



Comparative Phytochemical Analysis of the Leaves and Stem of Five Species of *Sida* L.

**Margaret Emmanuel Bassey¹, Imoh Imeh Johnny², Omodot Timothy Umoh^{1*}
and Utibe-Ima Monday George¹**

¹Department of Botany and Ecological Studies, Faculty of Sciences, University of Uyo, Akwa Ibom State, Nigeria.

²Department of Pharmacognosy and Natural Medicine, Faculty of Pharmacy, University of Uyo, Akwa Ibom State, Nigeria.

Authors' contributions

This work was a collaborative effort between all authors. Author MEB provided the research topic and supervised the work. Author OTU assisted in the collection and initial identification of the plant samples with Author UMG who also did the phytochemical screening of the plant samples with the assistance of author IJJ. Author MEB authenticated the identification of the plants. Author OTU wrote the first draft of the manuscript. Authors MEB and IJJ perfected the final manuscript. All authors read and approved the final manuscript.

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ABSTRACT

This study is aimed at evaluating the qualitative phytochemical constituents of the leaf and stem of five common species of *Sida* collected in Uyo metropolis. These species are medicinal plants used in folk medicine for the management of testicular swelling, elephantiasis, skin disease, fever, ulcer and urinary disease. Phytochemical screening was carried out on *Sida acuta* Burm. f, *Sida stipulata* Cav., *Sida rhombifolia* L., *Sida corymbosa* R. E. Fr. and *Sida* sp. using standard methods. Saponins, Tannins and Cardiac glycosides were present in the stem and leaves of all the five species. However, Tannins were strongly present in the leaves while Cardiac glycosides were strongly present in the stems of all the five species. Trace amounts of Phlobatannins were also present in the leaves and stems of all species. Terpenoids were present only in the leaves of *S. rhombifolia* and absent in all others. The strong presence of Saponins in both stem and leaf

*Corresponding author: E-mail: umoh.omodot@gmail.com;

extracts as well as the presence of alkaloid in the leaves of *Sida* sp. differentiated it from the other four species. The taxonomic implication of this is discussed in the work. The presence of these phytochemicals also lends credence for their usage in folk medicine.

Keywords: Cardiac glycosides; phlobatannins; phytochemicals; sida; saponins; tannins; terpenoid.

1. INTRODUCTION

Sida is a genus of flowering plants in the mallow family, Malvaceae. They are distributed in tropical and subtropical regions worldwide, especially in the America. Plants of the genus may be known generally as fan-petals or Sidas [1]. *Sida* species are mostly perennial shrubs with erect, sometimes prostrate woody, rounded, and scantily hairy or glabrous stem [2]. Leaves are simple, alternate, stipulate, acute, dentate to serrate, acute to rounded base, linear to lanceolate to elliptic, petiolate, with petioles that are 0.5–1 cm long and scantily hairy or glabrous. The leaves are 4–9 cm long and 3–8 cm broad. The inflorescence is a cyme. Calyx; 5, fussed; corolla, 5, yellow in colour. The flower is bisexual, has 7-10 carpels, syncarpous ovary. The fruit is a capsule and it splits into 7–13 nutlets [2].

The family Malvaceae comprises almost all life forms, from annual herbs to perennial trees represented by 243 genera and 4225 species, distributed all over the world mostly in warmer regions [3,4,5].

Hutchinson [6] divides Malvaceae into five tribes: Malopeae, Malveae, Hibisceae, Abutilaeae and Ureneae. Malveae is further divided into the subtribes Corynabutilinae and Malvinae, and Abutilinae is divided into the subtribes Abutilinae and Sidinae [7]. Subdivisions are traditionally based on position and number of carpels, position and number of ovules per carpel, fruit type, number of styler arms in proportion to number of carpels and other gynoecial characters.

Many *Sida* species such as Arrow leaf sida (*Sida rhombifolia*) are attractive to butterflies and moths. *Sida* has historically been a wastebasket taxon, including many plants that simply did not fit into other genera of the Malvaceae. Species have been continually reclassified. The circumscription of *Sida* is still unclear, with no real agreement regarding how many species belong there. Over 1000 names have been placed in the genus, and many authorities accept about 150–250 valid names today. Some sources accept as few as 98 species. There are

many plants recognized as *Sida* that have not yet been described to science [1].

The plant *Sida* is a very common weed which is also useful in ayurveda. It is used in the treatment of malaria, diarrhea, asthma, headache, cold, fever, skin diseases, urinary disease, ulcer, snake bite, facial paralysis, anti-fertility agent and sedative [8,9]. The juice of the leaves is boiled in oil and applied to testicular swellings and in elephantiasis. In the Phillipines, leaves are employed for making poultices for sores and anticancer activity [10]. This study examined the phytochemical components of the different species of *Sida* in Uyo metropolis in view of their applicability in traditional medicine.

2. MATERIALS AND METHODS

2.1 Collection and Identification of Plant Samples

All five plant samples *Sida acuta* Burm. f., *Sida stipulata* Cav., *Sida corymbosa* R. E. Fr., *Sida rhombifolia* L. and *Sida* sp. were collected at main campus, town campus annex, and town campuses of University of Uyo, Akwa Ibom State, Nigeria, in the month of November 2019. These plant samples were identified and authenticated by Professor M. E. Bassey, a Taxonomist in the Department of Botany and Ecological Studies, University of Uyo, Uyo, Akwa Ibom State, Nigeria. Phytochemical screening was Carried out in the Laboratory one (1) of the Department of Pharmacognosy and Natural Medicine, Faculty of Pharmacy, University of Uyo, Akwa Ibom State, Nigeria.

2.2 Phytochemical Screening

Each 50 g of the plant leaf and stem powders were extracted by maceration in 1200 ml of 70% ethanol in a conical flask. The mixture was vigorously stirred intermittently and allowed to stand for 72 hours. It was filtered and concentrated on a water bath at 40°C. All extracts obtained were stored in a refrigerator until required for use.

The standard methods of Sofowora [11] were used in the preliminary phytochemical screening of leaf and stem extracts of the five species of *Sida* for various secondary metabolites.

2.3 Test for Tannins

About 0.5 g of extract was mixed with 10 ml of distilled water and filtered. Ferric chloride was added to the filtrate. A blue-black precipitate was seen as evidence for the presence of tannins.

2.4 Test for Alkaloids

About 0.5g of the plant extract was dissolved with 5ml of 5 % hydrochloric acid in a test tube and heated in water bath. The mixture was allowed to cool and then filtered. The filtrate was then divided into two test tubes.

The first portion was treated with few drops of dragendoff's precipitating reagent while the second portion was treated with Mayer's reagent and observed. Brick red Precipitation or turbidity was taken as preliminary evidence for the presence of alkaloid in the plant extract.

2.5 Test for Saponins

About 0.5 g of the extract was shaken vigorously with 10 ml of distilled water in a graduated measuring cylinder for 15 minutes, frothing which persisted on warming after 15 minutes, indicates the presence of saponins. Also, few drops of olive oil was added to 1ml of the extract and vigorously shaken. Formation of soluble emulsion in the extract indicated the presence of saponin.

2.6 Test for Flavonoids

The extract (0.5 g) was stirred with 10ml of distilled water and filtered. Few pieces of magnesium metal were added to the filtrate followed with concentrated hydrochloric acid. The formation of a reddish precipitate indicated the presence of flavonoids.

2.7 Test for Terpenoids

A mixture of chloroform (2 cm³) and concentrated tetraoxosulphate (VI) acid (3 cm³) was added to 5 cm³ of each extract to form a layer. The presence of a reddish brown colouration at the interface shows positive results for the presence of terpenoids.

2.8 Test for Phlobatannins

About 0.5 g of the plant extract was dissolved in 2 mL of water and boiled with 5 mL of 1% aqueous hydrochloric acid. Deposit of red precipitate showed positive test.

2.9 Test for Cardiac Glycosides

About 0.5 g of the plant extract was dissolved in 2 mL of chloroform. Concentrated sulphuric acid was gently added by running it down the side of the test tube to form a distinct lower layer. A reddish brown coloration at the inter-phase indicated the presence of the steroidal ring.

3. RESULTS

This study revealed the type of phytochemicals present in both leaves and stems of five common species of the genus *Sida* found in Uyo metropolis and they are as summarized in Table 1.

The phytochemicals found were: saponin, tannin, flavonoid, alkaloid, cardiac glycoside, phlobatannin and terpenoid.

Saponin was strongly present in the leaves of all species except in *S. corymbosa* where it was just present. In the stem, saponin was strongly present in all species except in *S. acuta* and *S. stipulata* where it was just present. Tannin was strongly present in leaves of all the species and in the stem it was strongly present in all species except in *S. stipulata*, *S. corymbosa* and *Sida* sp. Flavonoids were present in trace amounts in the leaves of *S. acuta*, *S. corymbosa* and *Sida* sp. and absent in *S. stipulata* and *S. rhombifolia*. In the stem, it was present in all except *S. corymbosa* but strongly present in *S. rhombifolia* and present in trace amount in *S. acuta* and absent in *S. stipulata* and *Sida* sp. Alkaloid was absent in the leaves of all species except in *Sida* sp. where it was present in trace amount. In the stem, alkaloid was present in *S. acuta*, *S. stipulata*, *S. rhombifolia* and absent in *S. corymbosa* and *Sida* sp. Cardiac glycoside was present in both leaves and stem of all species. Phlobatannin was present in trace amount in both stem and leaves of all species. Terpenoids were present in trace amount in the leaves of *S. rhombifolia* and absent in the leaves of other species, and present in trace amount in the stem of *S. acuta*, *S. rhombifolia* and *Sida* sp. and absent in *S. corymbosa* and *S. stipulata*.

Table 1. Phytochemical screening of species of *Sida*

Phytochemicals	Sample	<i>S. acuta</i>	<i>S. stipulata</i>	<i>S. rhombifolia</i>	<i>S. corymbosa</i>	<i>Sida. sp.</i>
Saponin	Leaf	+	+	+	+	+++
	Stem	+	+	+++	+++	+++
Tannin	Leaf	+++	+++	+++	+++	+++
	Stem	+++	++	+++	++	++
Flavonoid	Leaf	+	-	-	+	+
	Stem	+	-	+++	++	-
Alkaloid	Leaf	-	-	-	-	+
	Stem	+	++	+	-	-
Cardiac glycoside	Leaf	++	+	+	+++	+
	Stem	+++	+++	+++	+++	+++
Phlobatannin	Leaf	+	+	+	+	+
	Stem	+	+	+	+	+
Terpenoid	Leaf	-	-	+	-	-
	Stem	+	-	+	-	+

Key= +++ strongly present, ++ present, + trace, - absent

4. DISCUSSION

Phytochemical analysis of the extract in this study showed the presence of bioactive components: alkaloids, tannins, saponins, terpenes, flavonoids and cardiac glycosides. These findings collaborate with the earlier reports of [12,13,14] on the roles of some phytochemical components inherent in plants.

Saponin was found present on the leaves and stems of the *S. acuta*, *S. stipulata*, *S. rhombifolia*, *S. corymbosa* and *Sida* sp. [15]. The qualitative screening of phytochemical constituents of species of *Sida* according to [16] revealed the presence of saponins. They also reported the presence of flavonoids which have also been reported for the stem in *S. acuta* and in *S. rhombifolia*.

The presence of saponins in all five species implies that they may all have cholesterol lowering properties and some deleterious properties (cytotoxic-permeabilizing of the intestine). Saponins have also been found to increase and accelerate the body's ability to absorb calcium and silicon [16].

Tannins and Phlobatanins are found in both leaves and stems of all the five species. Tannins are attributed to analgesic and anti-inflammatory activities, they have amazing stringent properties and they are known to hasten the healing of wounds and inflamed mucous membranes [17]. While phlobatannins have also been discovered to possess wound healing

properties, these are anti-inflammatory, analgesic and anti-oxidant [18,19].

Flavonoid was present in both leaves and stems of *S. acuta*, *S. corymbosa* and *Sida* sp. Earlier reports on the phytochemical screening of aqueous leaf extract of *S. acuta* showed the presence of flavonoid [20] and on the other hand flavonoid was absent in stems and leaves of *S. stipulata*, absent in leaf of *S. rhombifolia* but strongly present in the stem. Flavonoids have been referred to as nature's response modifiers because of the strong experimental evidence of their ability to modify the body's reaction to allergies, viruses and carcinogens [21].

Cardiac glycoside was present in both stems and leaves of all the five species. According to [22], Cardiac glycosides have been discovered to be effective remedies for treating heart diseases, and this is due to its ability to decrease the blood pressure which in turn increases the efficiency of the kidney [18].

Alkaloid was present in stems of *S. acuta*, *S. stipulata*, *S. rhombifolia* but absent in *S. corymbosa* and *Sida* sp. Meanwhile alkaloid was absent in the leaves of four species except in *Sida* sp. Plants having alkaloids are used as medicines for reducing headache and fever and this is due to their antibacterial and analgesic properties [23].

Terpenoids were absent in leaves of *S. acuta*, *S. stipulata*, *S. corymbosa* and *Sida* sp. and present in trace amount in *S. rhombifolia* and in the stem,

trace amounts were found in *S. acuta* and *S. rhombifolia* and *Sida* sp. and absent in *S. corymbosa* and *S. stipulata*.

Terpenoids have been found to be useful in the prevention and therapy of several diseases including cancer. They are also known to possess anti-microbial, anti-fungal, anti-parasitic, anti-viral, anti-allergenic, anti-spasmodic, anti-hyperglycemic, anti-inflammatory, and anti-immunomodulatory properties [24,25].

The phytochemical components of *Sida* sp. reveal that the species is almost similar to *S. acuta*. This unknown species of *Sida* could be an evidence of speciation process going on among the populations of *Sida* in Uyo metropolis as also reported by [26,27] using anatomical and palynological features respectively.

5. CONCLUSION

Phytochemical constituents are more present in the stems than in the leaves. Screening shows that the five species are similar due to the presence of saponins, tannins, cardiac glycosides and trace amounts of phlobatannins. This shows a relatedness of the investigated species as members of the same genus. The strong presence of Saponins in both stem and leaf extracts as well as the presence of alkaloid in the leaves of *Sida* sp. differentiated it from the other four species thus indicating the possible occurrence of a speciation process in the *Sida* population in Uyo Metropolis.

The presence of notably useful phytochemicals such as tannins, phlobatanins and cardiac glycosides that have been reported to have great medicinal roles in the pharmaceutical industry makes these species of *Sida* to be potential raw materials for the extraction of useful phytochemicals of pharmaceutical importance. This also lends credence to their usefulness in folk medicine.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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