic structure with favorable biochemical and antioxidant effects associated with various oxidative stress-related disorders (Burak & Imen, 1999; Castañeda-Ovando et al., 2009; Lee et al., 2009). Their other therapeutic activities include antioxidative,

anti-inflammatory, anti-mutagenic, anti-carcinogenic and enzyme modulating activities (Panchel et al., 2016).

CONCLUSION

The variety of phytochemicals found in the fruit, leaves, stem, and root barks of *Ficus thonningii* show that these parts of the plant could pharmacologically active against some disorders. Effort should be taking towards the identification and characterization of the various phytoconstituents of the *Ficus thonningii* plant.

CONFLICT OF INTERESTS

There is neither financial nor non-financial conflicts of interest among authors as regards this study.

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