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COMPARATIVE PHARMACOGNOSTIC STUDIES OF TWO GHANAIAN MEDICINAL PLANTS: *SABA SENEGALENSIS* AND *SABA THOMPSONII*

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Keywords:

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ABSTRACT: The study sought to describe the pharmacognostic features for identification and quality control of closely related species *Saba senegalensis* (A. DC.) Pichon and *Saba thompsonii* (A. Chev.) Pichon (Apocynaceae), useful medicinal plants against inflammation and its related diseases in Ghana and West Africa. Macro-morphological, qualitative and quantitative microscopic features as well as physicochemical, fluorescence and phytochemical properties, and Thin Layer Chromatography (TLC) profile of leaves, stem and roots of both plants were determined using standard methods. The results showed both plants are climbers with lanceolate leaves and acuminate apices. The differences in their calcium oxalate contents, the hypostomatic nature of the leaves with different stomatal types and epidermal cells, histological features of their midribs and surface data determinations and TLC profiles of the parts under study present useful data for clearly distinguishing between the two species of *Saba*. All plant parts contained varying amounts of nutritional elements. To the best of our knowledge, this is the first time detailed descriptions of the pharmacognostic features of the leaves, stem and roots of both plants have been provided to reinforce the differences in the species. This serves as important information for correct sourcing of these plants for research purposes and for use by individuals and herbal manufacturers.

INTRODUCTION: The relationship between plants and man has existed since antiquity and the use of plants as medicines is not new to man [1]. In Ghana, traditional medicine forms an integral part of the culture and is heavily relied on especially in remote areas where access to medical facilities is limited [2]. Owing to its high patronage and acceptability in Ghana, herbal medicine was integrated into the main stream healthcare system in the year 2011, allowing the concurrent delivery of both orthodox and herbal medicines in selected health centres [3].

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The practice of herbal medicine has however not been devoid of challenges such as adulteration and difficulty in the identification of closely related species [4]. In a bid to meet the growing demands of the market, plant medicines especially in powdered form have been adulterated with substandard and inferior varieties [5].

Again, documented ethnobotanical surveys reveal that various cultural groups in the country may refer to different medicinal plants, especially different species of the same genus with same or similar local names making it easy for substitution of one plant for the other due to mistaken identity [2, 6]. Moreover, due to similarity in morphology of closely related species, there is high chance of substitution of one species for the other. Pharmacognostic studies of medicinal plants are thus important as it lays down standards for the

correct identification, authentication, standardisation and selection of medicinal plants for both consumers and manufacturers [7].

Saba senegalensis (A. DC.) Pichon and *Saba thompsonii* (A. Chev.) Pichon are two plants of the genus *Saba* (Apocynaceae) useful in traditional Ghanaian medicine and in many other West African traditional medicinal practices [8]. *S. senegalensis* is locally known as "Bakɔɔ" and *S. thompsonii* as "Bakɔɔ nini" among the Akans (Twi) of Ghana. They are medicinally used in treating jaundice and other liver disorders [9]. The leaves serve as a haemostatic, an antiseptic for wounds, an anti-emetic and in treating blindness and headaches. Leaf and bark decoctions are used in treating severe diarrhoea and food-poisoning. The roots are useful in treating burns in children and urethral discharges. The latex from the stem and roots is used in treating pulmonary troubles including tuberculosis. The fruits are cherished in many West African countries and are used in preparing jams and syrups. Together with some other plants, the fruits are also used in treating sterility in women [8, 9].

Due to close similarities in the macromorphological features of these two species, they are often substituted during harvesting. There is however no known standard parameters for the proper identification of both plants. The work thus aims at providing pharmacognostic details of the leaves, stem and roots for the identification and authentication of *S. senegalensis* and *S. thompsonii*.

MATERIALS AND METHODS:

Chemicals and Equipment: All chemicals and reagents used were obtained from BDH chemicals (BDH Ltd., Poole, England). Photomicrographs were taken with Leica light microscope DM 1000 LED, Wetzlar, Germany and fluorescence analysis performed with UVGL-58 Handheld UV lamp (254/365 nm), Cambridge, UK.

Plant Collection, Authentication and Processing: The leaves, stem and roots of *Saba senegalensis* and *Saba thompsonii* were collected from Kwahu-Asakraka in the Eastern Region of Ghana in November 2016. The plants were authenticated by Mr. Clifford Asare and Dr George Henry Sam of the Department of Herbal Medicine, Faculty of Pharmacy and Pharmaceutical Sciences (FPPS), College of Health Sciences (CHS), Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana. Voucher specimens (KNUST/HM1/2016/S008, KNUST/HM1/2016/S006) have been deposited at the herbarium of the Department of Herbal Medicine, FPPS, CHS, KNUST. The plant materials were cleared of foreign matter, cut into smaller pieces and air-dried at room temperature for two weeks. The dried materials were then pulverised and stored in air-tight plastic bags at room temperature until needed for use. Part of the plant materials were kept whole for macro-morphological examinations.

Organoleptic and Macro-morphological Studies: The leaves, stem and roots of *S. senegalensis* and *S. thompsonii* were organoleptically and macroscopically examined to determine their features. This included odour, colour, leaf shape and arrangement [10, 11].

Microscopical and Histological Studies:

Whole Leaf Microscopy: Free hand sections of fresh leaves of both plants were made using a sharp razor blade. Leaf sections were boiled in 80% w/v chloral hydrate until leaves were cleared. The cleared leaves were then used in surface data determinations of the leaf including stomatal number, stomatal index, epidermal number, palisade ratio, vein islet and vein-let termination numbers [11].

Transverse Section of Midrib: A sharp razor blade was used to make free hand transverse sections of the midrib of the fresh leaves of *Saba senegalensis* and *Saba thompsonii* for qualitative studies. Sections were observed for the presence of tissues including parenchyma, collenchyma, lignified tissues and other identifying features with the aid of mountants such as phloroglucinol in HCl and N/50 Iodine. Photomicrographs of different cellular structures observed were taken [12].

Powder Microscopy: Coarsely powdered leaves, stem and roots of both plants were viewed under the microscope at different magnifications using mountants including chloral hydrate, phloroglucinol in concentrated HCl, water and iodine. Photomicrographs of the different cellular structures and inclusions were taken [11].

Physicochemical Parameters: Powdered leaves, stem and roots of both plant materials were subjected to physicochemical analyses. Their solvent soluble extractives, ash values, pH and mineral content as well as fluorescent characteristics under visible and UV light (254 and 365 nm) were determined [13 - 15].

Phytochemical Screening: Secondary metabolites present in the powdered leaves, stem and roots of both plant species were determined according to standard methods [11].

Thin Layer Chromatography: About five grams of the powdered plant materials were cold-macerated in 30 ml of chloroform for 24 hours. The filtrate was concentrated and spotted on TLC silica gel plate (G60 F_{254}, 0.25 mm thickness). The plates were allowed to dry and developed in pre-saturated chromatanks containing chloroform: methanol (95: 5). The developed plates were then dried and analysed under the UV lamp at 254 nm and 365 nm by observing the quenching or otherwise fluorescing nature of the developed spots or zones which represent compounds. Further analysis of the developed plates involved immersing the plates in detecting reagent vanillin/ sulphuric acid [11].

RESULTS AND DISCUSSIONS:

Organoleptic and Macro-morphological Studies: Organoleptic analyses is a qualitative process which provides the simplest and quickest means to determine the identity and purity of a drug, based on sensory perception and morphological assessments [7]. *Saba senegalensis* is a climber (liana) with ovate to lanceolate leaves, green on the adaxial surface and grey on the abaxial surface **Fig. 1**, **A1**. The petiolated leaves with a symmetrical base and an acuminate apex, has an entire margin, reticulate venation and papery feel. *Saba thompsonii* however, has lanceolate shaped leaves with a broadly acuminate apex, and a greyish green abaxial surface **Fig. 1**, **B1**. Morphological examination shows the smooth to rough textured outer stem and root barks of *S. senegalensis* is green to brown; and brown to red respectively **Fig. 1**, **A2 / A3** whereas *S. thompsonii* stem (smooth texture) and roots (rough texture) have dark green and dark brown outer barks respectively **Fig. 1**, **B2 / B3**. The inner wood of stem and roots of *S. senegalensis* is red in contrast to the cream coloured inner wood of *S. thompsonii* roots and stem. This is a key characteristic feature that can be used to distinguish between the stem and roots of *S. senegalensis* and *S. thompsonii*. The leaves, stem and roots of both species have a characteristic odour. Stem and roots exude latex characteristic of the Apocynaceae [16, 17].

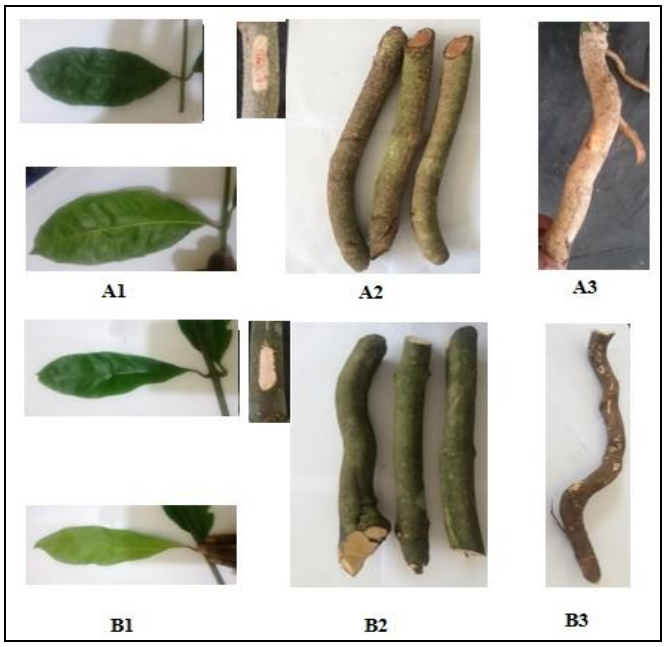

FIG. 1: LEAVES (1), STEM (2) AND ROOTS (3) OF *S. SENEGALENSIS* (A) AND *S. THOMPSONII* (B)

Microscopical and Histological Studies:

Leaf Anatomy and Quantitative Microscopy: Both leaves are hypostomatic with distinct types of stomata located only on their abaxial surfaces: anomocytic and anisocytic stomata surrounded by wavy walled epidermal cells in *S. senegalensis* **Fig. 2, A5** and paracytic stomata surrounded by slightly wavy walled epidermal cells in *S. thompsonii* **Fig. 2, B5**. Epidermal cells occurring on the adaxial surface are beaded in *S. senegalensis* **Fig. 2, A4** and straight walled in *S. thompsonii* **Fig. 2, B4**. This is a unique feature which could be used to distinguish between the two species. *S. senegalensis* and *S. thompsonii* are known xerophytes and the presence of well-defined stomata and their subsidiary cells may account for the plants survival during the dry season [18]. Rosette crystals are visibly noticeable on the cleared leaf surface of *S. thompsonii* **Fig. 3, B6 / B7**, a feature absent in *S. senegalensis*. This again presents a diagnostic feature for the identification of the leaves of these two plant species.

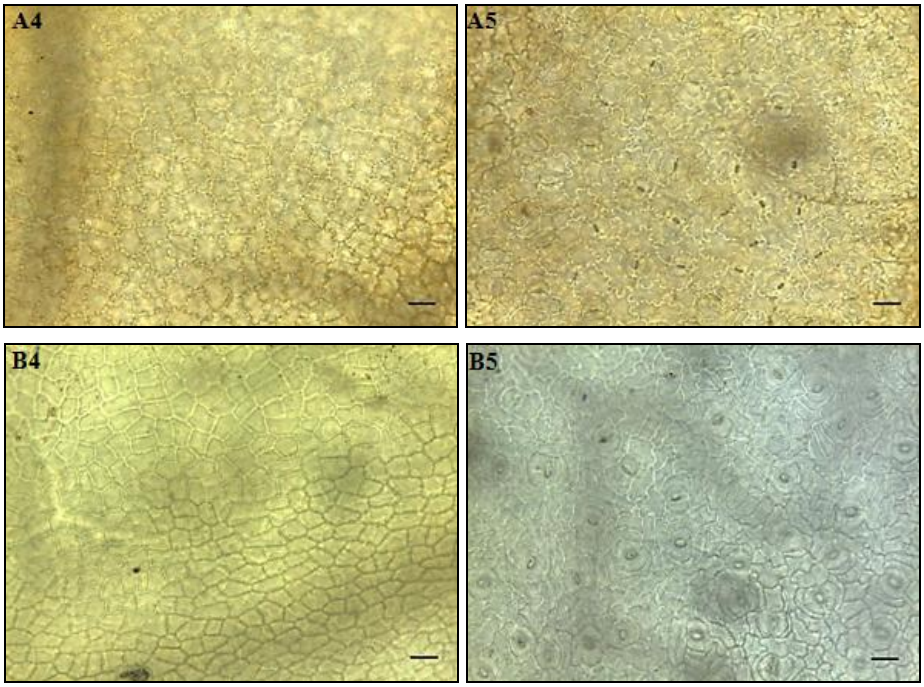

FIG. 2: EPIDERMAL CELLS AND STOMATA ON ADAXIAL (A4, B4) AND ABAXIAL (A5, B5) SURFACES OF *S. SENEGALENSIS* (A) AND *S. THOMPSONII* (B). A4 = Beaded walled epidermal cells, A5 = Anomocytic and anisocytic stomata with wavy walled epidermal cells, B4 = Straight walled epidermal cells, B5 = Paracytic stomata with slightly wavy walled epidermal cells. Scale bar represents 20 µm.

Quantitative microscopy provides data on constants that can be useful in the identification and standardisation of leafy drugs. Determinations of palisade ratio, epidermal number, stomatal number, stomatal index, vein islet number and vein-let termination number provide valuable leaf constants for the detection of possible adulterants [19]. Although the leaves of *S. senegalensis* and *S. thompsonii* resemble macro-morphologically, their surface data determinations **Table 1** show differences and are thus useful for differentiating between the two species.

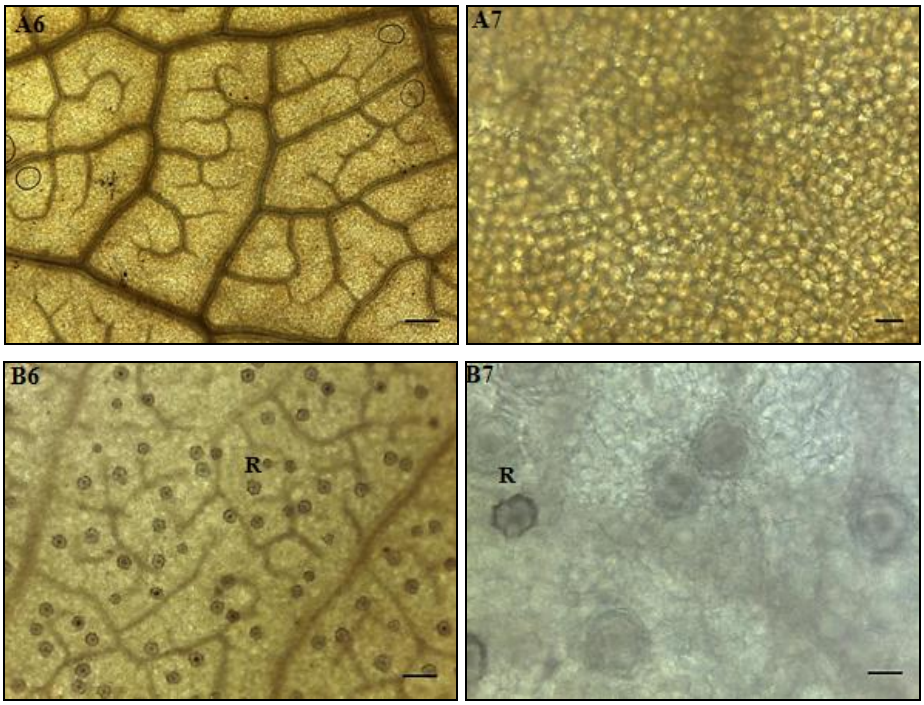

FIG. 3: VEIN ISLET AND VEINLET TERMINATION (A6, B6) AND PALISADE CELLS (A7, B7) OF *S. SENEGALENSIS* (A) AND *S. THOMPSONII* (B). B6/B7 in addition shows rosette calcium oxalate crystals (R). Scale bar represents 100 µm (A6, B6), 20 µm (A7) and 10 µm (B7).

TABLE 1 SURFACE DATA DETERMINATIONS OF THE FRESH MATURE LEAVES OF *S. SENEGALENSIS* AND *S. THOMPSONII*

Parameter	Ranges	
	S. senegalensis	***S. thompsonii***
Palisade ratio	2.8-(3.3)-3.8	1.3-(1.4)-1.5
Epidermal number/mm^2	2176-(2244)-2327	3267-(3396)-3465
Stomatal number/mm^2	693-(726)-792	446-(515)-594
Stomatal index	0.23-(0.24)-0.26	0.12-(0.13)-0.15
Vein islet number/mm^2	7-(12)-15	4-(5)-6
Veinlet termination number/mm^2	15-(24)-29	21-(22)-24

Transverse Section of Midrib: Histological and microscopic examination of the transverse sections of the midribs of both leaves revealed peculiar features characteristic for both plant species. *S. senegalensis* has a square shaped midrib base (dorsal surface) **Fig. 4**, **A8** whereas *S. thompsonii* has a cup shaped dorsal surface **Fig. 4**, **B8**. The upper epidermal cells are single layered in *S. senegalensis* **Fig. 4**, **A11** and double layered in *S. thompsonii* **Fig. 4**, **B10**. Palisade cells lying orthogonal to the upper epidermal layer conspicuously cover the entire ventral surface of the midrib of *S. thompsonii*. On the other hand, in *S. senegalensis*, a cluster of parenchymatous cells abound in the slight depression which occurs on the ventral surface of the midrib creating a bridge between the orthogonal lying palisade cells of its left and right sides. Vascular bundles of both species are lignified **Fig. 4**, **A9 / B9**.

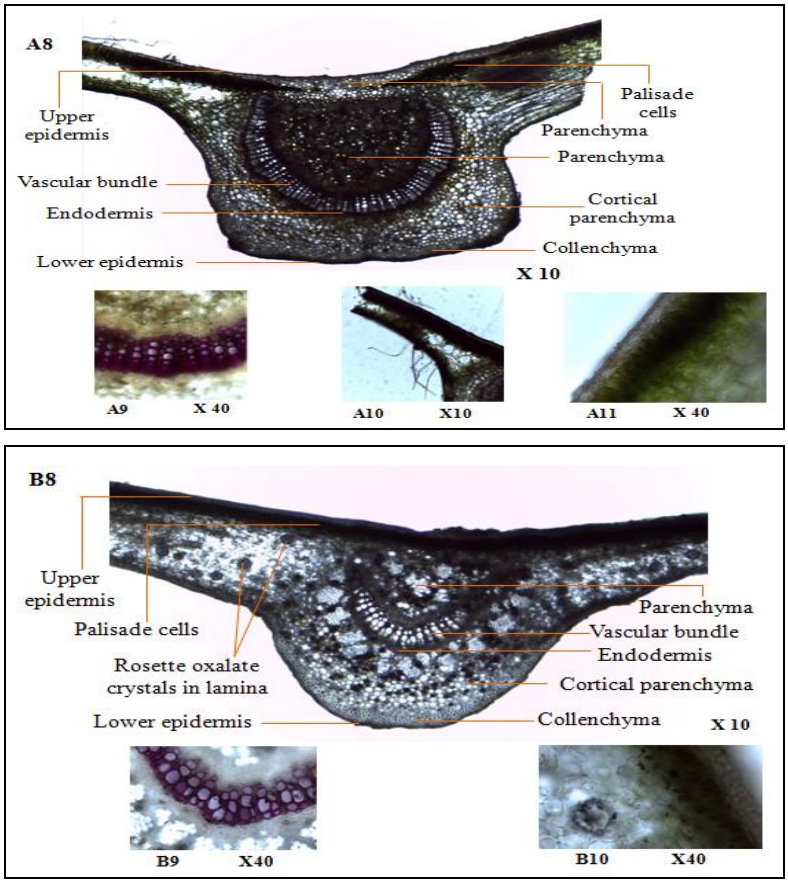

FIG. 4: TRANSVERSE SECTION OF THE MIDRIB OF THE LEAF OF *S. SENEGALENSIS* (A8) AND *S. THOMPSONII* (B8). A9/B9 = lignified vascular bundle, A10 = unicellular non-glandular trichomes of *S. senegalensis*, A11 = single-layered upper epidermis of *S. senegalensis*, B10 = rosette calcium oxalate crystal in lamina showing double-layered upper epidermis of *S. thompsonii*.

The length of the lignified vascular bundle and the arrangement of their xylem and phloem vessels are uniquely different for each plant. A longer set of vascular bundle is seen in *S. senegalensis* whereas a shorter one is observed in *S. thompsonii*.

The presence of unicellular non-glandular trichomes which arise from the abaxial surface of *S. senegalensis* **Fig. 4**, **A10** are notably absent in *S. thompsonii*. Visible rosette calcium oxalate crystals occur in the lamina of *S. thompsonii* **Fig. 4**, **B10**.

Powder Microscopy of Leaves, Stem and Roots: Plant medicines are often reduced to powdered form before usage. This destroys the macro-morphology of the plant therefore microscopic analysis to determine unique characteristics for easy identification of the powdered drug form is of necessity [10, 14]. Microscopy of powdered leaves, stem and roots of *S. senegalensis* and *S. thompsonii* revealed the presence of starch grains, calcium oxalate crystals (prismatic and rosette), lignified structures (pitted vessels, fibres, sclereids, cork cells) and unicellular non-glandular trichomes **Fig. 5 - 7**. The abundance of calcium oxalate crystals in all plant parts is a unique characteristic feature which can be used in the identification of the plant species. A characteristic feature useful for distinguishing between both leaves is the exclusive presence of prismatic calcium oxalate crystals in *S. senegalensis* **Fig. 5**, **A13** and the exclusive presence of rosette calcium oxalate crystals in the leaves of *S. thompsonii* **Fig. 5**, **B12**.

The relative abundance of prismatic calcium oxalate crystals as well as rosette calcium oxalate crystals **Fig. 6**, **A18 /A19** in the stem of *S. senegalensis* distinguishes it from the stem of *S. thompsonii* which contained only prismatic calcium oxalate crystals **Fig. 6**, **B16**. Both roots, however, contain only prismatic calcium oxalate crystals (**Fig. 7 A25, B22**). *S. senegalensis* and *S. thompsonii* belong to the tribe Willughbeieae (Apocynaceae) and climbers of this tribe are noted to be abundant in prismatic calcium oxalate crystals [20]. The abundance of these calcium oxalate crystal types in both plant species agrees with this feature. Lignified structures (pitted vessels, fibres, sclereids, cork cells) and or unicellular non-glandular trichomes were identified in the stem and roots of both species **Fig. 6** and **7**.

The observed sclereids in the stem and roots of both species vary. In *S. senegalensis*, sclereids of the stem are heavily thickened with a narrow lumen **Fig. 6**, **A14** whereas in *S. thompsonii*, mostly stratified sclereids are observed **Fig. 6**, **B13**. The roots of *S. thompsonii* in addition, contain thickened wall sclereids with pits in the lumen **Fig. 7**, **B17 / B18**. Sclereids are abundant in the stem and roots of both plants. They are known to give support to climbing species [21]. Unicellular non-glandular trichomes are unique to *S. senegalensis.* However trichomes cannot be used primarily for distinguishing between the species as they show a continuous variation. The plant therefore may or may not bear trichomes depending on the environmental conditions they grow in [22].

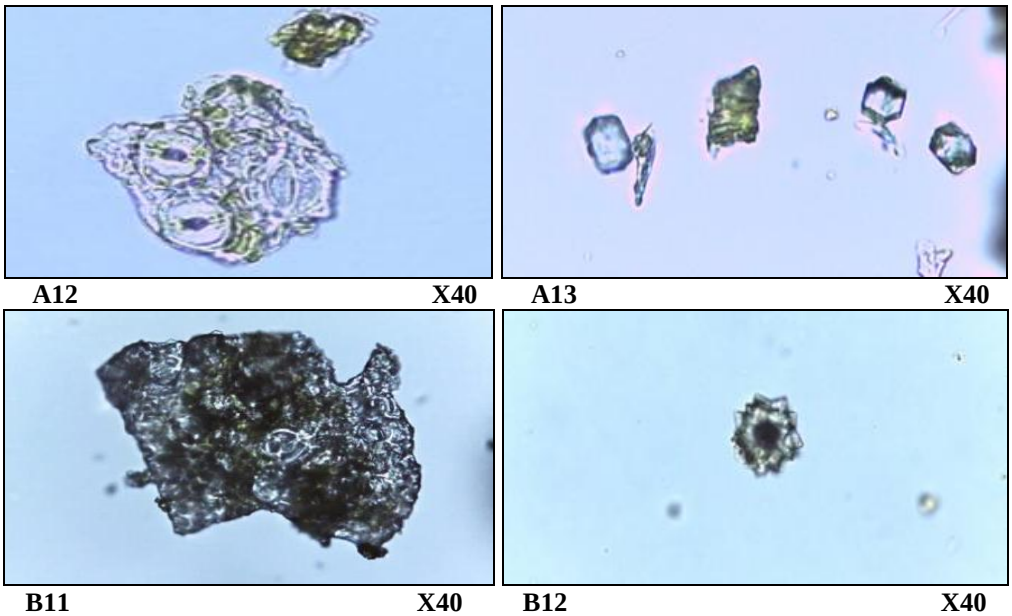

FIG. 5: MICROSCOPY OF POWDERED LEAVES OF *S. SENEGALENSIS* (A) AND *S. THOMPSONII* (B)

A12/B11= stomata and epidermal cells, A13 = prismatic calcium oxalate crystals, B12 = rosette calcium oxalate crystal.

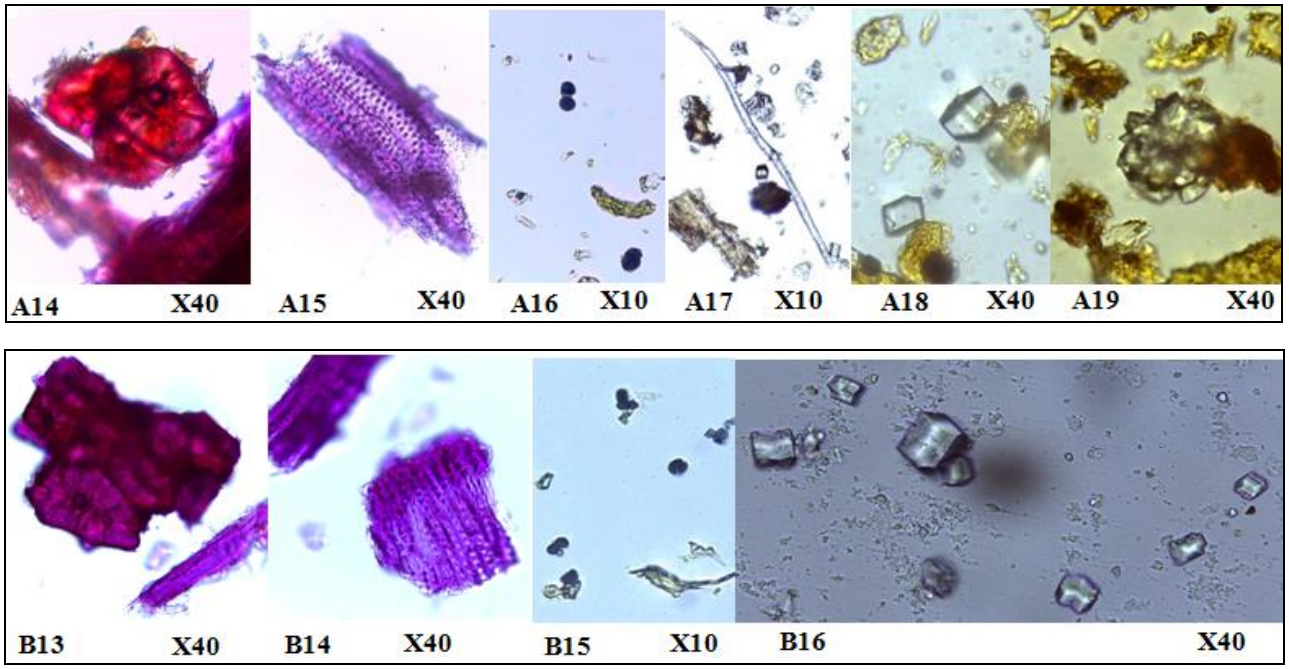

FIG. 6: MICROSCOPY OF POWDERED STEM OF *S. SENEGALENSIS* (A) AND *S. THOMPSONII* (B). A14/B13 = lignified sclereids and fibres, A15/B14 = lignified pitted vessels, A16/B15 = starch grains stained blue-black, A17 = unicellular non-glandular trichome and prismatic calcium oxalate crystals, A18/B16 = prismatic calcium oxalate crystals, A19 = rosette calcium oxalate crystal.

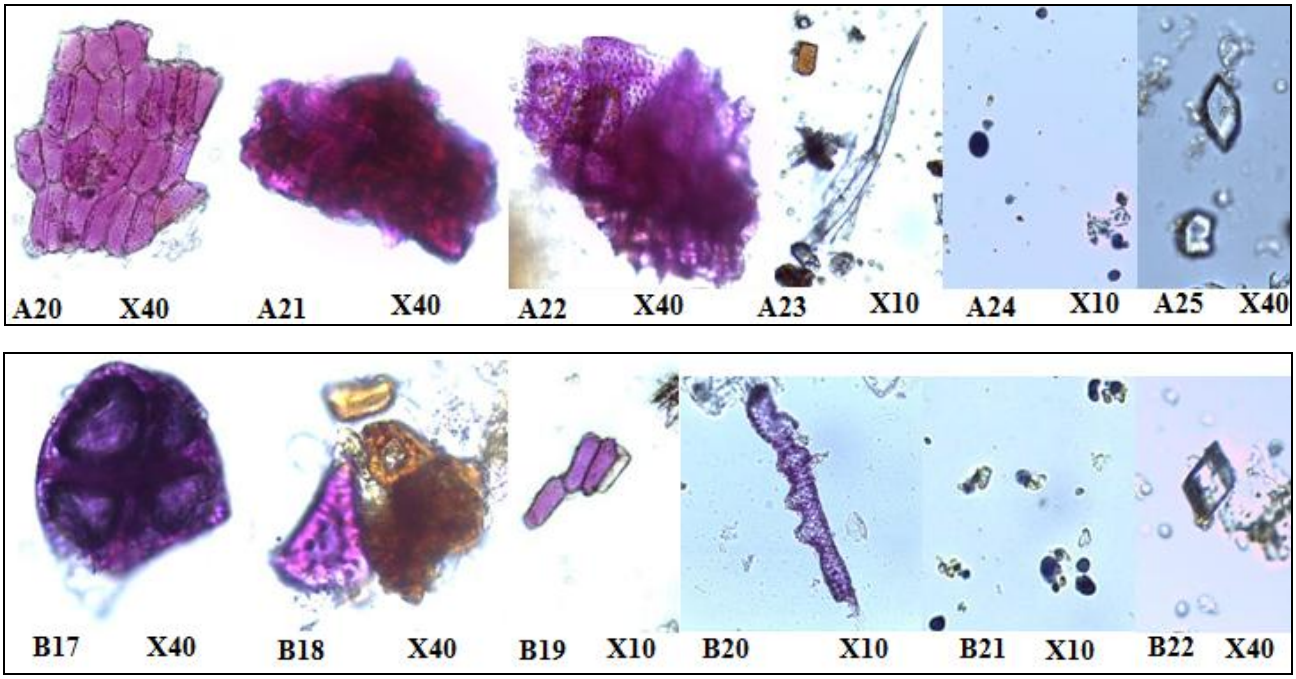

FIG. 7: MICROSCOPY OF POWDERED ROOTS OF *S. SENEGALENSIS* (A) AND *S. THOMPSONII* (B). A20 = lignified cork cells, A21/B17/B18 = lignified sclereids, B19 = lignified cork cells, A22/B20 = lignified pitted vessels, A23 = root hair, A24/B21 = starch grains stained blue-black, A25/B22 = prismatic calcium oxalate crystals.

Physicochemical Parameters:

Solvent Soluble Extractives: Solvent extractives suggest the best possible solvent for extraction of phytoconstituents as well as provide information on exhausted or otherwise adulterated plant materials [7]. It also gives an indication of the solubility nature of constituents present in the plant material [4]. In *S. senegalensis*, methanol, ethyl acetate and water may be the best solvent to extract the phytoconstituents of the leaves, stem and roots respectively **Fig. 8**. On the other hand, the best solvent for extracting the phytoconstituents of *S. thompsonii* may be water for both its leaves and stem and chloroform for its roots.

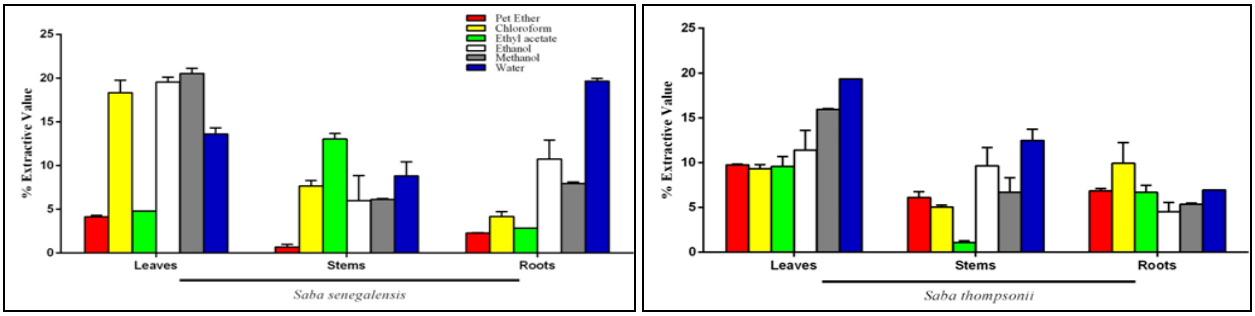

FIG. 8: SOLVENT SOLUBLE EXTRACTIVE VALUES OF LEAVES, STEM AND ROOTS OF *S. SENEGALENSIS* AND *S. THOMPSONII*

pH Analysis: pH analysis is useful in indicating preparations that may be possible irritants to the gastrointestinal tract (GIT) if high in acidity and hence, how best to make preparations meant for oral use [23]. Ethanol and water are solvents of choice for oral preparations of *S. senegalensis* and *S. thompsonii*. pH of the ethanol and water soluble extractives of the various plant parts were slightly acidic **Fig. 9**. In general, the pH of water extractives of both plant materials was observed to be less acidic than their ethanol extractives. Traditional aqueous or ethanol preparations may not cause GIT irritations when consumed.

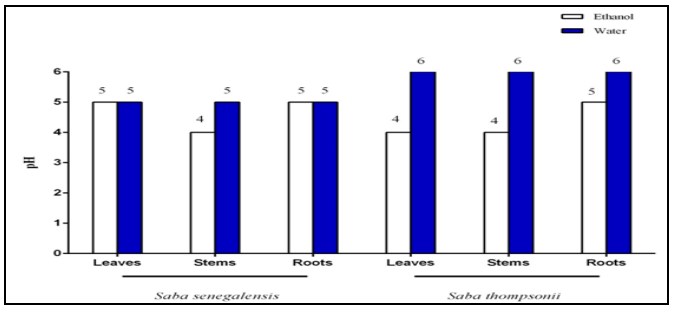

FIG. 9: pH VALUES OF ETHANOL AND WATER SOLUBLE EXTRACTIVES OF LEAVES, STEM AND ROOTS OF *SABA SENEGALENSIS* AND *SABA THOMPSONII*

Ash Values: Ash values provide useful indication of the purity of crude drugs. It gives information about possible contamination with inorganic materials such as silica and metallic salts [7, 19]. Water soluble ash is a good pointer to either previous extraction of the water soluble salts in the materials or indicative of incorrect preparation [19]. Total ash contents were observed to be highest in the leaves, stem and roots in decreasing order for both species **Table 2**.

This could be due to the varying contents of inorganic materials in the various plant parts. The total ash content alone however, cannot be used in isolation to determine the quality of *S. senegalensis* and *S. thompsonii* as both plant species contained a lot of calcium oxalate crystals. Increased acid-insoluble ash suggests adulteration due to dirt or soil. Acid-insoluble ash values for leaves, stem and roots of both plants were less than 2% and thus fall within the WHO acceptable range for crude drugs with no standard parameters [4].

TABLE 2: TABLE 2 ASH CONSTANTS OF LEAVES, STEM AND ROOTS OF *S. SENEGALENSIS* AND *S. THOMPSONII*

Physical parameter	*S. senegalensis*			*S. thompsonii*		
(% w/w)	Leaves	Stem	Roots	Leaves	Stem	Roots
Total Ash	11.08	4.42	3.86	10.47	5.64	4.29
Acid-insoluble Ash	0.56	1.01	1.89	0.64	0.78	0.65
Water-soluble Ash	3.70	0.30	0.21	3.47	1.79	0.08
Organic carbon	44.46	47.79	48.07	44.77	47.18	47.86

Mineral Analysis: The detection of high levels of some heavy metals in crude plant materials could be indicative of pesticide residues, human activities as well as industrialisation. Heavy metals are known to cause many health issues such as cancer, renal dysfunction, mental retardation and damage to the central nervous system when in excess amounts [24]. The amount of lead in the plant samples of both species were all within acceptable limits per WHO standards (≤ 10 ppm).

The zinc content of the plant materials were notably high but within the maximum permissible levels [25, 26]. Again some elements are reported to be implicated in the formation of active constituents in medicinal plants [27].

Some of these: potassium, phosphorous, calcium, magnesium and nitrogen were all in detectable amounts in varying concentrations in the different plant parts analysed **Table 3**. They may contribute to the observed therapeutic effects of the medicinal plants. These elements are also nutritional, promoting the general well-being of the consumer [28].

TABLE 3: MINERAL CONTENT OF LEAVES, STEM AND ROOTS OF *S. SENEGALENSIS* AND *S. THOMPSONII*

Metal	*S. senegalensis*			*S. thompsonii*		
	Leaves	Stem	Roots	Leaves	Stem	Roots
Potassium (% K)	0.23	0.09	0.05	0.01	0.08	0.02
Phosphorous (% P)	0.13	0.04	0.05	0.13	0.04	0.08
Calcium (% Ca)	1.60	1.15	1.12	2.30	1.38	1.18
Magnesium (% Mg)	0.34	0.13	0.12	0.29	0.17	0.16
Nitrogen (% N)	2.29	0.71	0.70	3.45	1.04	1.67
Iron (ppm Fe)	15.00	3.00	4.00	147.00	8.00	217.00
Zinc (ppm Zn)	292.00	503.00	141.00	105.00	69.00	41.00
Lead (ppm Pb)	6.00	1.00	5.00	3.00	1.00	4.00

Fluorescence Analysis: Table 4 and **5** presents a summary of characteristic fluorescent colours observed for the solvent soluble extractives (1% w⁄v) of the leaves, stem and roots of *S. senegalensis* **Table 4** and *S. thompsonii* **Table 5** under visible and UV lights (short (254 nm) and long (365 nm) wavelengths). These reproducible characteristics can be useful in determining possible adulterants in liquid preparations of the plant materials.

TABLE 4: FLUORESCENCE CHARACTERISTICS OF SOLVENT SOLUBLE EXTRACTIVES OF *S. SENEGALENSIS*

S. no.	Visible light			254 nm			365 nm		
	Leaves	Stem	Roots	Leaves	Stem	Root	Leaves	Stem	Roots
1	Yellowish green	Light yellow	Yellow	Brown	Light Yellow	Yellow	Red	Light yellow	Yellow
2	Brownish green	Pale yellow	Yellow	Brown	Light Green	Yellow	Red	Light yellow	Yellow
3	Dark Green	Light yellow	Yellow	Ashy brown	Yellow	Yellow	Red	Light pink	Light Pink
4	Dark Green	Light orange	Orange	Brown	Light Orange	Orange	Red	Blue	Ash
5	Dark Green	Light orange	Orange	Brown	Orange	Orange	Red	Bluish ash	Ash
6	Orange	Orange	Light Orange	Brown	Orange	Orange	Green	Light green	Light Green

Key: S=Solvent soluble extractives, 1= petroleum ether, 2=chloroform, 3=ethyl acetate, 4= ethanol, 5= methanol, 6= water

TABLE 5: FLUORESCENCE CHARACTERISTICS OF SOLVENT SOLUBLE EXTRACTIVES OF *S. THOMPSONII*

S. no.	Visible light			254 nm			365 nm		
	Leaves	Stem	Roots	Leaves	Stem	Root	Leaves	Stem	Roots
1	Yellowish Green	Light yellow	Light yellow	Brown	Light orange	Yellow	Red	Light yellow	Pink
2	Brownish Green	Light yellow	Pale yellow	Brown	Light orange	Light yellow	Red	Light yellow	Light Yellow
3	Olive Green	Pale yellow	Light yellow	Brown	Light yellow	Light orange	Red	Yellow	Light Pink
4	Green	Light yellow	Light yellow	Brown	Light yellow	Light pink	Red	Blue	Blue
5	Green	Light yellow	Light yellow	Brown	Light orange	Yellow	Red	Blue	Blue
6	Orange	Light yellow	Pale yellow	Yellow	Light yellow	Light green	Light green	Bluish green	Bluish green

Key: S = Solvent soluble extractives, 1 = petroleum ether, 2 = chloroform, 3 = ethyl acetate, 4 = ethanol, 5 = methanol, 6= water

Phytochemical Analysis: Preliminary phytochemical investigation of the powdered leaves, stem and roots of *S. senegalensis* and *S. thompsonii* revealed the presence of alkaloids, triterpenoids, tannins, saponin and anthracene glycosides **Table 6**. The family Apocynaceae is reported to be rich in alkaloids and glycosides [29, 30], it comes as no surprise therefore that all the plant parts studied in both species are rich in alkaloids and contained one or more of glycosides tested **Table 6**. The observed therapeutic effects presented by medicinal plants have been attributed to the secondary plant metabolites they contain [31, 32]. The presence of these metabolites in all the parts of *S. senegalensis* and *S. thompsonii* examined may contribute to their folkloric use as medicines.

Thin Layer Chromatography: Chemical profiling is useful for quality assessment of plant materials and in the detection of adulterants [4]. The TLC chromatogram developed for *S. senegalensis* and *S. thompsonii* showed phytoconstituents which were

common to all the parts studied further confirming their close relation **Fig. 10**. The chromatogram developed showed one prominent quenched spot A1 at 254 nm **Fig. 10A** and two prominent blue fluorescing spots B1 and B3 at 365 nm **Fig. 10B** which were common to all the plant parts. Another blue fluorescing spot B2 was located in the stem of both plants and in the root of *S. senegalensis*. Three conspicuous purple colored spots C2, C3 and C5 were also common to all plants parts Fig. 10C. Spots C1 (R_f 0.53) and C4 (R_f 0.90) were common to the stem and roots of both plants. The chromatogram can thus serve as a fingerprint useful for the identification and authentication of *S. senegalensis* and *S. thompsonii* from other plant species. However, it cannot be used in isolation to distinguish between the two species due to their close chemical profiles.

TABLE 6: PHYTOCHEMICAL CONSTITUENTS PRESENT IN LEAVES, STEM AND ROOTS OF *SABA SENEGALENSIS* AND *SABA THOMPSONII*

Test	*S. senegalensis*			*S. thompsonii*		
	Leaves	Stem	Roots	Leaves	Stem	Roots
Alkaloids	+	+	+	+	+	+
Triterpenoid	+	+	+	+	+	+
Condensed tannins	+	-	-	+	-	-
Hydrolysable tannins	-	-	-	-	-	-
Saponin glycosides	+	+	+	+	+	+
Anthracene glycosides	-	+	+	-	+	+

Key: + detected, - not detected

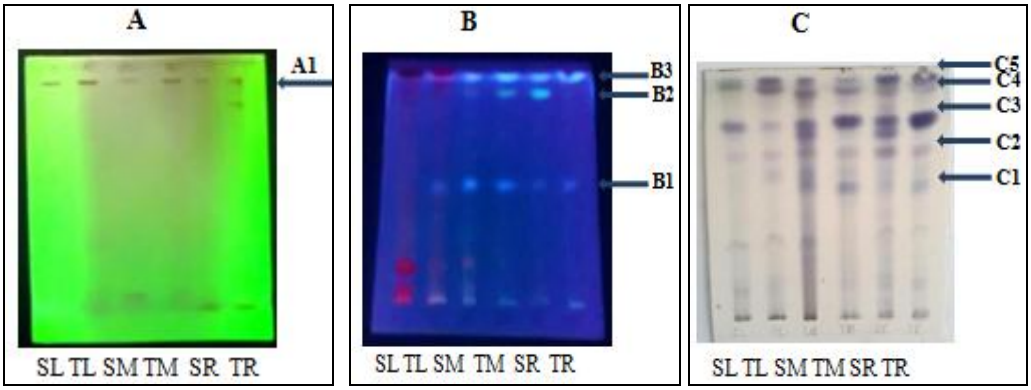

FIG. 10: TLC CHROMATOGRAM OF LEAVES, STEM AND ROOTS OF *SABA SENEGALENSIS* (S) AND *SABA THOMPSONII* (T) UNDER 254 nm (A), 365 nm (B) AND SPRAYED WITH VANILLIN/ H_2SO_4 (C)

Key: SL = leaves of *S. senegalensis*, TL = leaves of *S. thompsonii*, SM = stem of *S. senegalensis*, TM = stem of *S. thompsonii*, SR= roots of *S. senegalensis*, TR = roots of *S. thompsonii*

CONCLUSION: Pharmacognostic studies on the whole provides useful data for identifying and authenticating crude drugs for both consumer and manufacturing purposes. The present study, to the best of our knowledge, has provided the first report of detailed description of the pharmacognostic features of the leaves, stem and roots of *Saba senegalensis* and *Saba thompsonii*, clearly giving distinguishing characteristics of the two species. To the best of our knowledge, this is the first report of any such descriptions for the genus Saba.

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