

Phytochemical and Therapeutic Evaluation of *Spathodea campanulata* Used in Traditional Medicine in Kogi State

Aniama Salome Ojone¹; and Owa Dele Frank²

¹Department of Biology, Federal College of Education, Okene, Kogi State, Nigeria. ²Department of Integrated Science, Federal College of Education, Okene, Kogi State, Nigeria.

Corresponding author: salomeaniama@gmail.com

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Abstract

This study investigates the ethnomedicinal relevance of *Spathodea campanulata* (African tulip tree) in the management and treatment of commonly reported diseases in Kogi State, Nigeria, focusing on its traditional uses, phytochemical composition and therapeutic potential. Data were obtained through an extensive literature survey and structured interviews with 300 indigenous practitioners, documenting 16 distinct health conditions and a total of 2,903 ethnomedicinal citations. The most frequently reported uses were for skin rashes (254 responses; 84.7%), arthritis and rheumatism (231; 77%), ulcers (225; 75%) and syphilitic sores (203; 67.7%), indicating high reliance on the plant for dermatological, inflammatory and infectious conditions. The bark emerged as the most utilized plant part, followed by leaves, roots and flowers. Phytochemical screening across four plant parts and four solvent extracts confirmed the presence of seven major bioactive classes, notably alkaloids and glycosides (detected in nearly all extracts), flavonoids (present in over 80% of extracts) and tannins and saponins (moderately distributed). Phenolic compounds were also widely detected, while anthraquinones and anthocyanins showed limited occurrence and coumarins were absent in all samples. These compounds are associated with antimicrobial, anti-inflammatory, and antioxidant activities, thereby supporting the plant's traditional therapeutic applications. The findings validate indigenous knowledge of *S. campanulata* and underscore the medicinal potential of *S. campanulata*. However, comprehensive pharmacological evaluations and controlled clinical trials are necessary to establish its efficacy, safety and suitability for integration into modern healthcare systems.

Keywords: *Spathodea campanulata*, Phytochemical Composition, Ethnomedicine, Kogi State, Therapeutic Potential.

Introduction

Traditional healthcare systems remain central to disease management in many parts of Nigeria, especially in rural communities such as those in Kogi State, where access to orthodox medical facilities is often limited. In these settings, medicinal plants constitute an essential component of primary healthcare, providing affordable and culturally accepted remedies for a wide range of ailments. In Nigeria, traditional medicine is deeply embedded in cultural and health practices, with a substantial proportion of the population depending

on herbal remedies for the treatment and management of various diseases (World Health Organization [WHO], 2013). This reliance underscores the importance of ethnobotanical knowledge as a valuable foundation for drug discovery and the development of alternative therapeutic agents. Nevertheless, many of these medicinal plants have not been sufficiently validated through rigorous scientific investigation, highlighting the need for phytochemical and pharmacological studies. Among such plants is *Spathodea campanulata* (African tulip tree), a member of the family Bignoniaceae that is indigenous to West Africa. The species is locally known as *Ooruu* among the Igala, *Májútòrò* in Yoruba, and *Oruru* in Igbo communities and is widely recognized for its striking orange-red flowers as well as its therapeutic value in traditional medicine.



Figure 1: *Spathodea campanulata* (African tulip tree)

Ethnomedicinal Uses of *Spathodea campanulata*

The plant is widely recognized in traditional medicine for its versatility in treating a broad spectrum of ailments such as skin infections, malaria, gastrointestinal disturbances, wounds and inflammatory conditions. Across Africa, various parts of *Spathodea campanulata*, including leaves, stem bark, flowers and roots, are widely employed in traditional medicine to manage conditions such as malaria, ulcers, epilepsy, convulsions, skin infections, wounds, diabetes, dysentery, arthritis, fractures, kidney disorders and inflammatory diseases (Hutchinson and Dalziel, 1954; Burkill, 2000; Ilodigwe *et al.*, 2010; Iwu, 2014; Boniface *et al.*, 2017; Azuaga *et al.*, 2023). Ethnobotanical studies in West Africa further report its use in treating wounds, dermatological infections, febrile illnesses, ulcers and inflammation which are common targets of traditional healthcare systems (Wagh and Butle, 2018; Elusiyan *et al.*, 2010). However, detailed documentation of its ethnomedicinal applications in Kogi State remains limited.

In Kogi State, traditional healers utilize *S. campanulata* extensively. Leaf and bark preparations are applied to alleviate inflammation-related conditions such as arthritis and rheumatism, while infusions and decoctions manage fever and respiratory ailments. Topical applications of bark and flowers are used to treat wounds, burns, and skin infections,

reflecting the plant's antimicrobial properties (Hutchinson and Dalziel, 1954; Boniface *et al.*, 2017; Wagh and Butle, 2018; NParks, 2025). Bark and root decoctions are employed against malaria and general inflammatory disorders and flowers provide analgesic effects for toothaches and headaches (Mensah *et al.*, 2006; Tanayen *et al.*, 2014). Additional uses include treatment of gastrointestinal disorders, urethral infections, kidney ailments, reproductive health issues and regulation of blood sugar in diabetes (Tanayen *et al.*, 2014; Boniface *et al.*, 2017; Azuaga *et al.*, 2021).

Comparable practices are documented in other West African regions. In Ghana, stem bark treats anemia and leaf extracts manage wounds, illustrating cross-cultural knowledge transmission (Boakye *et al.*, 2023). Beyond Kogi State, in Southern Nigeria, the bark addresses ulcers, oedemas, skin eruptions, constipation, diarrhea and fevers, with decoctions used for scrotal hernia and syphilitic sores (Hutchinson and Dalziel, 1954). In Sierra Leone, leaves are consumed in soups or used for urethral inflammation, while in Ivory Coast, leaf decoctions act as antidotes for poisoning and urethral discharge, and in combination with other plant leaves and clay, are ingested for Pott's disease (spinal tuberculosis) (Azuaga *et al.*, 2021; Tanayen *et al.*, 2014). Collectively, these practices highlight the rich ethnomedicinal knowledge and therapeutic significance of *S. campanulata* across West Africa.

Phytochemical Characterization of *S. campanulata*

Scientific investigations into the phytochemical composition of *S. campanulata* provide strong support for its traditional applications. Studies have identified iridoid glycosides such as verminoside and specioside, alongside phenolic acids including caffeic acid, in the leaves, stem bark and flowers, all of which contribute to notable antioxidant activity (Elusiyan *et al.*, 2010). Furthermore, methanolic and ethyl acetate extracts of the leaves have demonstrated pronounced free-radical scavenging properties, suggesting a protective role against oxidative stress (Tanayen *et al.*, 2014; Umenwa *et al.*, 2017). Additional phytochemical constituents, including spathosides, flavonoids and terpenoids, have also been reported in the leaves and bark, aligning with the plant's traditional use in the treatment of pain, infections and inflammatory conditions (Begum *et al.*, 2020). These bioactive compounds belong to well-established classes of phytochemicals known to regulate inflammatory processes, enhance immune function and suppress microbial growth, thereby offering plausible biochemical explanations for the observed therapeutic effects of the plant. Laboratory-based studies further substantiate several ethnomedicinal claims associated with *S. campanulata*. Extracts from different plant parts have exhibited strong antioxidant activity, reinforcing their potential relevance in diseases associated with oxidative damage (Umenwa *et al.*, 2017). In vitro antimicrobial assays have also demonstrated inhibitory effects against pathogenic organisms such as *Staphylococcus aureus* and *Escherichia coli*, lending scientific credence to its traditional use in wound care and infection management (Gani *et al.*, 2024). Moreover, pharmacological evaluations of leaf extracts have revealed significant anti-inflammatory and analgesic activities, with

effects comparable to standard anti-inflammatory agents in experimental models (Wagh and Butle, 2018).

Beyond these properties, additional studies have reported anxiolytic, antiplasmodial, and anti-larvicidal activities of *S. campanulata* extracts, indicating a broad spectrum of pharmacological potential and reinforcing its value as an important medicinal resource in traditional healthcare systems (Begum *et al.*, 2020). This study systematically correlated traditional therapeutic uses with phytochemical composition, with the aim of providing a more robust scientific basis for its medicinal application and potential incorporation into modern healthcare systems.

Statement of the Problem

Spathodea campanulata is widely used by traditional healers in Kogi State, Nigeria—especially in rural and peri-urban areas with limited access to modern healthcare—for treating skin diseases, inflammatory conditions, gastrointestinal disorders, and febrile illnesses. However, its use is largely based on undocumented oral traditions, lacking standardization and scientific validation. A major problem is the scarcity of systematic and quantitative data on its ethnomedicinal applications in the region, alongside inadequate phytochemical studies that assess variations in bioactive compounds across different plant parts and extraction methods. Existing research was often fragmented and not directly connected to locally reported therapeutic uses, creating a gap between traditional knowledge and scientific evidence. This weakens confidence in its efficacy and limits its integration into evidence-based healthcare. This knowledge gap negatively impacts communities relying on herbal medicine, leading to inconsistent preparation, uncertain dosages and potential safety risks. It also hinders the development of standardized herbal products, pharmaceutical exploration and effective policy regulation. If unaddressed, valuable indigenous knowledge may be lost and the plant's medicinal potential underutilized. Therefore, a comprehensive study combining ethnomedicinal documentation with detailed phytochemical analysis is necessary to validate its uses and promote safe, standardized healthcare applications.

Aim of the Study

The study aims to evaluate the potential of *Spathodea campanulata* in the management and treatment of commonly reported diseases in Kogi State, Nigeria.

Objectives

1. To document the traditional medicinal uses of *Spathodea campanulata* in Kogi State.
2. To determine the phytochemical composition of the stem bark, roots, leaves and flowers of the plant.
3. To compare the phytochemical composition of different plant parts using various solvent extracts.

4. To evaluate the relationship between identified phytochemicals and the reported therapeutic uses of the plant.

Research Questions

1. What are the common ethnomedicinal uses of *Spathodea campanulata* in Kogi State?
2. What phytochemical constituents are present in the different parts (leaves, bark, roots, and flowers) of the plant?
3. How do phytochemical compositions vary across different plant parts and extraction solvents?
4. Is there a relationship between the phytochemical constituents of *S. campanulata* and its reported therapeutic uses?

Research Hypotheses

1. There is no significant relationship between the phytochemical constituents of *Spathodea campanulata* and its ethnomedicinal uses.
2. There is no significant difference in phytochemical composition among the leaves, bark, roots, and flowers of *S. campanulata*.
3. The choice of plant part used in traditional medicine is not significantly influenced by its phytochemical composition.

Theoretical and Conceptual Framework

This study is guided by two interrelated theoretical perspectives which are the Ethnobotanical knowledge framework and the Phytochemical–pharmacological Perspective.

The ethnobotanical knowledge framework describes how local communities acquire, refine and transmit knowledge about the medicinal value of plants over time. It recognizes that traditional healers rely on accumulated experience, observation and cultural practices in selecting specific plants and plant parts for the treatment of various ailments (Balick & Cox, 1996). Within Kogi State, the widespread use of *Spathodea campanulata* for multiple health conditions reflects a rich body of indigenous knowledge that remains largely undocumented and insufficiently validated through scientific methods. This perspective seeks to systematically document these traditional applications.

In contrast, the Phytochemical–pharmacological perspective provides a scientific explanation for the medicinal efficacy of plants by linking their therapeutic effects to the presence of biologically active compounds. Secondary metabolites such as alkaloids, flavonoids, tannins and saponins are widely recognized for their roles in antimicrobial, anti-inflammatory, antioxidant and antipyretic activities (Harborne, 1998; Sofowora, 2008). This perspective forms the basis for analyzing the chemical composition of *Spathodea campanulata* and relating these constituents to its reported medicinal uses. It focused on

phytochemical identification, comparative analysis and the establishment of relationships between chemical constituents and therapeutic functions.

Taken together, these perspectives bridge the gap between traditional knowledge systems and scientific inquiry by linking indigenous practices (plant use and selection) with biochemical evidence (mechanisms of action). This integrated approach provides a solid foundation for evaluating the medicinal potential of *Spathodea campanulata*.

The conceptual framework for this study outlines the interaction between ethnomedicinal knowledge, phytochemical composition and therapeutic effectiveness. It demonstrates how traditional knowledge of plant use is connected to scientifically measurable chemical constituents and their associated biological activities, ultimately influencing the plant's role in disease management.

Materials and Methods

This study employed a cross-sectional ethnobotanical survey integrated with laboratory-based phytochemical screening to document indigenous knowledge on the medicinal uses of *Spathodea campanulata* and to identify its bioactive constituents. The research was conducted in Kogi State, Nigeria, located between latitudes 6°30'N–8°50'N and longitudes 5°20'E–7°40'E. The area is characterized by a tropical climate with distinct wet and dry seasons, annual rainfall of 1,100–1,300 mm, and Guinea savanna vegetation. The population is predominantly rural and relies heavily on traditional medicine due to limited access to modern healthcare. A total of 300 respondents were selected using purposive sampling, targeting knowledgeable individuals such as traditional healers, herb sellers, and elderly community members. Snowball sampling was subsequently used to identify additional participants (Martin, 1995).

Data were collected through semi-structured questionnaires and oral interviews, capturing information on local plant names, plant parts used, preparation methods, therapeutic applications, and dosage/administration. Interviews were conducted in local languages where necessary. Data were coded and analyzed using descriptive statistics (frequencies and percentages). Ethnobotanical significance was evaluated using the frequency of citation, calculated as:

$$FC = \frac{\text{Number of respondents citing a use}}{\text{Total number of respondents}} \times 100$$

Total number of respondents

(Phillips & Gentry, 1993).

Ethical approval

Ethical approval was obtained from a recognized institutional review board. Informed consent was secured from all participants, participation was voluntary and confidentiality was maintained by making all respondent data anonymous in line with established ethical guidelines (International Society of Ethnobiology, 2006).

Phytochemical Analysis

Plant Collection and Identification

Leaves, stem bark, roots, and flowers of *S. campanulata* were collected from natural populations in Okene, Kabba, and Anyigba between May and June, between 9:00 a.m. and 11:00 a.m. when secondary metabolite concentrations are typically optimal (Eloff, 2000). Sample collection was conducted by the researchers with the assistance of local traditional healers, who provided insight into commonly used plant parts for medicinal purposes. Plant specimens were authenticated by a botanist at the Federal College of Education, Okene and voucher specimens were deposited for future reference.

Preparation of Plant Materials

The harvested plant materials were thoroughly washed with tap water to remove debris and air-dried at ambient temperature for three weeks until constant weight was achieved, ground into fine powder using a mechanical grinder and stored in airtight labeled containers at room temperature to prevent moisture absorption and degradation of bioactive compounds prior to extraction until further analysis.

Extraction Procedure

Two hundred grams of each powdered plant part were separately macerated in 200 mL of distilled water, hexane, methanol and ethyl acetate at room temperature for 48 hours with intermittent shaking to enhance solute-solvent interaction. The resulting mixtures were filtered using Whatman No. 1 filter paper and the filtrates were concentrated using a rotary evaporator at temperatures not exceeding 40°C to prevent thermal degradation of phytochemicals. The choice of solvents was based on differences in polarity to enhance the extraction of diverse phytochemical constituents (Harborne, 1998). The concentrated extracts were stored in dark, airtight containers at 4°C until further analysis.

Phytochemical Screening

Qualitative phytochemical analyses were performed following standard procedures described by Azuaga *et al.* (2021). The study relied on qualitative rather than quantitative phytochemical analysis as it provide faster and easy preliminary assessment and broad spectrum identification of phytochemical components and it is also cost effective, The extracts were screened for alkaloids, flavonoids, tannins, saponins, phenols, glycosides, terpenoids, steroids, anthraquinones and related compounds using established colorimetric and precipitation assays.

- Alkaloids – using Dragendorff's and Mayer's tests.
- Flavonoids – using the alkaline reagent and Shinoda tests.
- Tannins – using ferric chloride and gelatin tests.
- Saponins – using froth formation test.
- Phenols – using ferric chloride colorimetric test.
- Glycosides – using Keller-Killiani test.

- Terpenoids and Steroids – using Salkowski and Liebermann-Burchard tests.
- Anthraquinones – using Borntrager’s test.
- Anthocyanins – using pH-dependent color change tests.

Each test was conducted in triplicate to ensure reproducibility, and results were recorded as present (+) or absent (–).

Quality Control and Use of Controls

To enhance the validity of results, appropriate controls were incorporated into all assays. Positive controls, consisting of known standard compounds, were used to confirm reagent effectiveness and expected reactions. Negative controls, which included solvents without plant extracts, were used to rule out false-positive results due to reagent interference. All experiments were conducted in triplicate to ensure reproducibility and reliability of findings (Trease & Evans, 2009).

Results

Tables 1 and 2 collectively demonstrate the strong ethnomedicinal importance of *Spathodea campanulata* and provide phytochemical evidence that supports its extensive traditional use in the management of diverse health conditions. The integration of ethnobotanical data with phytochemical screening offers a clearer understanding of how indigenous knowledge aligns with the plant’s biochemical composition.

Table 1: Ethnomedicinal relevance of *Spathodea campanulata* in the management of diverse health conditions

Reported therapeutic uses	Frequency	Percentage	Parts used			
			Leaves	Bark	Root	Flowers
Skin rashes	254	84.7	+	+++	++	++
Arthritis and rheumatism	231	77	+++	++	–	–
Wounds	197	65.7	+	+++	–	++
Malaria fever	187	62.3	++	++	–	–
Typhoid fever	202	67.3	++	++	–	–
Diarrhea and dysentery	170	56.7	+	+	–	–
Coughs and bronchitis	202	67.3	+	+	–	–
Ulcers	225	75	–	++	++	+
Urethral infections	160	53.3	++	–	–	–
Kidney diseases	180	60	+	++	+	–
Menstrual disorders	152	50.7	+	++	++	–
Diabetes	147	49	–	+	–	–
Scrotal hernia	158	52.7	–	+	+	–
Syphilitic sores	203	67.7	–	++	+	+
Poison	147	49	+	+	++	–
Pelvic inflammation	97	32.3	–	+	–	+

Table 1 reveals that *S. campanulata* is widely employed in the treatment of both infectious and non-infectious diseases, reflecting its multipurpose role in traditional healthcare. Skin rashes recorded the highest usage frequency (84.7%), with bark, leaves and flowers all being utilized. Arthritis and rheumatism (77%), ulcers (75%), Syphilitic sores (67.7%), Coughs and bronchitis (67.3%) and Typhoid fever (67.3%) were also among the most frequently reported conditions. Similarly, wounds (65.7%) and syphilitic sores (67.7%) showed high usage, particularly involving bark and flowers, which are traditionally applied topically to promote healing and prevent infection.

Respiratory and febrile conditions such as coughs and bronchitis (67.3%) and fever (62.3%) were commonly managed using leaf and bark preparations, typically administered as decoctions or infusions. Gastrointestinal disorders, including diarrhea and dysentery (56.7%), also featured prominently, reflecting the plant's astringent and antimicrobial properties. Moderate use was observed for kidney diseases (60%), urethral infections (53.3%), menstrual disorders (50.7%), scrotal hernia (52.7%), and diabetes (49%), with bark and root often preferred, consistent with traditional beliefs that these parts contain stronger medicinal potency. Lower prevalence was recorded for pelvic disorders (32.3%) and poisoning (49%) Overall, the diversity of ailments treated and the use of multiple plant parts underscore the broad therapeutic versatility of *S. campanulata* in the study area. Generally, the table revealed that the bark is the most consistently utilized plant part across a wide range of ailments, followed by the leaves and roots, while flowers are used less frequently.

Phytochemical Composition of *Spathodea campanulata*

Table 2: Phytochemical composition on stem bark, root, leaves and flower extracts of *Spathodea companulata* in various extracts

Phytochemical	Stem bark				Root				Leaves				Flowers			
	HE	ME	Aq	EAE	HE	ME	Aq	EAE	HE	ME	Aq	EAE	HE	ME	Aq	EAE
Alkaloids	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+
Flavonoids	+	+	+	-	+	+	+	+	+	+	+	-	+	+	+	+
Tannins	-	-	+	+	+	+	+	+	-	-	+	+	-	-	+	+
Saponins	+	+	+	-	+	+	+	+	+	+	+	-	+	+	+	-
Antraquinone	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+	+
Phenols	-	+	+	-	+	+	+	+	-	+	+	+	-	+	+	-
Glycoside	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Terpenes and sterols	-	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-
Coumarin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthocyanins	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+

Key: + = Present, - = Absent, HE= hexane extract, ME= methanol extract, EAE= ethyl acetate extract.

The phytochemical profile presented in Table 2 provides biochemical justification for the ethnomedicinal applications observed in Table 1. Alkaloids and glycosides were consistently detected in almost all extracts, Flavonoids were also frequently present, while tannins, saponins and phenols showed variable occurrence depending on both the plant part and extraction medium. Alkaloids were widely distributed across most plant parts and solvent extracts, particularly in the stem bark, root and flowers. Flavonoids were detected in most extracts of all plant parts, Tannins were mainly present in aqueous and ethyl acetate extracts, especially in the bark and leaves, Saponins occurred widely across plant parts, except in a few ethyl acetate extracts, Phenolic compounds were moderately present, particularly in methanolic and aqueous extracts, Glycosides were consistently detected in all extracts and plant parts, Terpenes and sterols were sparsely detected, while coumarins were entirely absent. Anthocyanins were found only in flower and leaf extracts.

The study revealed clear differences in phytochemical composition based on both plant part and extraction solvent. Polar solvents such as methanol and water yielded a broader spectrum of phytochemicals, particularly phenols, tannins, and saponins, compared to non-polar solvents like hexane and moderately polar solvents such as ethyl acetate.

Discussion

Ethnomedicinal Relevance of *Spathodea campanulata*

Findings from Table 1 demonstrate that *Spathodea campanulata* is extensively used in Kogi State for the treatment of 16 identified health conditions, highlighting its wide therapeutic scope in traditional medicine. The highest frequency of use was recorded for skin rashes (84.7%), This widespread application suggests strong confidence in the plant's dermatological efficacy, likely linked to its antimicrobial, anti-inflammatory and wound-healing properties. This followed by arthritis and rheumatism (77%), ulcers (75%), and syphilitic sores (67.7%). This pattern indicates that the plant is primarily relied upon for managing skin-related ailments, inflammatory disorders and infections. The reliance on leaves and bark for arthritis and rheumatism highlights the perceived anti-inflammatory and analgesic effects of these plant parts, while the use of bark, root and flowers for ulcer treatment indicates that more potent or combined preparations are preferred for chronic or severe ailments. The use of the plant as an antidote for poisoning further highlights its perceived detoxifying and protective roles in indigenous medicine. Comparable observations have been reported in earlier ethnobotanical studies (Burkill, 2000; Iwu, 2014), which described the plant's role in treating similar conditions across West African communities.

Regarding plant part utilization, the stem bark emerged as the most prominently used component, showing the highest usage intensity (+++) in the treatment of several conditions, particularly skin diseases and wounds. Leaves and roots were also commonly employed, whereas flowers were used less frequently. This trend is consistent with previous reports (Akinpelu *et al.*, 2008), which identified the bark as a rich reservoir of bioactive compounds with antimicrobial properties. The dominance of bark usage may therefore be

linked to its comparatively higher concentration of pharmacologically active metabolites. These observations satisfactorily confirmed the significant role of *S. campanulata* in indigenous healthcare systems within the study area.

Phytochemical Composition and Therapeutic Relevance

The phytochemical analysis (Table 2) reveals that *S. campanulata* contains a diverse array of secondary metabolites distributed across its various parts. Alkaloids and glycosides were consistently detected in almost all extracts, suggesting that these compounds are widely distributed throughout the plant. Alkaloids are well known for their analgesic, antimicrobial, antimalarial and anti-inflammatory activities, which align with the reported use of *S. campanulata* in treating pain-related, infectious and febrile conditions (Edeoga *et al.*, 2005; Agyare *et al.*, 2013; Cushnie *et al.*, 2016; Kuete, 2014). The presence of Flavonoids in most extracts of all plant parts, indicated a strong antioxidant potential. Their presence supports the use of the plant in managing inflammatory disorders, wounds and chronic diseases where oxidative stress plays a significant role (Panche *et al.*, 2016). Tannins were mainly present in aqueous and ethyl acetate extracts, especially in the bark and leaves, suggesting water-soluble astringent compounds. This finding correlates with the traditional use of the plant in diarrhea, dysentery, ulcers and skin conditions (Saxena *et al.*, 2013;). Saponins occurred widely across plant parts, except in a few ethyl acetate extracts, and are known for their antimicrobial, immune-modulating, and membrane-permeabilizing properties. Their widespread presence may enhance the overall therapeutic efficacy of traditional herbal preparations by facilitating the absorption of other bioactive compounds. Phenolic compounds were moderately present, particularly in methanolic and aqueous extracts, further contributing to antioxidant and anti-inflammatory effects (Dai & Mumper, 2010).

Glycosides were consistently detected in all extracts and plant parts, suggesting that they represent a major class of bioactive constituents in *S. campanulata*. Depending on their structural type, glycosides may exhibit cardiogenic, anti-inflammatory, or antimicrobial activities, thereby supporting the plant's use in systemic conditions such as diabetes, kidney diseases and febrile illnesses (Wink, 2015). Terpenes and sterols were sparsely detected, indicating a more limited contribution, while coumarins were entirely absent. Anthocyanins were found only in flower and leaf extracts, which is consistent with their association with pigmented tissues and may explain additional antioxidant properties of these parts (Khoo *et al.*, 2017). These findings are in line with earlier studies (Ilodigwe *et al.*, 2010; Akinpelu *et al.*, 2008), which similarly reported the presence of these phytochemical groups in *S. campanulata*. The biological activities of these compounds such as antimicrobial, antioxidant and anti-inflammatory effects provide a scientific explanation for the plant's widespread therapeutic use. It is noteworthy that coumarins were not detected in any of the extracts, whereas anthraquinones and anthocyanins were restricted to specific plant parts, particularly the leaves and flowers. This selective occurrence points to tissue-specific biosynthesis and distribution of certain metabolites, reflecting biochemical diversity within

the plant. The results confirmed the presence of multiple bioactive constituents that may contribute to the plant's medicinal properties.

Variations in Phytochemical Composition across Plant Parts and Solvents

The study revealed clear differences in phytochemical composition based on both plant part and extraction solvent. Polar solvents such as methanol and water yielded a broader spectrum of phytochemicals, particularly phenols, tannins and saponins, compared to non-polar solvents like hexane and moderately polar solvents such as ethyl acetate. This suggests that solvent polarity plays a crucial role in the extraction efficiency of bioactive compounds. Furthermore, the stem bark and root extracts demonstrated greater phytochemical richness compared to leaves and flowers, especially in terms of tannins, phenols and saponins. For example, tannins were absent in hexane extracts of the stem bark but appeared in aqueous and ethyl acetate extracts, underscoring the influence of solvent type on compound recovery. These observations are consistent with established phytochemical principles (Harborne, 1998; Sofowora, 2008), which emphasize the importance of solvent polarity in extracting plant metabolites. The results also suggest that therapeutic efficacy may vary depending on the plant part and method of extraction employed.

Relationship between Ethnomedicinal Data and Phytochemical Findings

The strong concordance between the ethnomedicinal data (Table 1) and phytochemical findings (Table 2) suggests that the traditional uses of *Spathodea campanulata* are not arbitrary but are grounded in the presence of biologically active secondary metabolites supported by previous studies (Iwu, 2014; Sofowora, 2008) providing strong evidence for the plant's therapeutic validity and the predominant use of certain plant parts, correlates with their richer phytochemical profiles, suggesting that traditional practitioners may consciously or unconsciously select plant parts based on their efficacy as indicated by (Edeoga *et al.*, 2005; Sofowora, 2008), while the selective use of roots and flowers for specific ailments reflects differences in constituent distribution. Together, these findings reinforce the therapeutic relevance of *S. campanulata* and highlight its potential as a valuable source of bioactive compounds for further pharmacological investigation and possible development into standardized herbal or complementary medicinal products.

The survey revealed extensive use of *S. campanulata* in managing skin rashes, arthritis, wounds, fever, gastrointestinal disorders, respiratory infections, ulcers, urethral infections, kidney diseases, menstrual disorders, diabetes, hernia, syphilitic sores, poisoning and pelvic disorders (Burkill, 2000; Ilodigwe *et al.*, 2010; Iwu, 2014; Boniface *et al.*, 2017; Azuaga *et al.*, 2023). Different plant parts were employed depending on the condition, with leaves and bark being the most frequently utilized. Phytochemical analysis confirmed the presence of multiple secondary metabolites across different extracts, including alkaloids, flavonoids, tannins, saponins, phenols, glycosides, terpenes and steroids. These compounds are known

to exhibit antioxidant, antimicrobial, anti-inflammatory and wound-healing properties, thereby providing scientific justification for the plant's widespread ethnomedicinal use.

Recommendations

- Researchers should conduct advanced phytochemical, pharmacological, and clinical studies to isolate active compounds, validate efficacy and determine safety, dosage, and toxicity.
- Pharmaceutical researchers should develop standardized herbal formulations, particularly for dermatological and inflammatory conditions, using high-yield extraction methods and exploring synergistic effects.
- Traditional healers should adopt standardized preparation methods, avoid overharvesting stem bark, and collaborate in documenting indigenous knowledge.
- Policymakers should establish regulatory frameworks, fund research, and support integration of validated herbal medicines into healthcare systems.
- Conservation bodies should promote sustainable harvesting, replanting, and use of alternative plant parts to protect biodiversity.
- Finally, community education is needed to ensure safe use, raise awareness of risks, and encourage collaboration between traditional and conventional healthcare systems.

Conclusion

The study establishes that *Spathodea campanulata* has significant ethnomedicinal importance in Kogi State, where it is used to treat 16 health conditions, mainly skin disorders, inflammation, and infections. The stem bark is the most utilized part, followed by leaves and roots, indicating deliberate selection based on therapeutic value. Phytochemical analysis confirmed the presence of alkaloids, flavonoids, tannins, saponins, phenols and glycosides, with polar solvents (methanol and aqueous) extracting a wider range of compounds. A clear link exists between these phytochemicals and traditional uses for example, tannins and flavonoids support antimicrobial and wound-healing properties, phenols relate to anti-inflammatory effects and alkaloids to fever management. The higher phytochemical richness of the stem bark explains its preference, reflecting informed traditional knowledge. Overall, the study provides quantitative ethnopharmacological evidence, validates indigenous practices scientifically, and highlights the plant's potential for drug development, standardized herbal formulations, and integration into modern healthcare.

Conflict of Interest

The authors declare that no conflict of interest could have influenced the work. This work is original research and has not been published or submitted for publication elsewhere.

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