

## Original Research

# COMPARATIVE SYSTEMATIC ANATOMICAL STUDIES ON STEM AND ROOT OF STACHYTARPHETA SPECIES PRESENT IN AWKA, SOUTH EASTERN NIGERIA

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## ABSTRACT

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Investigations on the anatomical features of three species of *Stachytarpheta* (*S. angustifolia*, *S. cayennensis* and *S. jamaicensis*) common in Awka, south East Nigeria was made with the aid of light microscope. Anatomical significant features were found in the stem and root. The vascular bundles were oval and concentric, with the xylem towards the center surrounded by the phloem. The thickness of xylem was higher in *S. angustifolia*, which is a delimiting factor for the species. There was also a significant difference in the thickness of xylem among species. There was no significant difference in the thickness of upper epidermis, collenchymas and phloem among species, this therefore supports their similarities.

Keyword: *Stachytarpheta*, *jamaicensis*, *cayennensis*, *angustifolia*, epidermal anatomy, stem, root.

## INTRODUCTION

Verbenaceae is predominantly a tropical family exhibiting a wide range of growth habit and inhabiting diverse habitats (Lillyamma and Shah, 1987). The family has about 98 genera and 3,000 species (Idu *et al.*, 2009). They are low shrubs, herbs or trees. Flowers are in spikes. The genus, *Stachytarpheta* Vahl, belongs to the family Verbenaceae and is represented in West Africa and Nigeria by three species namely: *Stachytarpheta cayennensis* (Rich.) Vahl, *S. angustifolia* (Mill.) Vahl and *S. jamaicensis* (L.) Vahl (Hutchinson and Daziell, 1963). They are economic plants and may be grown as ornamentals (Gill, 1988). Members of family Verbenaceae are popular in traditional medicine. Moreover, all the *Stachytarpheta* species have been used ethnomedically as anti-diabetic, arbotifacient,

emmenagogue, sedative, antihypertensive, anti-asthmatic and anti-fever (Schwontkowski, 1993).

*Stachytarpheta* is an erect and branched half-woody plant, with stem slightly angled. The leaves are elliptic to oblong-ovate and 2 to 10 cm long. The leaf tips are pointed with toothed margins. The leaf base is decurrent on the petiole. The spikes are terminal, rather slender, 10-30 cm long, 3-4 mm thick, green and continuous. The calyx is small, oblique and 4-toothed. The corolla is deep-blue or blue-purple, 1 cm long. The fruit is enclosed in the calyx and oppressed to and somewhat sunk in the rachis which

is smooth, oblong and about 4 mm long (Idu *et al.*, 2009).

In spite of the fact that vegetative and floral characters are markedly modified in relation to the habitat and pollination mechanisms, the preceding observations and the summaries of character variation indicated that the taxonomic application of the diversity of epidermal morphology in plants cannot be overemphasized. The decision to choose epidermal characters to carry out studies in plants was informed by earlier declaration that these characters represented genetic variations and have been used to solve taxonomic problems in certain plant groups by Taxonomists (Oladele, 1990; Adegbite, 1995; Nwokeocha, 1996; Ogunkunle and Oladele, 1997; Ogunkunle and Oladele, 2008; AbdulRahaman and Oladele, 2010a,b). Nowadays virtually every anatomical aspect of plants has been studied by Taxonomists and the quality of enormous information is accumulated. Particularly, valuable taxonomic evidence has been obtained from studying pollen, wood, leaf, epidermis, cuticle, trichomes and stomata. Some of these anatomical features are so diagnostic that they are now commonly used in routine identifications, rather than being confined to use in problems of phylogeny or classification or in the identification of fragments of plants. Leaf epidermis and the leaf cross-sectional anatomy provide extensive taxonomic data and the literature on this subject is now vast. Results indicated that epidermal characters do not exhibit a uniform pattern and hence have very little significance as a taxonomic character within the family Boraginaceae (Oladele, 1990; Adegbite, 1995; Nwokeocha, 1996). In view of the complex taxonomic status of *Stachytarpheta* species, this research is aimed at the following:

- To study the root and stem anatomical features of these plants so as to know their various attributes.
- To delimit the species by knowing and comparing their various root and stem anatomical characters in order to establish a relationship.

## MATERIALS AND METHODS

### Materials

All reagent used were of analytical grade and obtained from Sigma Adrich. Other items include Olympus microscope fitted with a Nikon digital camera, razor blade, and glass slides.

## Methods

### Collection and identification of plants sample

Samples of *S. cayennensis* and *S. jamaicensis* were collected from the premises of Nnamdi Azikiwe University Awka, Anambra State, Nigeria. *S. angustifolia* was collected from Adabebe village in Amawbia community, Awka South Local Government Area (LGA), Anambra State, Nigeria. Samples of *S. cayennensis*, *S. angustifolia* and *S. jamaicensis* were collected and authenticated by Prof. J.C. Okafor and vouchers specimen deposited at the Herbarium of the Department of Botany, Nnamdi Azikiwe University.

### Anatomical analysis

Anatomic studies were conducted following the methods of Kadiri *et al.* (2007), Kadiri and Ayodele (2010) and Ajayi *et al.* (2011) with some modification. The stem and root samples were freely sectioned using razor blade and the thin slices obtained were kept in water before transferring onto a glass slide where a few drops of 99% ethyl alcohol were added for tissue hardening and then 2 drops of Safranin solutions. Excess stain was washed off with water before adding a drop of glycerine. Slides were covered with cover slips and then ringed with nail lacquer to prevent dehydration. All preparations were observed with an Olympus microscope and photographed with a Nikon digitized camera. Microscopic measurements were performed only on the stem, while the root was examine qualitatively.

### Statistical analysis

ANOVA was used in analysis of microscopic measurement of the studied anatomic features of the stem.

## RESULTS AND DISCUSSION

The results of anatomical studies of the stem are depicted in Table 1 and Figures 1 & 2 (A, B & C), while the microscopic features of the root are depicted in Figure 2 (D, E & F). Although the study revealed *S. cayennensis* had the highest upper epidermis thickness of  $200.00 \pm 28.28 \mu\text{m}$ , *S. cayennensis* had the highest collenchyma thickness of  $104.00 \pm 8.49 \mu\text{m}$ , *S. jamaicensis* had the highest phloem thickness of  $28.88 \pm 9.016 \mu\text{m}$ , while *S. angustifolia* had the highest xylem thickness of  $92.50 \pm 17.678 \mu\text{m}$  (Table 1), analysis of variance ( $p > 0.05$ ) showed no significant difference in the

thickness of upper epidermis, collenchyma, phloem, and xylem among *Stachytarpheta* species.

In the taxonomic studies of a number of families, and from biosystematics point of view, the root and stem epidermis have proven very helpful and remains

some of the most significant taxonomic characters (Bhatia, 1984; Adedeji, 2004). Also, in the rigorous and critical anatomical study of fewer morphological characters in the context of molecular phylogenies it is fruitful to integrate the strength of morphological data with those of sequence data (Hayat *et al.*, 2009).

Table 1: Stem anatomical characters of *Stachytarpheta* species

Species	Thickness of Upper epidermis ( $\mu\text{m}$ )	Thickness of Collenchyma ( $\mu\text{m}$ )	Thickness of phloem ( $\mu\text{m}$ )	Thickness of xylem ( $\mu\text{m}$ )
<i>S. angustifolia</i>	180.00 $\pm$ 28.28 <sup>a</sup>	93.00 $\pm$ 4.24 <sup>a</sup>	15.25 $\pm$ 3.89 <sup>a</sup>	92.50 $\pm$ 17.68 <sup>b</sup>
<i>S. cayennensis</i>	200.00 $\pm$ 28.28 <sup>a</sup>	104.00 $\pm$ 8.49 <sup>a</sup>	23.00 $\pm$ 7.07 <sup>a</sup>	20.14 $\pm$ 7.26 <sup>a</sup>
<i>S. jamaicensis</i>	200.00 $\pm$ 7.07 <sup>a</sup>	99.75 $\pm$ 3.18 <sup>a</sup>	28.88 $\pm$ 9.02 <sup>a</sup>	15.10 $\pm$ 4.10 <sup>a</sup>
<i>p-value</i>	ns	ns	ns	**

ns= non-significant, \*\*=significant.

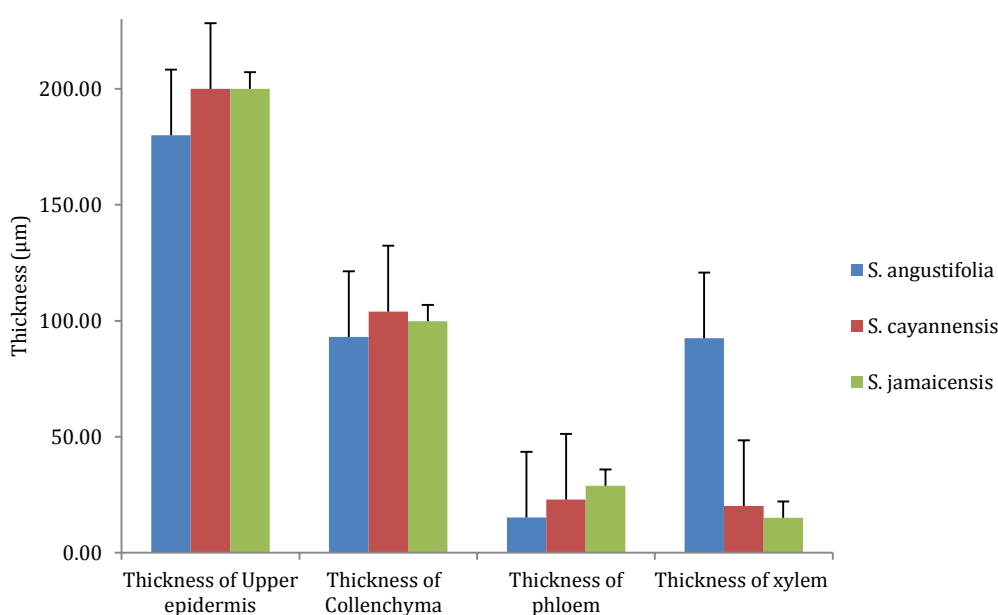


Figure 1: Mean Value of the Stem Epidermal Characteristics of *Stachytarpheta* species

On the stem anatomical study, transverse sections of the stem revealed that the structural arrangements in the three *Stachytarpheta* species are very similar, this was also the same for the root of the plants; an outer epidermal layer followed by 2-5 layers of collenchymatous cells. The vascular bundles were oval and concentric, with the xylem towards the center surrounded by the phloem. However, the evidence of secondary growth in the stem sections was in line with the woody morphological

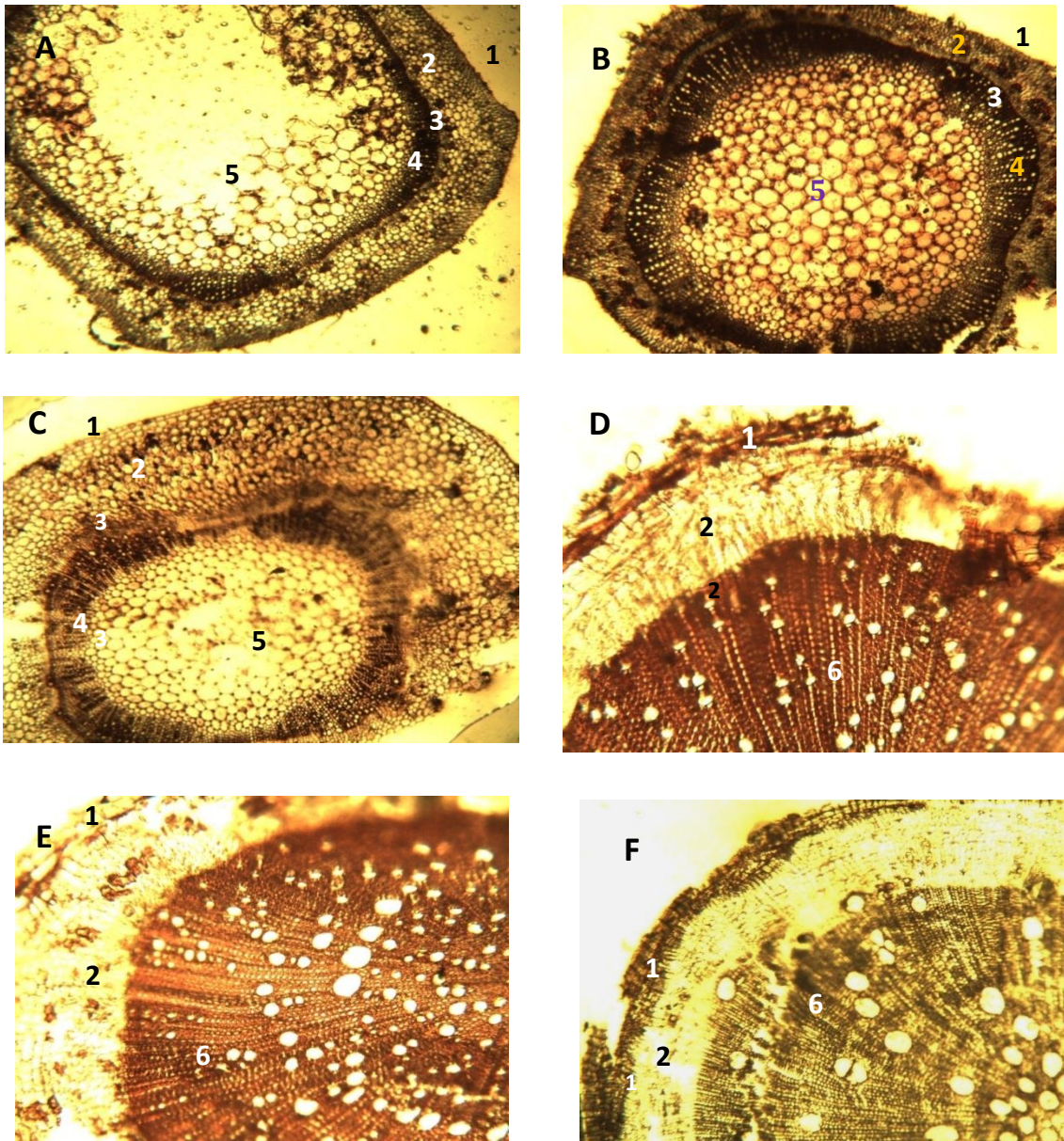
## CONCLUSION

Some of these anatomical features are so diagnostic that they are now commonly used in routine identification, rather than being confined to a use in problems of phylogeny or classification or in the

description earlier reported by Akobundu and Agyakwa (1998). The thickness of xylem was higher in *S. angustifolia* which is a delimiting factor for the species. There was also a significant difference in the thickness of xylem among the three species. There was no significant difference in the thickness of upper epidermis, collenchymas and phloem among the three species of *Stachytarpheta*, and this therefore supports their similarity.

identification of fragments of plants. Leaf epidermis and the leaf cross-sectional anatomy provide extensive taxonomic data and the literature on this subject is now vast. Results indicated that epidermal characters do not exhibit a uniform pattern and hence have very little significance as a taxonomic character.





1 = Epidermis, 2 = Cortex (collenchymatous cells present), 3 = Phloem (mostly surrounded by parenchymatous cells on the outside), 4 = Xylem, 5 = Pith (collenchymatous towards the center and parenchymatous cells present directly below xylem), 6 = Stele (made up of phloem, tracheids and tubes).

Figure 2: **A** is T/S of stem of *S. jamaicensis*  $\times 40$ ; **B** is T/S of stem of *S. cayennensis*  $\times 40$ ; **C** is T/S of stem of *S. angustifolia*  $\times 40$ ; **D** is T/S of root of *S. jamaicensis*  $\times 100$ ; **E** is T/S of root of *S. cayennensis*  $\times 100$ ; **F** is T/S of root of *S. angustifolia*  $\times 100$

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