



Taxonomic Study of *Chrysophyllum albidum* Found in Awka Anambra State, Nigeria

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ABSTRACT

Taxonomic study was carried out on the stem, leaf, root, flower, and fruit of *Chrysophyllum albidum* using standard techniques. Morphological result revealed that the plant is a tree with greyish brown to dark brown stem which is glabrous and circular in shape. The leaves are green, compound (imparipinnate in arrangement), pubescent texture, and elliptical in shape. The flowers are actinomorphic, free and arranged in clusters. The fruits are depressed globose, yellow to orange when mature and have about 5 seeds arranged in a star pattern in the fruit hence the name star apple. The quantitative characters revealed the leaf length as 24.7±4.01 cm, leaf width as 8.20±0.69 cm, petiole length 1.83±0.21 cm, and stem girth 1.44 ±0.67 m. Anatomical studies revealed the presence of cortical parenchyma containing prismatic crystals in the cross-sections of some of the organs studied. The parenchyma cells have a brick wall arrangement in the radial and transverse longitudinal section of the stem. The presence of sclerenchyma and well-defined vascular bundle in the transverse section of the stem was also revealed. The overall data collected could be used as a viable tool in the identification of African star apple and retain their characters now that many plant species are genetically modified and in the delimitation of the taxa in the species level.

Keywords: Taxonomy, Morphology, Anatomy, *Chrysophyllum albidum*

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INTRODUCTION

Chrysophyllum albidum commonly known as African star apple or white star apple is a forest fruit tree within the Sapotaceae family commonly found throughout tropical Africa. Primarily it is a forest tree species and naturally occurs in diverse Eco zones in Nigeria, Uganda, Niger Republic, Cameroon and Cote d'Ivoire (Bada, 2017). Sapotaceae family comprises

of 70 genera and 800 species, 23 genera and over 300 species are found in West Africa of which the genus *Chrysophyllum* can be found. Nigeria has 7 of the species including *albidum* (Gill, 2015). In Nigeria, it is called Agbalumo in Yoruba, Udara in Igbo, and Agwaliba or Agwaluma in Hausa. *C. albidum* is an evergreen tree which often grows to a height of 25 to 37m with a girth varying from 1.5 to 2m though it may be smaller. The bole is buttressed at the base,

extending into fluting, and can be up to 2 meters in diameter. Although the branches usually start from low down on the bole, occasional specimens have cleat boles for up to 20 meters (Burkil, 2015). The fruit of the plant species is a large berry (3-4cm) containing 3-5 flattened brown shiny seeds (1-1.5 x 2cm) arranged in a star shaped pattern in the yellow pulp with a hard seed coat (Keay, 2013). Recently the species has become a crop of commercial value in Nigeria. The fleshy pulp of the fruit is eaten especially as a snack and enjoyed by both young and old (CENRAD, 2017). The fruits are also suitable for the production of fruit jams and jellies (Ureigho and Ekeke, 2010). Each of the species produces milky latex. The bark, foliage, and fruit of *C. albidum* are used in traditional medicines. Ecologically, the tree has an efficient nutrient cycling and the high rate of mineralization of the leaves improves the quality of the top soil. Amusa et al. (2014). Members of this species are often characterized by the presence of reddish –brown hairs on the abaxial leaf surfaces. The species leaves are simple, alternate or they are rarely opposite usually entire and ciliate. They have regular flowers, usually bisexual and actinomorphic. Morphological characters can be grouped into vegetative and floral or reproductive characters this make up the greater part of the appearance of most species which enables us to recognize them. An anatomical character consists of the transverse, radial and micro morphological characters which are of taxonomic importance. *Chrysophyllum* species has close morphological resemblance and there is apparent conceptual similarity between plant anatomy and plant morphology as a tool in plant identification hence this study on the morphological, transverse and radial anatomical characteristics of *Chrysophyllum albidum* found in Awka to ascertain the classification and identification of the species and delimitation of the taxa.

MATERIALS AND METHODS

The leaves and stems of *Chrysophyllum albidum* were collected from the wild in a farm at Amansea, Anambra State. The samples were identified and authenticated by a plant Taxonomist Mr Chisom Iroka. The voucher specimen was assigned 29D as the number and then deposited at the herbarium of the Department of Botany, Nnamdi Azikiwe University, Awka.

Study Area

The morphological studies were done in the Botany laboratory of Nnamdi Azikiwe University, Awka; while the anatomical studies were carried out at the Anatomy laboratory of the Department of Plant Science and Biotechnology, University of Nigeria, Nsukka.

Morphological Studies

Morphological assessment was by physical observation and measurement of physiognomic features. Observations on vegetative characteristics were studied using samples collected from mature plant. For the leaves, the third and fourth fully opened leaves from the stem tip were used. Measurements were taken using a meter rule and tape rule. The meter rule was used to measure the leaf length, leaf base, and petiole length. The tape rule was used to measure the stem girth. The leaf shape, leaf texture, leaf margin, leaf arrangement, leaf type, leaf venation, and stem colour were studied by intense observation. Photographs of the prominent morphological features were taken.

Anatomical Studies

Materials used for carrying out anatomical studies

The following materials were used for the anatomical studies; petri-dishes, masking tape, camel brush, scalpel, forcep, slides, cover slip, digital camera and a compound binocular microscope (Olympus XN50V). The chemicals and reagents used include; safranin red, glycerin, 99% ethyl alcohol, absolute ethanol, formalin alcohol, acetic acid, distilled water

Procedure

Anatomical studies were carried out with the methods of Kadiri *et al.*, (2007), Kadiri and Ayodele (2010), and Ajayi *et al.*, (2011) with some modification. The stem and midrib samples were sectioned using a sliding Reichert microtome. The blade was well sharpened with the automatic microtome knife sharpener. The thin slices of plant parts obtained were kept in water before being transferred onto a glass slide after which few drops of 99% ethyl alcohol was added for tissue hardening and then 2 drops of safranin. Distilled water was used to wash off the excess stain and then a drop of glycerin was added afterwards. The slides were

covered with cover slips and ringed with nail varnish to prevent dehydration. The prepared sections were viewed under an Olympus light microscope at different magnifications. Photomicrographs of specimen were taken with a Nikon digitalized camera.

MORPHOLOGICAL RESULTS

Morphological features of *Chrysophyllum albidum*

Table 1: Floral Morphology of *C. albidum*

Characters Inflorescences	
Floral symmetry	Actinomorphic
Pedicle length (cm)	0.5-1
Type	Cymose
Free/ Fused	Free
Arrangement	Cluster
Sex	Bisexual
Flowering period	May- June
Calyx	
Colour	Greenish yellow
Number of sepal	6
Free/ Fused	Free
Corolla	
Number of petal	6
Colour	Light greenish
Free/ Fused	Free
Androecium	
Anther shape	Bilobed
Filament Number	10-12
Gynoecium	
Ovary position	Superior
Style	1
Stigma	Lobed
Fruit	
Shape	Ovoid –subglobose
Colour when unripe	Green
Colour when ripe	Yellow
Type	Berry
Seed arrangement	Star Shaped
Number of seed	3-5
Seed colour	Brown
Fruit colour	July- August

Table 2: Vegetative Morphology

STEM CHARACTERS	
Habit	Evergreen
Stem type	Dichotomously branching
Stem colour	Greyish to dark brown

Height (m)	32- 36
Tree shape	Dense
Bark	Rough
Girth (m)	1.8- 2.6
Type of root system	Tap root
LEAF	CHARACTERS
Leaf colour	Green
Leaf venation	Reticulate
Leaf Margin	Entire
Leaf Apex	Obtuse
Leaf base	Cuneate
Leaf shape	Elliptic
Texture	Leathery
Type	Simple
Arrangement	Alternate
Attachment	Petiolate
Petiole length (cm)	1.83± 0.21
Leaf Length (cm)	24.7± 4.01
Leaf width (cm)	8.20 ± 0.69
Stem girth (m)	1.44 ± 0.67



Plate 1: Leaf morphology



Plate 2: Stem of *C. albidum*

ANATOMICAL RESULTS

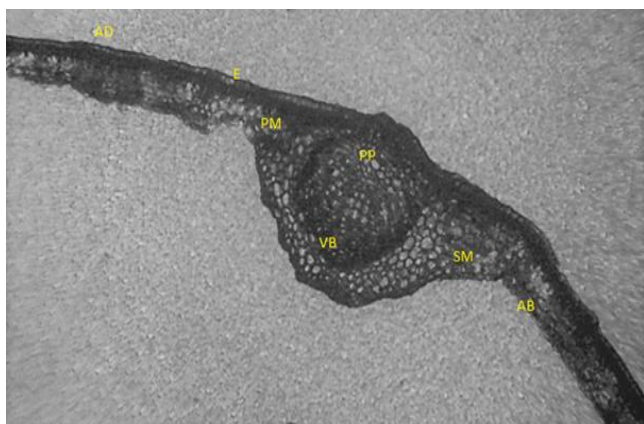


Plate 3: Transverse section of *C. albidum* Leaf

KEYS:

AB = Abaxial Surface AD = Adaxial Surface
 E = Epidermis PM = Palisade Mesophyll
 PP = Pith Parenchyma SM = Spongy Mesophyll
 VB = Vascular Bundle

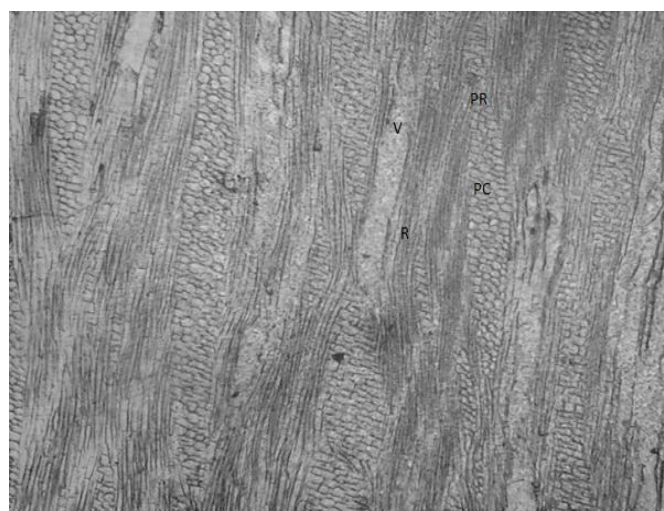


Plate 5: Transverse Longitudinal Section of *C. albidum*

KEYS:

PC = Parenchyma Cell
 PR = Prismatic crystal
 R = Ray
 V = Vessel



Plate 4: Radial Longitudinal Section of *C. albidum* stem



Plate 6: Transverse section of stem of *C. albidum*

KEYS:

C = Cortex
 E = Epidermis
 IC = Inter-Vascular Cambium
 P = Pith
 PC = Parenchyma Cell
 PH = Phloem
 S = Sclerenchyma
 X = Xylem



KEYS:

F = Fiber
 PC = Parenchyma Cell
 U = Uniseriate ray cell
 XV = Xylem Vessel

DISCUSSION

In plants, the older and most adopted methodology that has been used to produce classification system is the observation and description of internal and external plant characters. This has been used by many authors in the taxonomic studies of plant species. Morphological characters are easily observable and obtainable thus are used most frequently in taxonomic studies. They make up the greater part of the appearance of most species which allows us to recognize them virtually. Plant anatomy deals with formed structures which are the inner structures of plants that become visible only when the plant is dissected and this enables the structures to be observed comparatively. Plant anatomy provides characters such as trichomes, stomata, cuticular pattern, leaf venation, wood anatomy growth rings. The morphological and anatomical features of *C.albidum* revealed distinctive characteristics that can be used for taxonomic decisions in the identification of the plant. *C. albidum* is an evergreen and dichotomous branched tree with an average height of 25m and a low branched crown and sometimes a buttress bole. This supports the work of Bada, 2017, on the morphological characters of the plant. The result of the average stem girth observed in this study was 1.44m as opposed to the girth being between 1.5-2m according to Burkil, 2015; this may be as a result of environmental factors. The leaves are green, compound (imparipinnate in arrangement), pubescent, elliptical in shape. The leaf margin is entire with an acuminate leaf apex and a cuneate leaf base. This is in accordance with Besong et al. 2006 observation on the characters of the leaf length and petiole length. Leaves are one of the most diverse plant organs in terms of morphology and anatomy and such morphological and anatomical characters can vary drastically according to environmental conditions. This may attribute to some variations in the morphological and anatomical characters observed in this study as regards its environment. However studies has revealed that analysis of certain external and internal leaf structures could be of substantial information to aid species classification; Bibian et al. (2016) and Chinelo et al. (2013). The morphological character of the flower showed that the flowers are small, actinomorphic cluster at the axil leaves, bisexual and cyme; this is a good taxonomic attribute. The sepals are greenish – yellow also a good character for differentiating the plant species

from other species of *Chyrsopyllum* species and delimiting the taxa at species level. The fruits of African star apple are depressed globose with a yellow to orange colour when ripe; the inside is fleshy and red to orange in colour with laterally compressed shiny brown ellipsoid seeds arranged in a star shaped pattern within the fruit. The stem is circular, glabrous, and greyish brown to dark brown in colour, and the roots are adventitious, this conforms to Burkil, 2015. Anatomy has been of great help in learning the differences and similarities between various plant species which has helped in plant identification. In the radial anatomy, two plants may appear very similar on the surface but when sectioned they are different. The anatomical studies showed sections of the leaf and stem. There were prismatic crystals in their cortex, pith and vascular bundles (mostly xylem tissues). The mesophyll is characterized by palisade parenchyma and spongy parenchyma. The vascular bundles are embedded mainly in the spongy mesophyll extending to the adaxial epidermis. The radial longitudinal section of the stem revealed a brick wall arrangement of the parenchyma cells, the xylem fiber in its longitudinal line, uniserate ray and vessel, while there was presence of prismatic crystals in the parenchyma cells of the transverse longitudinal section of the stem. This also is in line with the study of Ekeke and Agogbua (2019). Presence of intervacular cambium in the vascular bundle of the stem signifies secondary growth and a wide pith for food storage which is located at the center of the stem, the cortex which is located to the outside of the vascular bundles. There were also sclerenchyma cells present on the epidermis of the stem.

CONCLUSION

Based on the findings of this study, morphology of *C. albidum* investigated conforms to the already morphological characters described by some authors. The differences that may be seen in the quantitative characters may be as a result of environmental factors. Morphological characters are easily observable and obtainable, hence frequently used in the taxonomic studies. Anatomical study has revealed that it can be used in addition to morphology in the identification, and delimitation of the taxa at species level.

COMPETING INTEREST

Authors have agreed no competing interest exist.

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