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RESEARCH ARTICLE

MORPHOLOGICAL, ANATOMICAL AND PHYTOCHEMICAL PROPERTIES ON *DATURA METEL* LINN

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ABSTRACT

This study investigated the morphological, anatomical and phytochemical properties on *Datura metel* Linn. a member of the family Solanaceae also found mostly in the Niger Delta, Nigeria. The habit is biennial to perennial sub wood growing up to120cm in height. They are used mainly as snake repellant and environmental embellishment. The leaves are large, deep green in color, simple, ovate to triangular-ovate and elliptic, with few dentate lobes, measuring upto 25 ± 7cm long and 14±4cm wide, suspended with a long petiole up to 5±2cm long with alternate phyllotaxy. The flower is trumpet-like and solitary actinomorphic hermaphrodite measuring up to 1.0 cm in diameter. The creamy-whitish gamopetalous corolla is up to 10 ±5cm in length and greenish gamosepalous tubular calyxup to 4±2cm in length. Stamens and carpels are equi-equals up to 9±3cm in length each. Fruit is greenish dehiscing 4-valved capsule covered with blunt warts up to 4 ±1cm in diameter. The brownish seeds are up to 0.4cm in size. The epidermal studies of both adaxial and abaxial foliar epidermis revealed anisocytic stomata with 22.56% stomatal index for the former and 15.79% for the latter. The trichomes are simple and uniseriate. The anatomy of mid-ribs and petioles showed bicollateral vascular systems. There are three vascular traces and the node is unilacunar. The petioles have 2 rib traces at primary growth phase. At secondary growth phase, the mid-rib and petiole revealed vascular arcs and the stem has a ring of open vascular system. Alkaloids, saponin, tannins, flavonoids, combined anthraquinones and free anthraquinones are present while phlobatannins and cardiac glycosides are absent.

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INTRODUCTION

Datura metel Linn. is abiennual to perennial sub woody ornamental plant sometimes found in the wild which belongs to the family Solanaceae (Watson and Dallwitz, 1992; Hutchinson and Dazliel, 1958). It is known to be poisonous. A variety of phytochemicals have been found in *Datura metel* (Okwu and Igara, 2009). Main constituents of the *Datura* plant are a large number of tropane alkaloids with anolides and several trigloyl esters of tropine and pseudotropine. It has been shown that different species of *Datura* have calystegines, the nortropane alkaloids with glycosidase inhibitory activity (Ghani, 2003). Huge number of atropine is found in the root compared to the other parts of the plant. The aerial sections generally have moderately higher numbers of scopolamine and relatively lesser numbers of atropine compared to the root of *Datura* (Afsharypuor *et al*., 1995). *Datura metel* Linn. is a 4-valved capsule (Hutchinson and Dalziel, 1958).

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The relevance of the study is to enhance information on the existing literature and taxonomic characteristics of *Datura metel* Linn. Thus, the objectives of the study are aimed at considering: the comparative morphological, anatomical and phytochemical investigations of *Datura metel* Linn.

MATERIALS AND METHODS

Study Area: Fresh green leaves of *Datura metel* Linn. were collected from a seed raised ornamental plant in Choba community, Obio-Akpo L.G.A Rivers State; and identified by a plant taxonomist in the Department of Plant Science and Biotechnology, University of Port Harcourt, Nigeria.

Epidermal Study

Fresh leaves and stem collected for this study were peeled and bleached using sodium hypochlorite for about 2 minutes following the method of Cutler (1978). The clear epidermal layers obtained were stained with Alcian blue or safranin and temporarily mounted in aqueous glycerol solution. Photomicrographs were taken from good preparations. Arnold

(1973) was adopted for ascertaining stomatal length and width. The stomatal index [S.I.] was done using the formula:

$$\frac{S}{E+S} x \frac{100}{1}$$

where *S* and *E* mean numbers of stomata and epidermal cells within the particular area under investigation.

Likewise trichomes (T.I.) $= \frac{T}{E+T} x \frac{100}{1}$

Anatomical Study

Seeds of the plant were plated in petri dishes containing wetted 110mm Whatman filter paper. After three days to two weeks, harvested stems and roots were fixed, alongside with mature leaves, flowers, fruits and petioles from mature plants in FAA in the ratio of 1:1:18 of 40% formaldehyde, acetic acid and 70% alcohol for at least 48 hours following the method of Johansen, (1978). Also the free hand sectioning using a systematic arrangement of 5 razor blades as described by Wahua *et al*. (2013) was also adopted. Microphotographs were taken from good preparations.

Phytochemical Study

Qualitative analyses of the leaves of species studied was sun dried for 72 hours (3 days) and weighed. Fifty grams (50g) of the leaves were macerated in 96% ethanol using a pestle and a mortar. The extract was thereafter filtered and evaporated to dryness using a rotary evaporator set at 45^0C to constant weight. Residue yields were noted and a portion was used for the phytochemical screening. Phytochemical screening for saponin, frothing tests was done following the method described by Wall *et al*. (1952) and as shown below: The ability of saponin to produce frothing in aqueous solution and to haemolyse red blood cells was used as screening test for these compounds. 0.5g of each plant extract was shaken with water in a test tube. Frothing which persisted on warming was taken as preliminary evidence for the presence of saponin. The disc was then washed in ether, dried and placed on a 7 percent blood nutrient agar. Complete haemolysis of red blood cells around the disc after 6 hours was taken as further evidence of presence of saponin.

Test for alkaloids: 0.5g of each extract was stirred with 5ml of 1 percent aqueous hydrochloric acid on a steam bath; 1ml of the filtrate was treated with a few drops of Mayer's reagent and a second 1ml portion was treated similarly with Dragendorff's reagent. Turbidity or precipitation with either of these reagents was taken as preliminary evidence for the presence of alkaloids in the extract being evaluated Harborne (1973),Trease and Evans (1989). A modified form of the tin-layer chromatography (TLC) method as described by Farnsworth *et al*. (1962) was used. 1g of the extract was treated with 40 percent calcium hydroxide solution until the extract was distinctly alkaline to litmus paper, and then extracted twice with 10ml portions of chloroform. The extracts were combined and concentrated in vacuo to 5ml. The chloroform extract was then spotted on thin-layer plates. Four different solvent systems were used to develop each plant extract. The presence of alkaloids in the developed chromatograms was detected by spraying the chromatograms with freshly prepared Dragendorff's spray reagent. A positive reaction on the chromatograms (indicated by an orange or darker coloured spot against a pale yellow background) was confirmatory evidence that the plant extract contained alkaloid.

Test for tannins: 5g of each portion of plant extract was stirred with 10ml of distilled water, filtered, and ferric chloride reagent added to the filtrate. A blue-black, green, or blue-green precipitate was taken as evidence for the presence of tannins (Shoppee, 1964).

Test for anthraquinones: Borntrager's test was used. 5g of each plant extract was shaken with 10ml benzene, filtered and 5ml of 10 per cent ammonia solution added to the filtrate. The mixture was shaken and the presence of a pink, red, or violet colour in the ammonia (lower) phase indicated the presence of free hydroxyl anthraquinones. Test For combined anthraquinones, 5g of each plant extract was boiled with 10ml aqueous sulphuric acid and filtered while hot. The filtrate was shaken with 5ml of benzene, the benzene layer separated and half its own volume of 10 per cent ammonia solution added. A pink, red or violet coloration in the ammonia phase (lower layer) indicated the presence of anthraquinone derivatives in the extract (Trease and Evans, 1989).

Test for phlobatannins: Deposition of a red precipitate when an aqueous extract of the plant part was boiled with 1 percent aqueous hydrochloric acid was taken as evidence for the presence of phlobatannins (Trease and Evans,1989).

Test for cardiac glycosides: Lieberman's test was used. 0.5g of the extract was dissolved in 2ml of acetic anhydride and cooled in ice. Sulphuric acid was carefully added in drops Untila colour change from violet to blue to green indicated the presence of a Steroidalaglycone portion of the cardiac glycoside (Shoppee, 1964).

RESULTS AND DISCUSSION

Morphological Characteristics

The geographic location of the parent plant studied was 040521342711N and $006^0 54^1 889^{11}$E at 21m altitude. The plant grows up to 120cm or more in height Plate 1. The leaves are large, deep green in colour, simple , ovate to triangular-ovate and elliptic, with few dentate lobes, measuring up to 25 ± 7cm long and 14±4cm wide, suspended with a long petiole up to 5±2cm in length. The flower is trumpet-like solitary and actinomorphic hermaphrodite up to 1.0 cm in diameter. Plate 2.The creamy-whitish gamopetalous corolla is up to 10 ±5cm in length and greenish gamosepalous tubular calyx up to 4±2cm long. Stamens and carpels are almost of the same size up to 9±3cm in length each. The fruit is greenish dehiscing 4-valved capsule up to 4±2cm in diameter. Plate 3. The brownish seeds measure up to 0.4cm in diameter Plates 4.

Observation on vegetative and floral features of *Datura metel* Linn. revealed the habit of the species as a biennial to perennial sub woody plant as also supported by Watson and Dallwitz (1992) and Hutchinson and Dalziel (1958). The structure of the stamens and carpels are almost equal in size, and their basi fixed nature, are of taxonomic relevance in delimitations at the generic and species level.

Plate 1: *Datura metel* Linn. Plate 2: Half flower. Plates 3: The fruit cut into half, Plate 4: The seeds of the plant

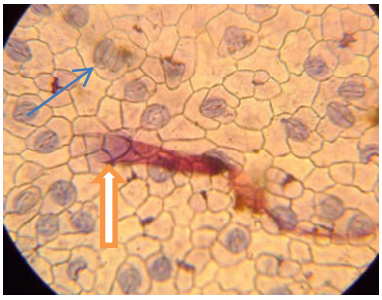

Plate 5: Adaxial epidermal layer showed contiguous cells in *Datura metel*

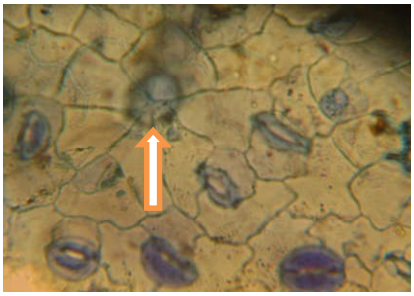

Plate 6: Abaxial epidermal layer Linn adaxial and stem epidermal layers,

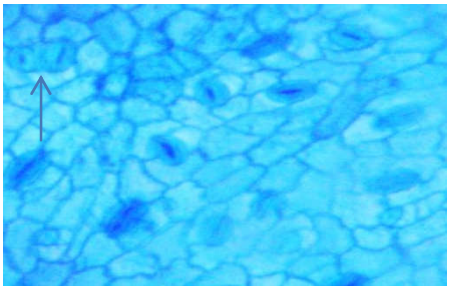

Plate 7: Stem epidermal layer Black arrow white arrow revealed the trichome base

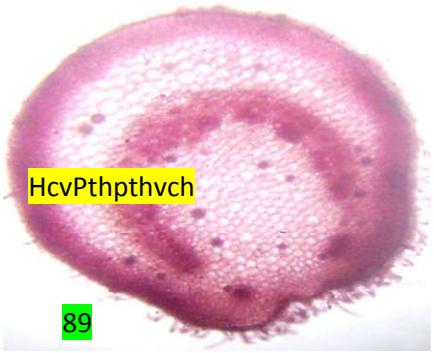

Plate 8. The petiole

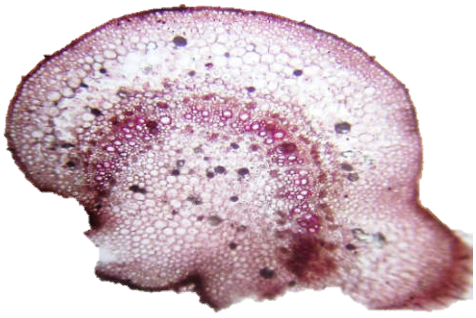

Plate 9. The mid-rib anatomy

Plate 10. The Stem anatomy of *Datura metel* Linn.

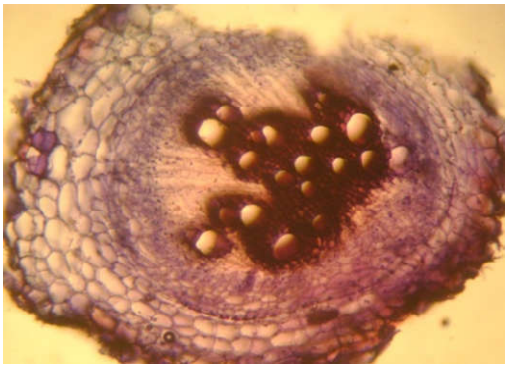

Plate 11. The root anatomy of *Datura metel* Linn

Epidermal Study: The foliar epidermal investigation showed the presence of anisocytic stomata for both upper and lower epidermis.Plates5 and 6.The study revealed an average number of 30 stomatal cells and those of epidermal cells as 103 with stomatal index of22.56% for adaxial layer and average abaxial stomatal cells of 15 with those of epidermal cells as 80 having 15.79% stomatal index. Whereas the trichomes are simple uniseriate forms which revealed average number of adaxial trichome cells of 10 and average of 350 epidermal cells with trichome index of 2.94% whereas the average number of abaxial trichomes is 15 and 250 for epidermal cells with trichome index of 5.66%. The stem epidermal layer also revealed anisocytic stomata and uniseriate trichomes. Plate 7.The stomatal characteristics showed adaxial stomatal length of 13.6±1.10 µm and width of 9.0±2.67µm; abaxial stomatal length of 11.7±0.95 and width of 8.7±0.95µm.

Anatomical Study

The mid-ribs and petioles anatomical sections showed bicollateral vascular system. There are 3 vascular traces andthe petioles are associated with 2 rib traces at primary growth while the secondary phase revealed vascular arcs.Plate8.The mid-rib showed a roll of epidermal cells. The collenchymatous cells occupy the region of the hypodermis; the general cortex is predominated by parenchymatous cells. 3 vascular traces with no rib bundle wings revealed in the primary growth phase. Plate 9. The endodermal layer is made of a layer of barrel-shaped cells. The pericycle is multilayered. The pith region is made of large parenchymatous cells which are replaced with a central hole with time. The stem has rings of open vascular system. Plate 10. The root anatomy has exarch xylary structure. The piliferous layer is single-cell thick. The vascular bundles are radially symmetrical. Centralized parenchymatous cells occupy the pith region of the root. Plate 12. The ovary anatomy revealed the placentation as axile type. Ovary is trilocular and 3-celled. Plate 13. Pth revealed the position of the pith. V represents the vascular system; C showed the general cortex and h represents the position of the hypodermis of *Datura metel* Linn.

Phytochemical Studies

Qualitative analysis carried out revealed the presence of the following phytochemical constituents: alkaloids, saponin, tannins, flavonoids and combined anthraquinones.

Conclusion

Datura metel Linn. is useful as snake repellant ornamental plant. Researches in morphological, anatomical, cytological, and phytochemical properties may not be altogether new; areas of interest need are DNA barcoding, Palynology, proximate analysis and quantitative aspect of phytochemistry.

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