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# Qualitative Phytochemical Screening of Some Medicinal Plants

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**ABSTRACT**

Medicinal plants are abundant in bioactive compounds that are useful in the treatment of a wide range of human illnesses. The phytochemical compounds of these medicinal plants are thought to have medicinal potential. In the present study, qualitative phytochemical screening was conducted on leaf extracts of four medicinal plants - *Sphaeranthus indicus, Celosia cristata*, *Tephrosia purpurea,* and *Kigelia africana*. Solvent extraction was performed using a cold maceration method with ethylacetate, ethanol and aqueous solvents. Qualitative phytochemical analyses were carried out to detect the presence of flavonoids, saponins, tannins, phenolics compounds, coumarins, and quinine   Among the extracts, the ethanol extract of *S. indicus* exhibited the highest number of phytochemicals, while other plants showed the least. The presence of these phytochemicals suggests that these plants possess significant therapeutic potential and may serve as valuable sources for the development of novel plant-based drugs.

## Introduction

Plants with healing powers, known as medicinal plants or herbs, have played an important role in human healthcare from ancient times. According to historical records, Hippocrates, the father of medicine, encouraged the logical use of medicinal herbs around 400 BCE (Agidew, 2022). Major traditional medical systems such as Ayurveda, Siddha, Unani, and Traditional Chinese Medicine (TCM) have evolved around the use of medicinal plants for holistic health management (Ayyadurai, 2014; Liu et al., 2015). Medicinal plants are still used as a primary source of treatment for approximately 80% of the population in underdeveloped nations, owing to their low cost, accessibility, and perceived safety (WHO, 2002). It is estimated that around 30% of medications marketed worldwide contain plant-derived chemicals, and more than half of all modern therapeutic pharmaceuticals have natural origins (Rani et al., 2023).

Medicinal plants have been used for centuries in traditional medicine systems around the world for the treatment and prevention of various ailments. Their medicinal potential is primarily attributed to a wide range of bioactive secondary metabolites such as, alkaloids, flavonoids, tannins, phenolics, terpenoids, glycosides, and saponins. These bioactive compounds exhibit a number of biological activities, including antioxidant, antimicrobial, anti-inflammatory, anti-diabetic, and cytotoxic effects (Balunas & Kinghorn, 2005). Globally, between 35,000 and 70,000 plant species are known to have medicinal value, accounting for about 14–28% of all plant species (Sytar & Hajihashemi, 2024). However, because of variables including weather circumstances, soil type, geographic location, development stage, and extraction techniques, the quantity and concentration of these constituents can change greatly between species and even between different portions of the same plant. For example, there are notable differences in the total phenolic content, total flavonoid content, and antioxidant activity among Smilax china rhizome extracts gathered from various geographical locations (Lee et al., 2024).

***Spheranthus indicus* Kurz (Asteraceae) (Plate 1)**

The plant is widely distributed throughout India, Sri Lanka, and tropical regions of Asia, and is commonly found in wastelands, roadsides, open grasslands, and sandy soils. It has also been reported as an introduced species in certain regions of Africa and Southeast Asia. Morphologically, the plant is an annual or short-lived perennial herb that is branched and aromatic in nature. The stem is erect, cylindrical, and typically 30–60 cm tall, often bearing soft hairs and showing green coloration with purplish tinges at the nodes. The leaves are alternate, simple, and either sessile or shortly petiolate, with an oblong-lanceolate to linear-lanceolate shape; the margins are entire or slightly serrated, and the surface is sparsely hairy. Traditionally, the plant holds a prominent place in *Ayurvedic*, *Siddha*, and folk medicinal systems across South and Southeast Asia. In *Ayurvedic* system, the entire plant is used to treat epilepsy and mental disorders. Leaves are applied externally to wounds, boils, ulcers, and eczema, while roots are utilized for digestive disorders, diarrhea, and as a general tonic. The plant is also traditionally employed for managing diabetes, liver disorders, and blood purification. Flower extracts are used as anthelmintic agents and in the treatment of eye infections. In rural communities, the plant is regarded as a general health tonic, enhancing vitality, immunity, and overall well-being. Phytochemical investigations have revealed the presence of various bioactive compounds such as flavonoids, terpenoids, carbohydrates, and essential oils which are responsible for its diverse pharmacological activities. The plant exhibits potent anxiolytic activity, neuroleptic activity, sedative effect, immunomodulatory effect, antioxidant, anti-inflammatory, skin diseases, anti-diabetic, hepatoprotective, antimicrobial, larvicidal activity, analgesic and antipyretic activity (Galani et al., 2010).

***Celosia argentea var. cristata* (Amaranthaceae) (Plate 1)**

The plant is native to tropical regions but is now widely cultivated in subtropical and warm temperate climates around the world. It thrives best in well-drained, fertile soils and under full sunlight. In addition to its ornamental appeal, the plant holds significant ethnomedicinal value, particularly its leaves and seeds, which are commonly used in traditional medicine. Phytochemical analyses have revealed the presence of a variety of bioactive compounds including flavonoids, alkaloids, tannins, terpenoids, steroids, glycosides, phenols, and saponins (Gaibimei et al. 2018). These constituents are responsible for the plant's diverse pharmacological activities. It exhibits significant antimicrobial activity against various bacterial and fungal strains and possesses anti-inflammatory and antioxidant properties, effectively neutralizing free radicals through phenolic compounds and betalains. The plant also demonstrates hepatoprotective and antidiabetic effects, aiding in the regulation of blood glucose levels and enhancing insulin sensitivity. Other pharmacological activities include wound healing, neuroprotective, hemostatic, analgesic, and antipyretic properties. Extracts of the plant have also shown cytotoxic and anticancer potential by inhibiting the proliferation of cancer cells in vitro, as well as cardioprotective and antihyperlipidemic effects that help maintain normal lipid profiles and prevent oxidative damage to tissues (Varadharaj and Muniyappan, 2017).

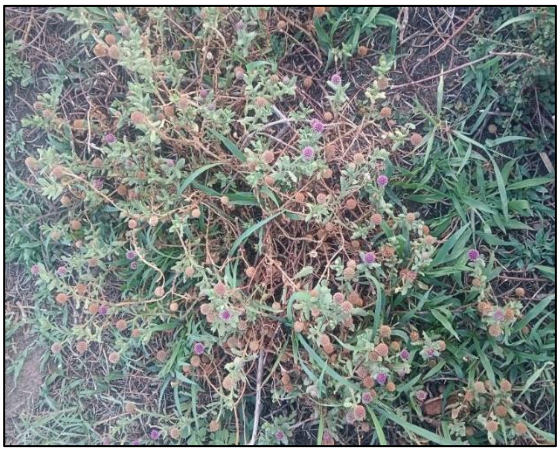
***Tephrosia purpurea* (L.) Pers. (Leguminosae) (Plate 1)**

The plant is widely distributed throughout India, Sri Lanka, Pakistan, and tropical regions of Africa. It typically grows in dry plains, wastelands, coastal regions, and along roadsides, thriving particularly well in sandy and alkaline soils. This adaptability allows it to survive under diverse environmental conditions, making it a common species across tropical and subtropical ecosystems. The different parts of the plant have a long history of usage for treating a number of ailments diarrhea, bronchitis, asthma, inflammation, boils, pimples, spleen enlargement, liver, heart, kidney, and blood disorders, tumors, ulcers, leprosy, and asthma (Mude et al., 2023)

***Kigelia africana* (Lam.) Benth.**

The plant is native to sub-Saharan Africa and is widely distributed from Senegal and Ethiopia to South Africa. It typically grows in riverine forests, savannas, woodland edges, and open grasslands. Adapted to tropical and subtropical climates, the species is known for its resilience, thriving in drought-prone regions and poor soils. Its ecological adaptability allows it to flourish across a wide geographical range, making it an important species in both natural and traditional medicinal contexts. Phytochemical investigations have revealed the presence of various bioactive compounds, including naphthoquinones (such as kigelinone and isokigelinone), flavonoids, iridoids, saponins, steroids, tannins, and alkaloids. These constituents contribute to the plant's wide range of pharmacological properties including antimicrobial, anti-inflammatory, antioxidant, anticancer, hepatoprotective, nephroprotective, anti-diabetic wound healing, skin protection and cardiovascular protection (Nabatanzi et al., 2020).

**Plate 1: Selected medicinal plants**



***Sphaeranthus indicus***

***Celosia argentea var. cristata***

***Kigelia Africana***

***Tephrosia purpurea***

## Materials and methods

### Collection plants

The fresh aerial parts of the selected plants (*Sphaeranthus indicus*, *Celosia cristata*, *Tephrosia purpurea*, and *Kigelia africana*.) were collected from Thoothukudi District in Tamil Nadu, India and it identified and a voucher specimen was deposited in the herbarium of the Department of Botany, our college. The collected plants thoroughly washed with water, and dried in a shaded, well-ventilated area at ambient temperature until completely dry. The dried leaves were then ground into a fine powder using a mechanical grinder.

### Preparation of extracts

### Aqueous extraction

100 grams of dried powder were extracted in distilled water for 6 h at slow heat. Every 2 h it was filtered through Whatman no.1filter paper and centrifuged at 5000 g for 15 min. The supernatant was collected. This procedure was repeated twice and after 6 h the supernatant was concentrated to make the final volume one-fifth of the original volume.

### Solvent extraction

100 grams of dried plant powdered samples were extracted with 200 ml of ethyl acetate/ethanol kept on a rotary shaker for 24 h. Thereafter, it was filtered and centrifuged at 5000 g for 15 min. The supernatant was collected and the solvent was evaporated to make the final volume one-fifth of the original volume. It was stored at 4°C in airtight bottles for further studies, *viz.* antimicrobial, antioxidant, anticancer and phytochemical analysis (Plate 1).

### Bioactive compounds screening

Phytochemical screening of crude extracts of all the plants were carried out according to the methods described by Trease and Evans (1989 & 1983).

Qualification phytochemicals analysis of the crude powder of the samples for the identification of phytochemicals like as a saponins, tannin, phenols and terpenoid, flavonoid, coumarin, *etc.*

**Test for flavonoids**

One ml of the extract, a few drops of dilute sodium hydroxide was added. An intense yellow color was produced in the plant extract, which become colorless on addition of a few drops of dilute acid indicates the presence of flavonoids.

**Test for saponins**

The extract was diluted with 20 ml of distilled water and it was agitated in a graduated cylinder for 15 minutes. The formation of 1 cm layer of foam showed the presence of saponins.

**Test for tannins**

5 ml of the extract and a few drops of 1% lead acetate were added. A yellow precipitate was formed, indicates the presence of tannins.

**Test for Phenolic compounds**

To 2 ml of filtered solution of the aqueous macerate of the plant material, 3 drops of a freshly prepared mixture of 1 ml of 1% ferric chloride and 1 ml of potassium ferrocyanide was added to detect phenolic compounds. Formation of bluish-green colour was taken as positive.

**Test for Coumarins**

3 ml of 10 % sodium hydroxide (NaOH) was mixed with 2 ml of crude extract, appearance of yellow color depicts the presence of coumarins

**Test for Quinine**

To 1 ml of concentrated H2SO4 was added. Formation of red colour shows the presence of quinine.

**Results and Discussion**

Secondary metabolites are the classes of compounds which are known to show curative activity against several human ailments and therefore could explain the use of traditional medicinal plant for treatment of some illnesses. These plants can also be used to discover bioactive natural products that may serve as leads for the development of new pharmaceuticals. All plant parts synthesize some chemicals in themselves which metabolize their physiological activities. In our present study, the selected plants have exhibited different kinds of secondary metabolites. The crude (ethyl acetate, ethanol, and aqueous) extracts of the selected traditional medicinal plant were subjected to qualitative phytochemical analyses (Tables 1-4; Plates 2-5). When performed qualitative tests for phytochemicals in *Sphaeranthus indicus*, *Celosia cristata*, *Tephrosia purpurea,* and *Kigelia africana,* a number of phytochemicals shows positive results in their specific tests. In the present study, the phytochemical screening of four medicinal plants namely *Sphaeranthus indicus*, *Celosia cristata*, *Tephrosia purpurea*, and *Kigelia africana* showed positive results for flavonoids, saponins, tannins, phenolics compounds, coumarins, and quinine.

Phytochemical screening of *S. indicus* revealed that the ethyl acetate extract tested positive for phenolic compounds and coumarins. The ethanol extract showed the presence of tannins, phenolic compounds, and coumarins, while the aqueous extract also exhibited positive results for tannins, phenolic compounds, and coumarins (Table 1; Plate 2). *C. cristata* showed positive results for tannins, phenolic compounds, and coumarins in its ethyl acetate extract. The ethanol extract tested positive for tannins and phenolic compounds, whereas the aqueous extract also revealed the presence of tannins, phenolic compounds, and coumarins (Table 2; Plate 3).

*T. purpurea* exhibited the presence of phenolic compounds in its ethyl acetate extract. The ethanol extract showed positive results for tannins and phenolic compounds, while the aqueous extract tested positive for tannins, phenolic compounds, and quinine (Table 3; Plate 4). *K. africana* contained phenolic compounds and coumarins in its ethyl acetate extract. The ethanol extract exhibited the presence of tannins and phenolic compounds, while the aqueous extract tested positive for tannins, phenolic compounds, and quinine (Table 4; Plate 5).

**Table 1: Qualitative Phytochemical analysis of *Sphaeranthus indicus***

| Phytochemicals | Ethyl Acetate | Ethanol | Water |
|---|---|---|---|
| Flavonoids | - | - | - |
| Saponins | - | - | - |
| Tannins | - | + | + |
| Phenolic Compounds | + | + | + |
| Coumarins | + | + | + |
| Quinine | - | - | - |

**'+' indicates: Present** **'-' indicates: Absent**

**Table 2: Qualitative Phytochemical analysis of *Celosia cristata***

| Phytochemicals | Ethyl Acetate | Ethanol | Water |
|---|---|---|---|
| Flavonoids | - | - | - |
| Saponins | - | - | - |

| | | | |
|---|---|---|---|
| Tannins | + | + | + |
| Phenolic Compounds | + | + | + |
| Coumarins | + | - | + |
| Quinine | - | - | - |

**'+' indicates: Present** **'-' indicates: Absent**

**Table 3: Qualitative Phytochemical analysis of *Tephrosia purpurea***

| Phytochemicals | Ethyl Acetate | Ethanol | Water |
|---|---|---|---|
| Flavonoids | - | - | - |
| Saponins | - | - | - |
| Tannins | - | + | + |
| Phenolic Compounds | + | + | + |
| Coumarins | - | - | - |
| Quinine | - | - | + |

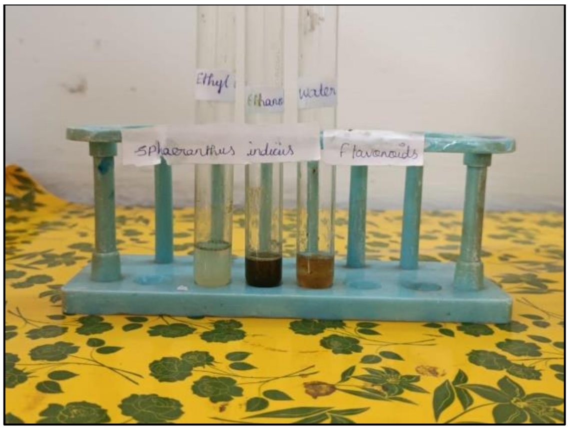
**'+' indicates: Present** **'-' indicates: Absent**

**Table 4: Qualitative Phytochemical analysis of *Kigelia africana***

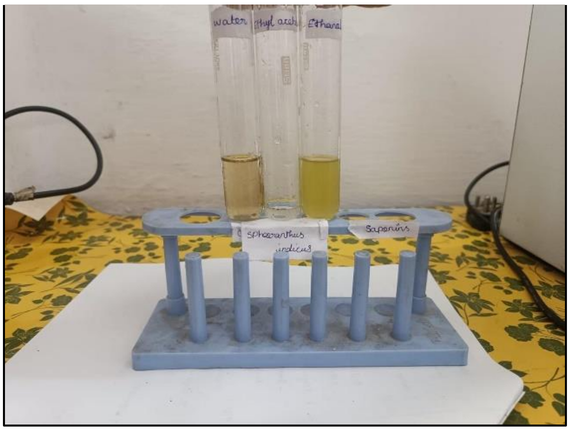
| Phytochemicals | Ethyl Acetate | Ethanol | Water |
|---|---|---|---|
| Flavonoids | - | - | - |
| Saponins | - | - | - |
| Tannins | - | + | + |
| Phenolic Compounds | + | + | + |
| Coumarins | + | - | - |
| Quinine | - | - | + |

**'+' indicates: Present** **'-' indicates: Absent**

**Plate 2: Phytochemical screening of crude extracts of *Sphaeranthus indicus***



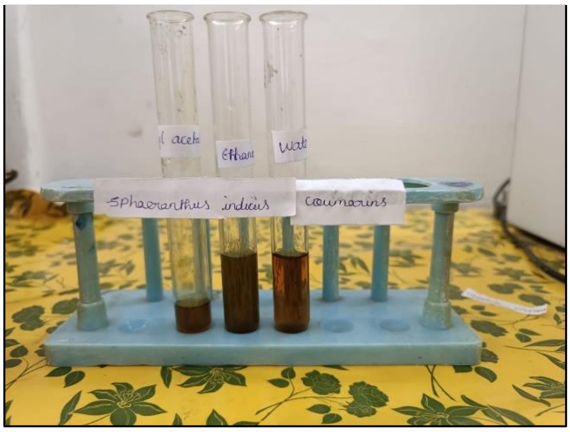

**Flavonoids**



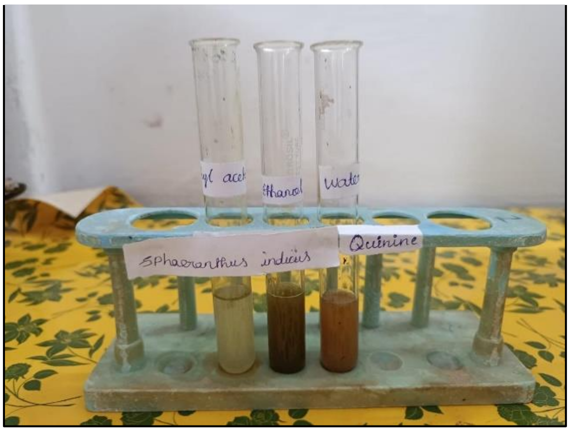

**Saponins**


**Tannins**


**Phenolic Compounds**

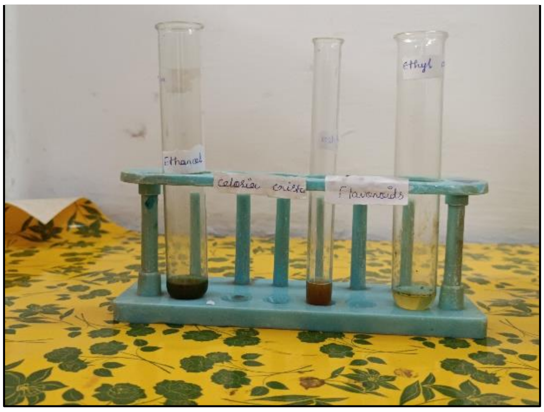



**Coumarins**

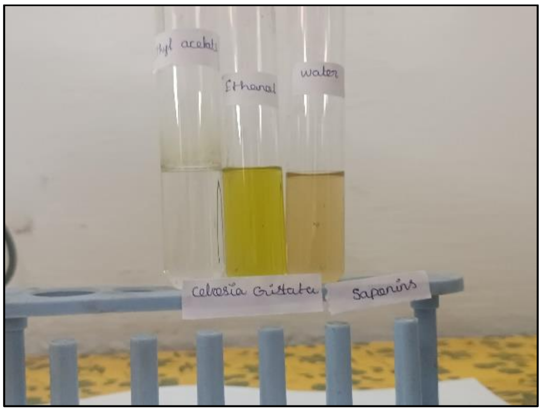



**Quinine**

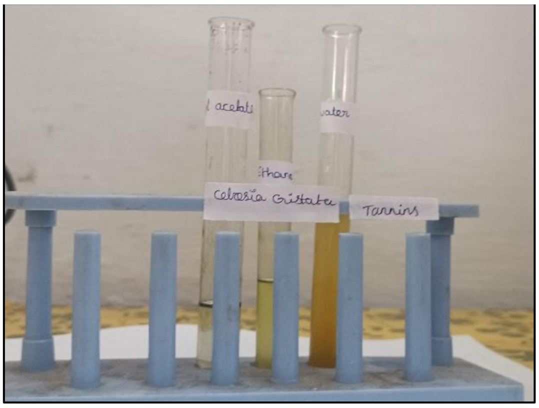
**Plate 3: Phytochemical screening of crude extracts of *Celosia cristata***



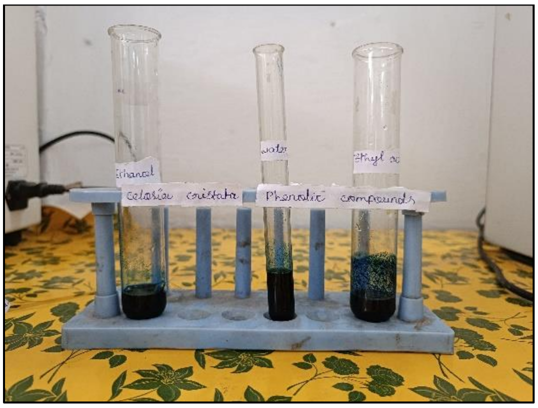

**Flavonoids**




**Saponins**




**Tannins**



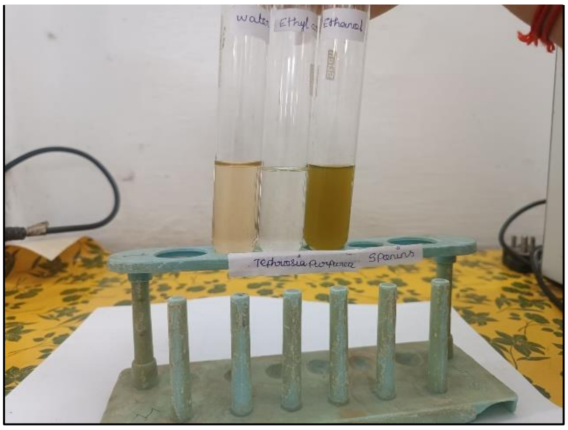

**Phenolic Compounds**


**Coumarins**

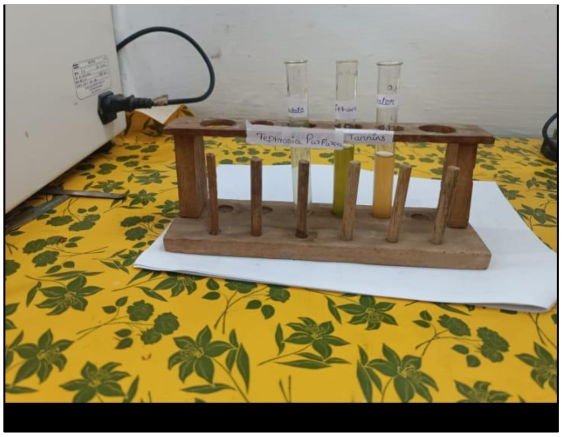

**Quinine**

**Plate 4: Phytochemical screening of crude extracts of *Tephrosia purpurea***

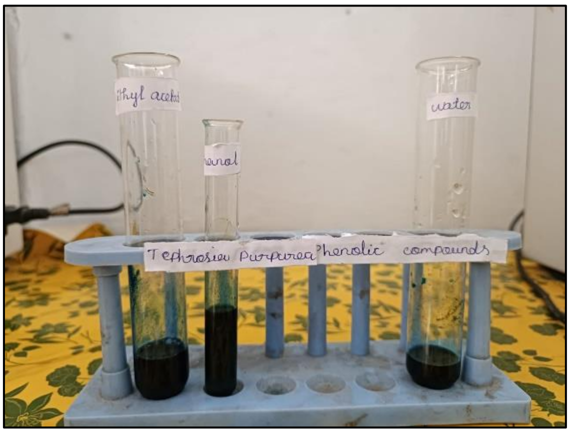

**Flavonoids**



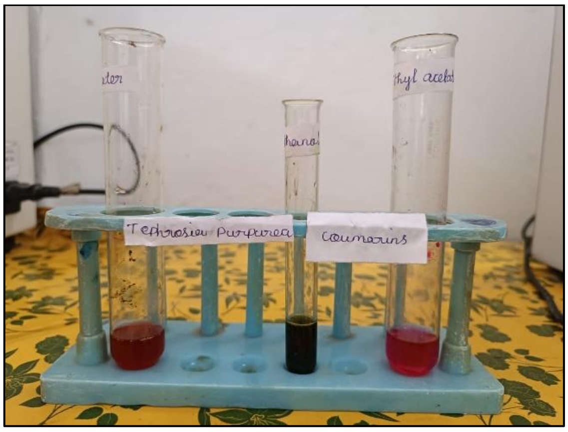
**Saponins**



**Tannins**




**Phenolic Compounds**

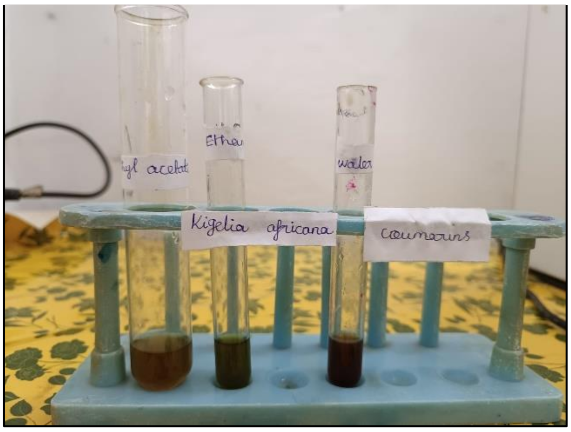



**Coumarins**

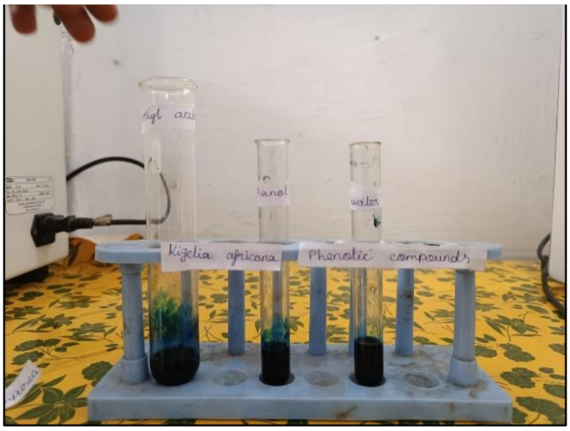

**Quinine**

**Plate 5: Phytochemical screening of crude extracts of *Kigelia Africana***

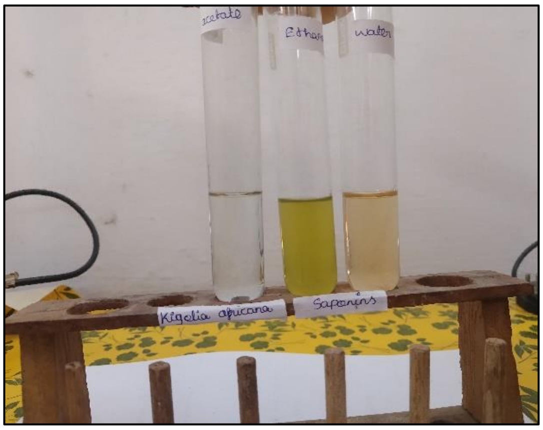

**Flavonoids**



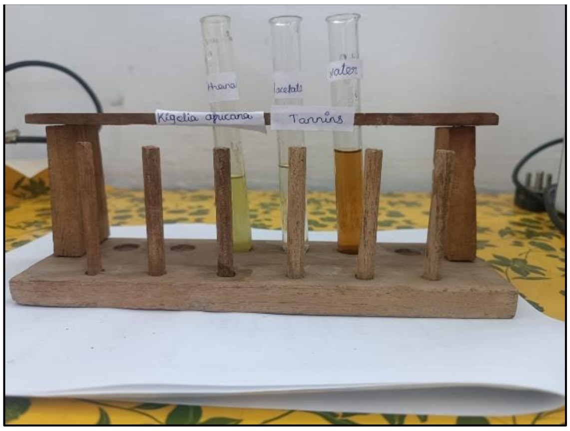

**Saponins**



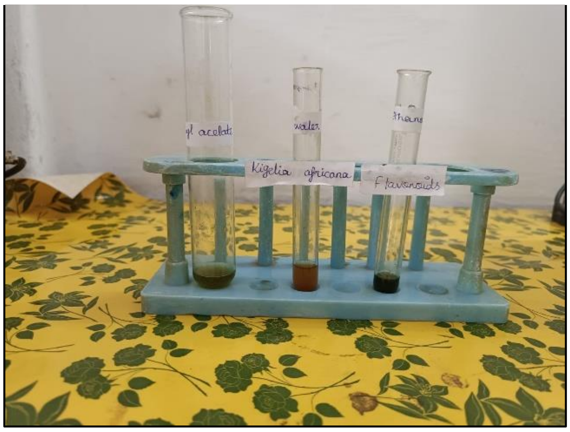

**Tannins**




**Phenolic Compounds**




**Coumarins**




**Quinine**

The phenolics such as flavonoids, tannins are the group of compounds that act as primary antioxidant or free radical scavengers (Jing *et al.*, 2010). Flavonoids are referred as natures biological response modifiers, because of their inherent ability to modify the body's reaction to allergies, anti-inflammatory, antimicrobial, anticancer activities. Apart from the flavonoids shows potent antihyperglycemic activity in animal studies (Mukherjee *et al.*, 2006). Tannins were reported to exhibit antidiabetic (Ajebli and Eddouks, 2019), anti-inflammatory, antibacterial and antitumor activities. It has also been reported that certain tannins were able to inhibit HIV replication selectively besides use as diuretics. Plant tannins have been widely recognized for their pharmacological properties and are known to make trees and shrubs a different meal for many caterpillars.

Coumarins are a class of phenylpropanoid-derived secondary metabolites found broadly in higher plants, often associated with multiple bioactivities including antioxidant, antimicrobial, anti-inflammatory, and cytotoxic effects (Stringlis et al., 2019; Sharifi-Rad et al., 2021). In the present study, the detection of coumarins across different solvent extracts (ethyl acetate, ethanol, aqueous) supports their moderate polarity and solubility in both semi-polar and polar media. Their co-occurrence with phenolic compounds suggests possible synergism, enhancing radical scavenging capacity and antimicrobial potential. Such synergistic interactions have been reported in African medicinal plants, where coumarins contributed significantly to both antimicrobial and antioxidant activities (Anywar and Muhumuza, 2024) Bioactivity and toxicity of coumarins from African medicinal plants, 2023). The presence of these phytochemicals suggests that these plants possess significant therapeutic potential and may serve as valuable sources for the development of novel plant-based drugs.

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