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RECENT ADVANCES IN THE PHYTOCHEMICAL AND PHARMACOLOGICAL EVALUATION OF *SPATHODEA CAMPANULATA* EXTRACT: A COMPREHENSIVE REVIEW

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ABSTRACT

The African tulip tree, Spathodea campanulata P. Beauv. (Family: Bignoniaceae), is a plant of medicinal importance which has attracted a great deal of scientific interest due to the variety of its phytochemical constituents and the wide range of pharmacological activities it shows. In traditional medicine, used both in Africa and in Asia, the leaves have been employed for the treatment of inflammation, diabetes, wounds, microbial infections, fever, and gastrointestinal disorders. More recent studies into its phytochemistry, using sophisticated analytical methods such as high-performance liquid chromatography (HPLC), liquid chromatography–mass spectrometry (LC–MS), gas chromatography–mass spectrometry (GC–MS), Fourier-transform infrared spectroscopy (FTIR), and nuclear magnetic resonance (NMR) spectroscopy, have led to the discovery of a number of bioactive compounds, such as flavonoids, phenolic acids, iridoids, triterpenoids, steroids, tannins, alkaloids, and glycosides. Experimental research has shown that the leaf extract of S. campanulata has significant antioxidant, anti-inflammatory, antimicrobial, antidiabetic, wound-healing, hepatoprotective, analgesic, and cytotoxic properties. These biological effects occur via a number of mechanisms, including

the modulation of oxidative stress pathways, the inhibition of pro-inflammatory mediators, the suppression of microbial growth, the inhibition of α-amylase and α-glucosidase enzymes, and the induction of apoptosis in cancer cells. This review critically summarizes the recent progress in the phytochemical characterization and pharmacological assessment of the *S. campanulata* leaf extract, highlights the analytical methods employed for identifying its bioactive components, discusses the molecular mechanisms involved, and examines the future possibilities for the development of standardized phytopharmaceutical formulations and evidence-based therapeutic uses.

KEYWORDS: *Spathodea campanulata*, African tulip tree, leaf extract, phytochemistry, flavonoids, antioxidant, anti-inflammatory, antimicrobial, antidiabetic.

1. INTRODUCTION

Medicinal plants are still one of the most important sources of drugs all over the world and are an essential part of traditional healthcare systems. According to the World Health Organization, a large number of people around the globe use traditional, complementary and herbal medicine for their primary healthcare, especially in developing countries where medicinal plants are usually the most accessible and cheap form of treatment.[1] The increasing interest in plant-based therapies is due to their long history of use in ethnomedicine, the variety of bioactive compounds they contain, and their potential for leading to the creation of safer and more effective pharmaceutical agents.[2,3,8,9]

The tropical medicinal plants, *Spathodea campanulata* P. Beauv. (family: Bignoniaceae), more commonly called the African tulip tree, has become a promising species due to its wide use in traditional medicine and its rich phytochemical composition.[2] Different parts of the plant, especially the leaves, bark, flowers, and stem, are employed in traditional medicine in both Africa and Asia for the treatment of wounds, skin infections, inflammatory conditions, diabetes, kidney problems, gastrointestinal disorders, and microbial infections.[2,3] The plant includes a wide variety of secondary metabolites such as iridoids, triterpenoids, flavonoids, phenolic compounds, and other bioactive components which are responsible for its various pharmacological properties.[2,3,5,9]

Phytochemical and pharmacological studies have recently shown that extracts of *S. campanulata* have significant antioxidant, anti-inflammatory, analgesic, antimicrobial, antiviral, antiangiogenic, and antidiabetic properties.[3,4] The results offer scientific backing for a number of the plant's traditional uses and point to its value as a source of phytopharmaceutical compounds. As a result, *S. campanulata* has drawn a great deal of attention and is now the subject of further phytochemical characterization, mechanistic studies, and therapeutic development.[2-4]

2. Plant Profile

Spathodea campanulata P. Beauv., commonly known as the African tulip tree, belongs to the family *Bignoniaceae*.

2.1. Taxonomic Classification[6-10]

Table No 1: Taxonomic Classification.

Taxonomic Rank	Classification
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Lamiales
Family	Bignoniaceae
Genus	*Spathodea*
Species	*Spathodea campanulata* P. Beauv.

It is a fast-growing evergreen tree which attains a height of 15 to 30 metres. Its leaves are arranged opposite each other, are pinnately compound and comprise 5 to 19 leaflets. The large orange-red campanulate flowers are a characteristic feature of the species and are responsible for its ornamental value.[5]

2.2. Common Names[11]

- **English:** African Tulip Tree, Flame of the Forest, Fountain Tree
- **Hindi:** Rudra Palash
- **Odia:** Ranipalasha
- **Bengali:** Afrikan Tulip
- **Tamil:** Ponnarali
- **Local Names:** Vary across regions depending on cultural use

2.3. Morphological Characteristics[12]

- **Height:** 7–25 meters.
- **Stem/Bark:** Grayish-brown, rough, with a straight cylindrical trunk.
- **Leaves:** Opposite, pinnate, dark green, glossy, 30–60 cm long.

- **Flowers:** Large, bright orange-red, campanulate, arranged in terminal clusters; known for abundant nectar.
- **Fruits:** Long, brown, woody pods (15–25 cm) containing numerous winged seeds.
- **Seeds:** Thin, flat, papery wings aiding wind dispersal.

Flower

Leaf

Stem

Trunk

Fruit

Root

Figure 1: Different Parts of *Spathodea campanulata.*

3. Ethnomedicinal Importance of the Leaves

Traditional medicinal systems employ the leaves for multiple therapeutic purposes.[13,14]

Table No 2: Traditional Use of *Spathodea campanulata.*

Traditional use	Preparation	Region	Referrence
Wound healing	Fresh leaf paste	Africa, India	13,14
Anti-inflammatory	Leaf decoction	Nigeria, Uganda	13,15
Diabetes management	Leaf infusion	East Africa	13,14
Skin infections	Topical application	Cameroon	13
Fever reduction	Leaf decoction	Ghana	13
Kidney disorders	Decoction	West Africa	13,14

The broad traditional use strongly suggests the presence of multiple bioactive metabolites acting through different pharmacological pathways.

4. Phytochemical Composition of Leaf Extract

4.1 Major Secondary Metabolites

Phytochemical investigations reveal that *S. campanulata* leaves contain a wide spectrum of secondary metabolites.[13,14]

Table No 3: Phytochemical of *Spathodea campanulata*.

Phytochemical class	Representative compounds
Flavonoids	Quercetin derivatives, kaempferol derivatives
Phenolic acids	Gallic acid, caffeic acid, chlorogenic acid, ferulic acid
Tannins	Hydrolysable and condensed tannins
Saponins	Triterpenoid saponins
Alkaloids	Nitrogen-containing secondary metabolites
Iridoids	Catalpol-type and related glycosides
Terpenoids	Monoterpenes, sesquiterpenes, triterpenoids
Steroids	β-Sitosterol and related phytosterols

The comprehensive reviews show that the major phytochemical classes found in *S. campanulata* are iridoids, triterpenoids, steroids, cinnamic acid derivatives, cerebrosides, flavonoids, and phenolic compounds.

5. Recent Advances in Phytochemical Characterization[2,3]

5.1 Preliminary Phytochemical Screening of *S. campanulata*

Qualitative studies on phytochemicals consistently show that leaf extracts contain flavonoids, phenols, tannins, saponins, glycosides, terpenoids, alkaloids, carbohydrates, and proteins.

5.2 Quantitative Estimation

The total phenolic content (TPC) has been determined using the Folin–Ciocalteu method and the total flavonoid content (TFC) has been measured by means of the aluminum chloride colorimetric assay. Extracts of the leaves in ethanol generally show higher TPC and TFC values than aqueous extracts, these values being closely related to antioxidant activity.

5.3 GC-MS Analysis

Gas chromatography–mass spectrometry has made it possible to identify volatile and semi-volatile components such as phytol, derivatives of hexadecanoic acid, fatty acid methyl esters, terpenoids, and aromatic phenolic compounds. The GC-MS profiling yields chemical fingerprints which are useful for authentication and for quality control.

5.4 HPLC and LC-MS profiling

High-performance liquid chromatography and LC-MS analyses have detected chlorogenic acid, caffeic acid, ferulic acid, rutin-like derivatives, quercetin glycosides, and kaempferol derivatives. These compounds are able to influence oxidative stress, inflammatory signalling, and glucose metabolism.

5.5 FTIR and spectroscopic characterization

The FTIR studies revealed the presence of functional groups linked to hydroxyl, carbonyl, aromatic, ether, and glycosidic groups; this supports the structural characterisation and enables the standardisation of the extract.

6. Pharmacological Activity

6.1 Antioxidant

Oxidative stress is involved in diabetes, cancer, cardiovascular disease, neurodegeneration, and inflammatory disorders and the extract obtained from the leaves of *S. campanulata* has demonstrated significant antioxidant activity in a number of in vitro models.[16–20]

Table No 4: Antioxidant Assay of *Spathodea campanulata.*

Assay	Mechanism
DPPH radical scavenging	Hydrogen atom donation
ABTS radical cation assay	Electron transfer
FRAP	Ferric reducing ability
Reducing power assay	Electron donation
Nitric oxide scavenging	Reactive nitrogen species inhibition
Superoxide scavenging	Superoxide radical neutralization

Ethanolic leaf extract shows dose-dependent free radical scavenging activity. Its effect is similar to standard antioxidants in several experimental models.[19,20]

Mechanism of Action

The antioxidant activity mainly results from the fact that flavonoids and phenolic compounds are capable of neutralizing reactive oxygen species by donating hydrogen, transferring electrons, chelating metal ions, and inhibiting lipid peroxidation.

6.2 Anti-inflammatory Activity

The anti-inflammatory properties have been tested by means of inhibition of protein denaturation, inhibition of egg albumin denaturation, membrane stabilization tests, the use of the carrageenan-induced paw edema model, and the formalin-induced inflammation model.[22-24] Leaf extract exerts an anti-inflammatory effect by inhibiting cyclooxygenase (COX) enzymes, suppressing the activation of NF-κB, reducing the levels of TNF-α, IL-1β, and IL-6, decreasing the production of nitric oxide, and stabilising its lysosomal membranes.

An experimental assessment of the analgesic and anti-inflammatory properties of *S. campanulata* showed a significant reduction in both inflammatory responses and the perception of pain.[22-23]

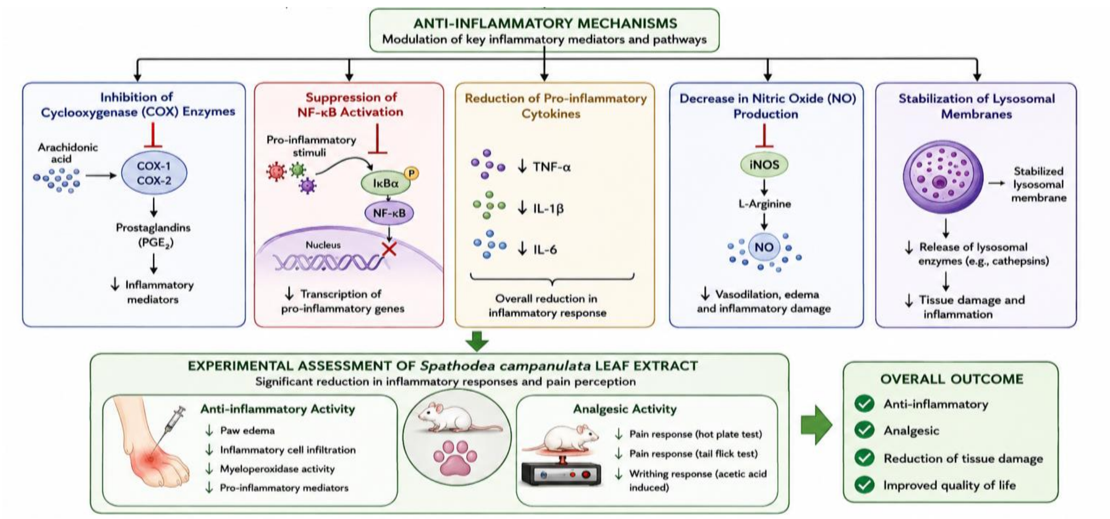

Figure No 2: Mechanism of Anti-inflammatory Activity.

6.3 Antibacterial Activity

Leaf extracts exert an inhibitory effect on a number of pathogenic bacteria, including *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, and *Klebsiella pneumoniae*. Extracts produced by means of methanol and ethanol generally have greater antibacterial activity than those made using water.

The antimicrobial effects result from the disruption of the membranes of micro-organisms, an increased permeability of these membranes, the inhibition of nucleic acid synthesis, enzyme inhibition, and the synergistic effects of the flavonoids, tannins, and saponins.[25-27]

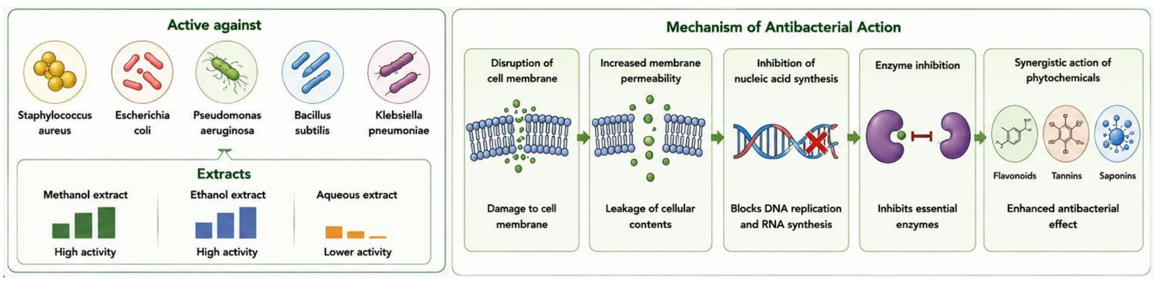

Figure No 3: Mechanism of Anti-bacterial Activity.

6.4 Antifungal Activity

The extract from *Spathodea campanulate* has considerable antifungal properties with respect to Candida albicans, the Aspergillus species, and the dermatophytic fungi including Trichophyton and Microsporum. Extracts prepared with methanol and ethanol are more active than aqueous extracts since they contain higher levels of flavonoids, tannins, saponins, and phenolic compounds.[26-28]

The antifungal effect is mainly due to the disruption of the fungal cell membrane, an increase in membrane permeability, the inhibition of ergosterol and nucleic acid synthesis, and enzyme inhibition, all of which together prevent fungal growth and can result in death of the fungal cells. The fact that these findings have been obtained indicates that the leaf extract of Spathodea campanulate has potential as a natural antifungal agent for the management of fungal infections.[17,28]

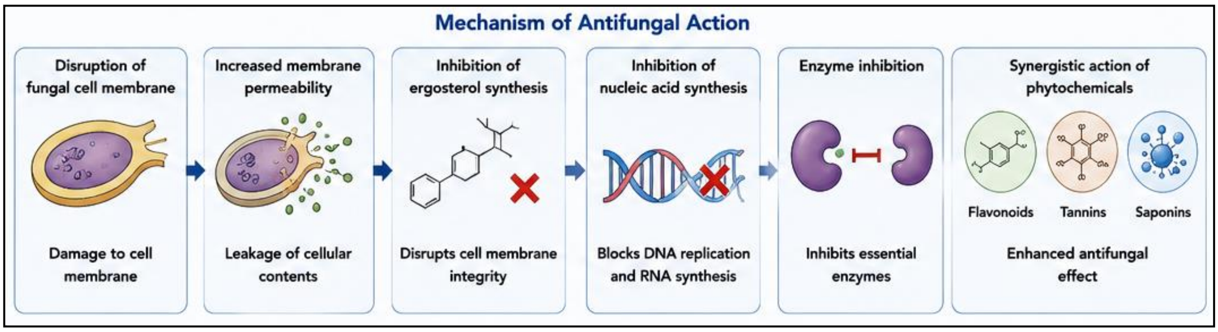

Figure No 4: Mechanism of Antifungal Activity.

6.5 Antidiabetic Activity (Enzyme Inhibition)

Leaf extracts have the ability to inhibit the α-amylase and α-glucosidase enzymes, which delays the digestion of carbohydrates and the absorption of glucose and thus reduces postprandial hyperglycemia.[29-31]

The suggested mechanisms are glucose uptake being enhanced, insulin sensitivity being improved, protection of the pancreatic β-cells, a reduction in oxidative stress, and the inhibition of advanced glycation end products.[29-31]

The studies which examined the solvent fractions of *S. campanulata* have shown that there is significant antihyperglycemic activity, especially in the polar fractions containing phenolic compounds.[30-31]

6.6. Wound Healing Activity

The long-established practice of using fresh leaves as a remedy for wounds is supported by experimental evidence.[23-32.32]

Leaf extract speeds up the repair of wounds by enhancing the proliferation of fibroblasts, increasing the production of collagen, promoting angiogenesis, offering antioxidant protection, having antimicrobial effects, and also exhibiting cytotoxic and anticancer properties which contribute to healing.

6.7. Cytotoxic and Anticancer Potential

Recent investigations have managed to isolate cytotoxic components from extracts of S. campanulata and have shown that they are active against certain cancer cell lines.[33-34]

Mechanisms

The proposed anticancer mechanisms include induction of apoptosis, activation of caspases, cell cycle arrest, mitochondrial membrane depolarization, modulation of reactive oxygen species levels, and inhibition of proliferative signaling pathways.[33,34] Experimental studies also indicate that leaf extract reduces lipid peroxidation, restores glutathione levels, enhances superoxide dismutase and catalase activities, improves liver enzyme profiles, and preserves hepatic architecture under oxidative stress conditions.[20,35]

Overall, acute toxicity studies suggest that therapeutic doses of the leaf extract have relatively low toxicity; however, prolonged administration of high doses may produce dose-dependent hepatotoxicity, emphasizing the need for standardized dosing and comprehensive chronic toxicity evaluation.[35,36] Recent research increasingly relies on bioactivity-guided fractionation, metabolomics, molecular docking, and nanotechnology-based formulations to identify active constituents, predict molecular targets, improve bioavailability, and enhance therapeutic efficacy.[34,36]

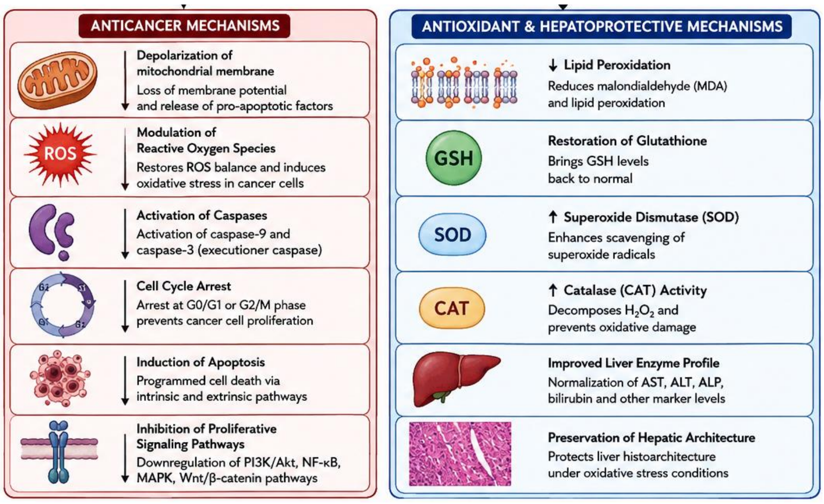

Figure No 5: Mechanism of Cytotoxic and Anticancer Potential.

7. Future Perspectives in the Pharmacological Development of Spathodea campanulata

Despite the growing experimental evidence supporting the pharmacological potential of *Spathodea campanulata*, several limitations currently restrict the translation of preclinical findings into standardized therapeutic applications. Considerable variation exists in extraction procedures, plant material, solvent systems, extract yields, and experimental models, making direct comparison among studies difficult. In addition, many investigations have not used well-defined chemical marker compounds or standardized extracts, which limits reproducibility and the establishment of consistent dose–response relationships. Recent LC-MS-based investigations have demonstrated that *S. campanulata* extracts contain a complex mixture of iridoids, flavonoids, and phenolic acids, highlighting the need for systematic chemical standardization and quantitative characterization of bioactive constituents.[16,17]

Another important limitation is the paucity of pharmacokinetic, bioavailability, and long-term toxicological information, particularly for standardized leaf extracts and their isolated bioactive constituents. Although several in vitro and in vivo studies have demonstrated antioxidant, anti-inflammatory, antimicrobial, antidiabetic, wound-healing, and cytotoxic activities, much of the available evidence remains preclinical. A comprehensive review of *S. campanulata* reported that most pharmacological findings were derived from experimental models and that clinical evidence remains very limited; the authors emphasized the need for further investigation of isolated compounds, clinical trials, and product development.[18]

Future research should therefore prioritize the development of validated HPLC, UHPLC, and LC-MS/MS fingerprinting methods for chemical standardization and quality control of *S.*

campanulata leaf extracts. Bioactivity-guided fractionation combined with metabolomics and advanced spectroscopic techniques may facilitate the identification and quantification of bioactive marker compounds and help establish relationships between chemical composition and pharmacological activity. Recent LC-ESI-QTOF-MS studies demonstrate the feasibility of this approach and provide a useful foundation for further phytochemical investigations.[16]

Further studies should also include pharmacokinetic and pharmacodynamic characterization, investigation of molecular targets and signaling pathways, assessment of chronic and reproductive toxicity, and evaluation of potential herb–drug interactions. Well-designed randomized controlled clinical trials are particularly important to determine whether the promising activities observed in experimental studies can be translated into clinically meaningful benefits. Standardized extraction methods, validated biomarkers, adequate sample sizes, appropriate controls, and clearly defined dosing regimens should be incorporated into future studies.

8. CONCLUSION

The leaf extract of *Spathodea campanulata* P. Beauv. is a promising medicinal resource, containing a high amount of flavonoids, phenolic acids, iridoids, and triterpenoids, all of which show significant antioxidant, anti-inflammatory, antimicrobial, antidiabetic, hepatoprotective, wound-healing, and cytotoxic activities. There is current evidence confirming a number of its traditional medicinal uses and indicating its potential for use in phytopharmaceuticals. Yet it is necessary to have standardized methods for extraction, to carry out a thorough toxicological evaluation, to conduct pharmacokinetic studies, and to carry out well-designed clinical trials if the resource's safety, effectiveness, and therapeutic applications are to be established. Its clinical potential could be further improved by the future incorporation of advanced phytochemical profiling and nanotechnology-based formulations.

9. Conflicts of interests

The authors do not disclose any conflicting interests.

10. ACKNOWLEDGMENT

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11. REFERENCES

1. Lee EL, Richards N, Harrison J, Barnes J. Prevalence of use of traditional, complementary and alternative medicine by the general population: a systematic review of national studies published from 2010 to 2019. Drug Saf, 2022; 45(7): 713-735.
2. Newman DJ, Cragg GM. Natural products as sources of new drugs over the nearly four decades from 1981 to 2019. J Nat Prod, 2020; 83(3): 770-803.
3. Padhy GK. *Spathodea campanulata* P. Beauv.—A review of its ethnomedicinal, phytochemical, and pharmacological profile. J Appl Pharm Sci, 2021; 11(1): 120-132.
4. Boniface PK, Verma S, Shukla A, Khan F, Srivastava SK, Pal A. Membrane stabilisation: a possible anti-inflammatory mechanism for the extracts and compounds from *Spathodea campanulata*. Nat Prod Res, 2014; 28(23): 2203-2207.
5. Oregon State University. *Spathodea campanulata* | Landscape Plants [Internet]. Corvallis (OR): Oregon State University; https://landscapeplants.oregonstate.edu/plants/spathodea-campanulata
6. Patil VM, Mandal A, Tomar S, Kumar L, Masand N. Phytochemical and pharmacological profile of *Diospyros melanoxylon*. Nat Prod J, 2017; 7(4): 267-275.
7. Mallavadhani UV, Panda AK, Rao YR. *Diospyros melanoxylon* leaves: a rich source of pentacyclic triterpenes. Pharm Biol, 2001; 39(1): 20-24.
8. World Health Organization. WHO global report on traditional and complementary medicine 2019. Geneva: World Health Organization; 2019. https://www.who.int/publications/i/item/978924151536
9. Mbosso EJT, Ngouela S, Nguedia JCA, Beng VP, Rohmer M, Tsamo E. *Spathodea campanulata*: a phytochemical and pharmacological review. J Med Plants Res, 2015; 9(34): 873-886.
10. Shehab NG, Eid HH, El Zalabani SM. Bioactivity and composition of the flowers of *Spathodea campanulata* P. Beauv. World J Pharm Res, 2014; 3(4): 213-230.
11. Wijayanti T, Setiawati D. The road shade plants composition and morphology profile in Malang City, East Java, Indonesia. In: AIP Conference Proceedings. Vol. 3001. Melville (NY): AIP Publishing; 2024; 080052.
12. Sonibare MA, Osiyemi OA. Morphological and anatomical studies of two medicinal plants: *Harrisonia abyssinica* Oliv. (Simaroubaceae) and *Spathodea campanulata* P. Beauv. (Bignoniaceae) and their systematic significance. J Chem Pharm Res, 2012; 4: 800-807.

13. Boniface PK. Advances on ethnomedicinal uses, phytochemistry, and pharmacology of *Spathodea campanulata* P. Beauv. EC Pharmacol Toxicol, 2017; 5(2): 51-62.
14. Świątek Ł, Sieniawska E, Sinan KI, Zengin G, Uba AI, Bene K, Maciejewska-Turska M, Rajtar B, Polz-Dacewicz M, Aktumsek A. Bridging the chemical profiles and biological effects of *Spathodea campanulata* extracts: a new contribution on the road from natural treasure to pharmacy shelves. Molecules, 2022; 27(15): 4694. doi: 10.3390/molecules27154694.
15. Zhou R, et al. Phytochemical, pharmacological and medicinal properties of selected African medicinal plants with emphasis on *Spathodea campanulata*. Int J Tryptophan Res, 2024; 17.
16. Betteridge DJ. What is oxidative stress? Metabolism, 2000; 49(2 Suppl 1): 3-8.
17. Valko M, Rhodes CJ, Moncol J, Izakovic M, Mazur M. Free radicals, metals and antioxidants in oxidative stress-induced cancer. Chem Biol Interact, 2006; 160(1): 1-40.
18. Madamanchi NR, Vendrov A, Runge MS. Oxidative stress and vascular disease. Arterioscler Thromb Vasc Biol, 2005; 25(1): 29-38.
19. Agyare C, et al. Evaluation of antioxidant and wound healing properties of *Spathodea campanulata* leaf extract. Evid Based Complement Alternat Med, 2013; 2013.
20. Mbosso EJT, et al. Phytochemical screening and antioxidant properties of *Spathodea campanulata* leaf extracts. BMC Complement Altern Med, 2016; 16: 594.
21. Apak R, et al. Methods of measurement and evaluation of natural antioxidant capacity/activity (IUPAC Technical Report). Pure Appl Chem, 2013; 85(5): 957-998.
22. Ilodigwe EE, Akah PA, Nworu CS. Evaluation of the analgesic and anti-inflammatory activities of *Spathodea campanulata* P. Beauv. leaves. J Med Plants Res, 2010; 4(17): 1810-1815.
23. Ofori-Kwakye K, Kipo SL, Kuntworbe N. Antimicrobial activity of extracts and topical products of the stem bark of *Spathodea campanulata* for wound healing. Afr J Tradit Complement Altern Med, 2009; 6(2): 168-174.
24. Akah PA, et al. Anti-inflammatory properties of *Spathodea campanulata* leaf extract in experimental models. J Ethnopharmacol, 2011; 137: 1196-1202.
25. Kuete V, et al. Antibacterial activities of the methanol extract of *Spathodea campanulata* leaves. BMC Complement Altern Med, 2009; 9: 46.
26. Kuete V, et al. Antimicrobial activity of *Spathodea campanulata* extracts and isolated compounds. J Ethnopharmacol, 2008; 119: 296-302.

27. Mbosso EJT, et al. Antibacterial and antifungal properties of phenolic-rich fractions of *Spathodea campanulata*. BMC Complement Altern Med, 2016; 16: 594.
28. Agyare C, et al. Antifungal activity of *Spathodea campanulata* against pathogenic fungi. Pharmacogn Mag, 2012; 8: 181-186.
29. Tadera K, et al. Inhibition of α-glucosidase and α-amylase by flavonoids. J Nutr Sci Vitaminol (Tokyo), 2006; 52(2): 149-153.
30. Mbosso EJT, et al. Antihyperglycemic and antioxidant activities of *Spathodea campanulata* extracts. BMC Complement Altern Med, 2016; 16: 594.
31. Agyare C, et al. In vitro antidiabetic potential of *Spathodea campanulata* leaf fractions. Evid Based Complement Alternat Med, 2013; 2013: 579742.
32. Agyare C, et al. Wound healing activity of *Spathodea campanulata* in experimental animal models. J Ethnopharmacol, 2010; 127: 220-226.
33. Kuete V, et al. Cytotoxicity of *Spathodea campanulata* extracts toward human cancer cell lines. BMC Complement Altern Med, 2014; 14: 204.
34. Mbosso EJT, et al. Cytotoxic and phytochemical investigation of *Spathodea campanulata*. J Ethnopharmacol, 2016; 190: 1-10.
35. Agyare C, et al. Hepatoprotective and antioxidant effects of *Spathodea campanulata* leaf extract. Evid Based Complement Alternat Med, 2013; 2013.
36. Kuete V, editor. Medicinal Plant Research in Africa: Pharmacology and Chemistry. Amsterdam: Elsevier; 2013.