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REVIEW ARTICLE

Phytochemistry and Pharmacological Review: *Spathodeacampanulata*

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ABSTRACT

Spathodeacampanulata (*S.campanulata*) belongs to the family Bignoniaceae, commonly known as the Fountain tree, African tulip tree, Flame-of-the forest. *S.campanulata* parts of the plant such as flowers, leaves, stem, bark, and roots are used for anti-malaria, healing of wound, diureticanalgesic and anti-inflammatory activities in folk medicine. The *S.campanulata* is known to possess various therapeutic properties have been reported for possessing anti-inflammatory, analgesic, cytotoxic, anti-diabetic, and anticonvulsant activity. Phytochemical study shows the presence of various secondary metabolites like alkaloids, tannins, flavonoids, glycosides, and sterols. This review aims to provide detailed information regarding geographical distribution, phytochemicals, and pharmacological properties of the *S.campanulata*.

Keywords: Anti-cancer, Flavonoids, *S.campanulata.*

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INTRODUCTION

Medicinal plants play an important role in our natural wealth. They serve as an important therapeutic agent and valuable raw material for manufacturing numerous traditional medicines and acts as the lead for modern medicines. The history of medicinal plants uses for treating disease and ailments is probably dated back to human civilization. World Health Organization (WHO) estimated that about three-quarters of the world's population currently uses herbs or other forms of traditional medicines to treat illness. Even in the USA, the use of plants and phytomedicines has increased dramatically.[1] The large diversity of medicinal plant species is a huge source of potentially active phytochemicals with novel structures. Approximately 119 pure chemical substances isolated from higher plants are used in medicine worldwide.[2] *Spathodeacampanulata* P. Beauvais is one of the medicinally important perennial plants commonly used as folkloric medicine in Nigeria. The species *Spathodeacampanulata* belong to the family Bignoniaceae and is native to Africa. It is often used in gardening in tropical and subtropical areas, including South America.[3] The flowers are used as diuretic and anti-inflammatory, while the leaves are against kidney diseases, urethra inflammations and as an antidote against animal poisons.[4] Several phytochemical studies were performed with different parts of *Spathodeacampanulata* , including stem barks, leaves, flowers, and fruits. The leaves contain spathodol, caffeic acid, other phenolic acids, and flavonoids, while fruits contain polyphenols, tannins, saponins and glycosides.[5] The plant leaves are reported to have antiplasmodial, analgesic, anti-inflammatory, and anti-larvicidal activity. The stem bark decoction of *Spathodeacampanulata* have been displayed hypoglycemic, anticomplementary, anti-malarial and anti-HIV activity.[6]

S.campanulata is a tree, commonly known as the African tulip tree belonging to the family Bignoniaceae.

Synonyms

Bignonia tulipiferaThonn, Spathodeatulipifera (Thonn.), Spathodeanilotica Seem.

Vernacular names:

African tulip tree

Nandi flame

English: fountain tree

Tulipier du Gabon,

arbre-flamme (Fr).

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Tulipeira-do-Gabão (Po
Kifabakazi (Sw).

Local names:

Kannada: Neerukayimara; Hindi (rugtoora); Malay (panchut-panchut); Tamil (patadi);Trade name (Nandi flame, flame of the forest)

Taxonomy:

Domain: *Eukaryota*
Kingdom: *Plantae*
Subkingdom: *Viridaeplantae*
Phylum: *Tracheophyta*
Subphylum: *Euphyllophytina*
Infraphylum: *Radiatopses*
Class: *Magnoliopsida*
Subclass: *Lamiidae*
Superorder: *Lamianae*
Order:*Scrophulariales*
Family: *Bignoniaceae*
Tribe: *Tecomeae*

BOTANICAL DESCRIPTION

S.campanulata is medium-sized, reaching a height of 10-35 m, deciduous, with a round, heavy crown of dense, dark foliage, sometimes somewhat flattened; young bark pale, grey-brown and smooth but turns grey-black, scaly and cracked vertically and horizontally with age. The opposite imparipinnate leaves are exstipulate. Each leaf consists of 5-7 pairs of opposite leaflets and a terminal one. The leaflets are oblong-elliptic, about 1 cm long and 0.5 cm broad, entire, broadly acuminate, unequal at the base, dark green on top, and light green on the underside; there are glandular swellings at the base of the lamina (usually a pair); the midrib and nerves are yellow, raised and very slightly pubescent; the venation is reticulate; the short, thick petiole is about 0.7 cm long; there are conspicuous lenticels on the rachis; rachis base is swollen. Flowers large, red, hermaphrodite, orange inside; calyx green, about 1 cm long and split on the posterior side, ribbed and tomentellous; petals 5, each about 1.5 cm long; stamens 4 with orange filaments; style extruding with a 2-lipped stigma; flower buds curved and contain a red sap. A yellow-flowered variety has been reported. Fruit upstanding, dark brown, cigar-shaped, woody pod, 15-25 cm long and split on the ground into 2 boat-shaped valves, releasing many flat-winged seeds; 1-4 pods usually develop from 1 flower cluster; seeds thin, flat, and surrounded by a filmy wing.

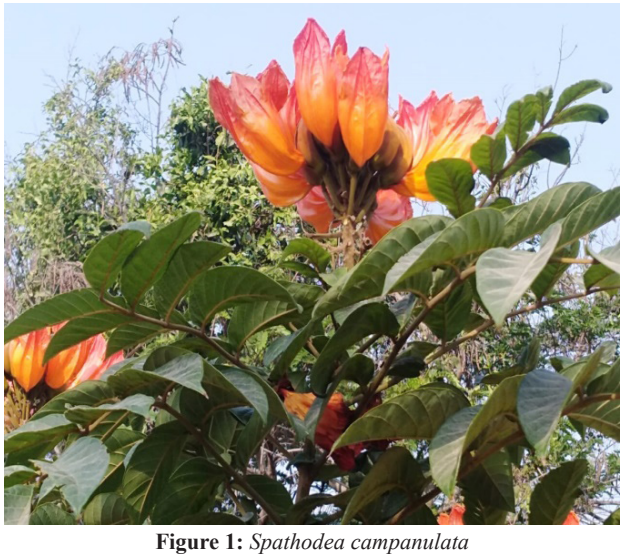

Figure 1: *Spathodea campanulata*

The generic name comes from the Greek word ‘spathe’ (blade), from the shape of the corolla. The specific name means about a Campanula, a name coined in 1542 by Fuchs for the type of corolla with a broad rounded base and a gradually expanded tube corresponding to the sound bow of a church bell.[7]

Biology

Large, orange to scarlet, funnel-shaped hermaphrodite flowers are produced from rust-colored, hairy buds in the bunches at the ends of branches. The flowers open from the outside of the bunch towards the center. *S.campanulata* may begin flowering as young as 3 or 4 years of age, with open-grown trees flowering when they are about 5 m tall; in some

Figure 2: Different parts of *S. campanulata*

tough environments, flowering is delayed until the trees are much larger. Flowering stretches over a 5 or 6-month period, and the pods mature and begin releasing their seeds about 5 months after flowering. The tree reproduces aggressively, so it is frequently a nuisance in pastures and fields with perennial crops. The winged seeds are wind-dispersed.[7]

Ecology

S. campanulata grows naturally in Africa in secondary forests in the high forest zone and in deciduous, transition, and savannah forests. It colonizes even heavily eroded sites, though form and growth rate suffer considerably on difficult sites. It is native to tropical Africa. Introduced and cultivated in India (Bangalore, Hassan, Mysore).[7]

Growth and Development

Growth of the bole may be up to 5 cm/year in diameter. Flowering may start 2–3 years after planting. The flowers are individually short-lived but carried in succession over long periods. Under favorable conditions, African tulip trees may flower throughout the year. In areas with a pronounced dry season (e.g., Kenya) or cold season (e.g., southern United States, Spain) the trees are deciduous and have a marked peak in flowering. High temperatures during flowering interfere with pollen development and fertilization. The seeds are wind-dispersed. Coppice growth is reported to be excellent; trees will coppice up to at least pole size.[8]

Propagation and Planting

Propagation is mostly by seed. Seeds do not require treatment; they are recalcitrant, and their viability is short. One kg contains about 125,000 seeds. Cuttings can also be used for propagation, with larger diameter cuttings (up to 10 cm) giving the best results. Saddle and side grafting are sometimes used to multiply desirable ornamental forms, such as those as yellow flowers, with higher success rates for side grafting (75% vs. 25%). However, saddle-grafted plants have better growth. Root suckers can also be used for propagation.[8]

Table 1: Morphological characteristics of *S.campanulata*

Morphological Parameters	Observation
Size	
Length:	17.3cms
Width:	9.7cms
Shape	Oblong
Apex	Acute
Margin	Entire
Base	Normal
Petiole	Short solid petiole
Surface	Hairy
Colour	
Inner:	Light green
Outer:	Dark green
Odour	Characteristic
Taste	Bitter taste

Uses

The African tulip tree is planted as an ornamental, wayside tree and shade tree. It is used for soil improvement, re-afforestation, erosion control and land rehabilitation, and as a live fence. Its dense crown does not allow intercropping, but its leaves make it useful. It has been used as a shade tree in coffee plantations. In teak plantations, African tulip trees can attract initial populations of teak defoliator (*Hyblaeapuera* which can then be easily destroyed. In West Africa, wood is used for carving but considered inferior for other purposes. In Ethiopia, it is used as firewood and to produce charcoal. Plywood seems the only widespread commercial use for timber, traded as African tulip (En) or tulipier (Fr); African tulip tree is grown as a plantation crop for this purpose in the Philippines. The seeds are eaten in many parts of Africa. The flower buds contain a reddish sap, and are used as water pistols by children.[8]

Medicinal Uses

It is used in African traditional medicine. The stem, bark and leaf are used in treatment for dyspepsia and peptic ulcer. The leaf, root, bark and fruit are used for arthritis and fractures. The stem bark is used for toothache and stomache. Root bark seed is used for stomach ulcers.

S. campanulata has many medicinal uses both where it is native and introduced. Extracts of bark, leaves, and flowers are used to treat malaria, HIV, diabetes mellitus edema, dysentery, constipation, gastrointestinal disorders, ulcers, skin diseases, wounds, fever, urethral inflammation, liver complaints, and liver poison antidote. It may be effective as malaria prophylactic and in the control of *Aedes*mosquitoes. Pulverised bark is used in skin diseases, decoction given in dysentery, renal and gastrointestinal troubles. Infusion of leaves used in urethral inflammation. The bark has laxative and antiseptic properties, and the seeds, flowers, and roots are used as medicine. The bark is chewed and sprayed over swollen cheeks. The bark may also be boiled in water used for bathing newly born babies to heal body rashes.[9]

Phytochemical Constituents

Preliminary phytochemical screening of *Spathodeacampanulata* P. Beauvais revealed the presence of alkaloids, reducing sugars, carbohydrates, flavones, glycosides, and phenolic compounds.[10] Several compounds have been iso-

Table 2: Parts of the plant and their respective chemical constituents

Parts of the plant	*Phytochemicals*
Stem Bark	Triterpenes and Sterols N-alcohols (35%), octacosanol and triacontanol.[11] Spathoside, n-alkanes, linear aliphatic alcohols, sitosterol and their esters, beta-sitosterol-3-O-beta-D-glucopyranoside, oleanolic acid, pomolic acid, p-hydroxybenzoic acid and phenylethanolester.[12] 13β-acetoxyoleanolic acid, siaresinolic acid, 3β-acetoxy-12-hydroxyoleanan-28, 13-olide and oleanolic acid.[13]
Leaves	Spathosides A, B and C, Verminoside, 6'-O-trans-caffeoyl-loganic acid, Catalpol and Ajugol.[14] Spathodol, Caffeic acid, Phenolic acid and Flavonoids.[15]
Root peels	Methyl *p*-hydroxybenzoate and *p*-hydroxybenzoic acid.[16]
Fruits	Polyphenols, Tannins, Saponins and Glucosides.[16] 1,1-diethoxy-3-methyl-butane, N-hexadecanoic acid, 1,2-benzenedicarboxylic acid diisooctyl ester, and oleic acid.[17]
Flowers	Phytol, *α*-methyl Cinnamaldehyde, *β*-sitosterol-3-acetate, naringenin, catechin-3-O-*α*-rhamnopyranoside and 5, 6, 4' trihydroxyflavonol-7-O-*α*-rhamnopyranoside, Anthocyanins.[18]

lated from different parts of the *Spathodeacampanulata* P. beauv (Table 2).

Pharmacological Properties

Anti-solar Activity

Methanolic extract of flowers of *S. campanulata* as antisolar activity. The results obtained showed the extract's ability to absorb UV radiation and hence proved its UV production ability. This ability may be due to the presence of flavonoids.[19]

The Schizontocidal and Anti-malarial Activity

Effects of extracts of *S. campanulata* on *Plasmodium berghei*in mice have been investigated. Schizontocidal activity of the plant in blood was determined on both the early and established infections. The repository action of the plant was also investigated. The alcoholic extract of the leaves of the plant demonstrated antiplasmodial activity. The plant extract was more effective in treating the early infection than the established ones. This report provides scientific data for the use of the aqueous-alcoholic decoction of the leaves of *S. campanulata* for the treatment of malaria.[20]

Antifungal Activity

The phenolic derivatives could play an important role in root tissues in defensive mechanism against fungi and other organisms in tropical soil.[21]

Antibacterial Activity

Spathoside, a new cerebroside, was isolated from the stem bark of *Spathodeacampanulata*, besides known compounds (*n*-alkanes, linear aliphatic alcohols, sitosterol and their esters, β-sitosterol-3-*O*-β-D-glucopyranoside, oleanolic acid, pomolic acid, *p*- hydroxybenzoic acid and phenylethanol esters). The structures of the isolated compounds were established by spectroscopic studies. The antibacterial activity of the isolated compounds against a wide range of microorganisms was examined. They significantly inhibited the growth of some gram-positive and -negative bacteria.[22]

Antimicrobial Activity (Wound Healing Activity)

The antibacterial activity of the aqueous, ethanol, methanol, and petroleum ether extracts of sundried stem bark of *Spathodeacampanulata*P. Beauv. (Bignoniaceae) was investigated by testing the extracts against *B. subtilis*, *E. coli*, *P. aeruginosa*and*S. aureus*. The methanol extract's minimum inhibitory concentration (MIC) was determined against the four bacteria strains and *C. albicans*usingthe broth dilution method. Four topical products were prepared by incorporating the methanol extract of *S. campanulate* (20 % w/w) into aqueous cream, soft paraffin, emulsifying ointment, and simple ointment bases and evaluated for their *in vitro* antimicrobial efficacy. The effect of storage time on the activity of the methanol extract of *S. campanulata*and*S. campanulata*extract incorporated in an aqueous cream base was also investigated. The methanol and ethanol extracts showed good activity, while the aqueous and petroleum ether extracts exhibited little activity. The methanol extract showed the best antibacterial action.[23]

Analgesic and Anti-inflammatory Activity

The analgesic and anti-inflammatory potentials of the ethanol leaf extract of *Spathodeacampanulata*, a Nigerian traditional medicinal plant was studied using cold, thermal, and chemical-induced pain models and carrageenan-induced acute inflammation in rats. Ethanol leaf extract of *S.*

campanulate possesses both peripheral and central analgesic properties. The leaf extract of *Spathodeacampanulata*has both analgesic and anti-inflammatory properties and could be beneficial in alleviating painful inflammatory conditions.[24]

Healing of Burns

The methanolic extract of the barks of *S.campanulata*has burn healing effectiveness.[25]

Hypoglycemic and anti-HIV Activity

*S. campanulata*stem bark decoction (SCD) has shown hypoglycemic activity in mice. It was separated by column chromatography into different fractions, which were evaluated for their hypoglycemic, anti-complement and anti-HIV activities. The most polar fraction exerted by far the most prominent effect in different biological models.[26]

Anti-oxidant Activity

The extracts have been shown to have anti-inflammatory and anti-oxidant properties due to flavonoids, triterpenoids, diterpenoids, and caffeic acid derivatives from *S. campanulate.*[27]

Antidiarrheal Activity

Alcoholic and aqueous extracts of stem bark of *S. campanulata*has anti diarrheal activity.[28]

Cytotoxic Activity

Victor *et al.* investigated the cytotoxic activity of the methanolic extract of *Spathodeacampanulata* P. beauv. The methanolic extract was obtained by soaking the air-dried material in methanol for 48 h at room temperature activity and studied for cytotoxic activity by Resazurin Reduction assay against sensitive leukemia CCRF-CRM cell lines. The methanolic extract displayed IC_{50} value below 80µg/mL.[29]

Anti-cataract Activity

Adio *et al.* evaluated the anti-cataract activity of fresh flower bud exudates of *Spathodeacampanulata* P. beauv against cataract genesis using rat lenses. Cataractogenesis was evaluated by determining the levels of anti-oxidant parameters such as total protein, glutathione, malondialdehyde, and superoxide dismutase, and catalase activities were evaluated in the lens homogenates. Exudates significantly decrease the levels of glutathione and total protein, reduction in superoxide dismutase and Catalase activities, and an increase in malondialdehyde content were observed in cataractous lenses compared with those of the latter the normal control. Flower bud exudates of *Spathodeacampanulata* P. beauv displayed a dose-related anti-cataract activity.[30]

REFERENCES

1. Parul T, Aditi S. Natural resources from plants in the treatment of cancer: an update. Asian J Pharm Clin Res 2017;10: 13-22.
2. Farnsworth NR, Akerele O, Bingel AS, Soejarto DD, Goo ZG. Medicinal plants in therapy. Bull WHO 1985;63:965-81.
3. Joly AB. Introduction to taxonomic vegetation. 7th ed. Sao Paulo: Ed. National; 1985.
4. Mensah AY, Houghton PJ, Dickson RA, Fleischer TC, Heinrich M, Bremner P. *In vitro* evaluation of effects of two Ghanaian plants relevant to wound healing. Phytother Res 2006;20:941-4.
5. Ngouela S, Tsamo E, Sondengam BL. Extractives from bignoniaceae: constituents of the stem bark of *Spathodeacampanulata.* Planta Med 1988;54:476.
6. Niyonzima G, Laekernan G, Witvrouw M, Van Poel B, Pieters L. Hypoglycemic, anti-complement and anti-HIV activities of *Spathodeacampanulata* stem bark. Phytomedicine 1999; 6:45-9.
7. https://www.worldagroforestry.org/sites/treebs/treedatabases.asp
8. http://database.prota.org/PROTAhtm/Spathodea%20campanulata_En.htm
9. Taman HerbaVokasma. Blog tentangjenis-jenisherba 2005 October 5.
10. Brindha P, Nagarajan A, Saralla RP, R Narendran R, Sridharan K. A study on chemical and botanical standards of a traditional drug source *Spathodeacampanulata* beauv. Int J Pharm PharmSci 2012;4:157-60.
11. Gormann R, Schreiber L, Kolodziej H. Cuticular wax profiles of leaves of some traditionally used African Bignoniaceae. Z Naturforsch C 2004;59:631-5.
12. Mbosso EJ, Ngouela S, Nguedia JC, Penlap V, Rohmer M, Tsamo E. Spathoside, a cerebroside and other antibacterial constituents of the stem bark of *Spathodeacampanulata.* Nat Prod Res 2008;59:296-304.
13. Silvere N, Etienne T, Beibam L. Sondengam. Extractives from bignoniaceae: constituents of the stem bark of *Spathodeacampanulata.* Planta Med 1988;54:476.
14. Gouda YG. Iridoids from *Spathodeacampanulata* P. Beauvais leaves. Nat Prod Commun 2009;4:753-6.
15. El-Hela A. Phenolics from *Spathodeacampanulata* Beauv leaves. Afr J Plant Sci 2001;27:152-62.
16. Amusan OO, Adesogan K, Makinde JM. Anti-malarial active principles of *SpathodeaCampanulata* stem bark. Phytother Res 1996;10:692-3.
17. Kumaresan M, Palanisamy PN, Kumar PE. Chemical investigation of the flower of *Spathodeacampanulata* by GC-MS. J Nat Prod Plant Resour 2011;1:14-7.
18. Naglaa GS, Hanaa HE, Soheir M. Bioactivity and composition

of the flowers of *Spathodeacampanulata* p. Beauv World J Pharm Res 2014;3:213-30.

19. VinayakV.Patil., et al. "Study of metanolic extract of flower of Spathodeacampanulata as anti-solar." International Journal Of Green Pharmacy 2009.
20. Makinde., et al. "The anti-malarial activities of Spathodeacampanulata stem bark extract on Plasmodium bergheiberghei in mice". Plant Med. 1988;54(2):122-5
21. Adriana Pianaro., et al. "Iridoid glucoside and antifungal phenolic compounds from Spathodeacampanulata roots." SeminaCienciasAgrarias. 2007;28:251-256.
22. Jigna P., et al. "Antibacterial activity of aqueous and alcoholic extracts of 34 medicinal plants against some Staphylococcus Species." Turk J Biol. 2008; 32:63-71.
23. Ofori-Kwakya., et al. "Antimicrobial activity of extracts and topical products of the stem bark of Spathodeacampanulata for wound healing." Afr J Trad CAM. 2009; 6(2):168-174.
24. Emmanuel El., et al. "Spathodeacampanulata: an experimental evaluation of the analgesic and anti-inflammatory properties of a traditional remedy." Asian Journal of Medical Sciences. 2009; 1(2):35-38.
25. Sy GY, Ngewou PW., et al. "Healing activity of methanolic extract of the barks of SpathodeacampanulataBeauv (Bignoniaceae) in rat experimental burn model." Dakar Med. 2005; 50(2):77-81.
26. Niyonzima G., et al. "Hypoglycemic and anticomplement and anti-HIV activities of Spathodeacampanulata stem bark Phytomedicine." 1999; 6(1):45-49.
27. Ngouela s., et al. "Extractives from Bignoniaceae: Constituents of stem bark of Spathodeacampanulata." Planta Med. 1988; 54(5):476.
28. Rajesh S., et al. "Antidiarrheal activity of stem bark extracts of Spathodeacampanulata in rodents." Pharmacologyonline. 2009; 1:396-405.
29. Victor K, Cedric T, Flora TM, Veronique PB, Thomas E. "Cytotoxicity of methanolic extracts of 10 Cameroonian medicinal plants towards multi-factorial drug-resistant cancer cell lines." BMC Complementary Altern Med 2016;16:1-18.
30. Adio GI, Faluyi JO, Osoniyi O. "Evaluation of the effect of *Spathodeacampanulata* flower bud exudates on Cataractogenesis in rat lenses." Afr J Tradit Complement Altern Med 2014;11:83-91.