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Chemotaxonomic studies on *Schwenckia americana* LINN.

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ABSTRACT: This study investigated the chemotaxonomic studies on *Schwenckia americana* Linn., a member of the family Solanaceae predominantly found mostly in low grass fields, Nigeria. The habit is annual herbaceous weed with slender stem characterized with free branching and growing up to 45cm in height.They are used mainly as medicine. The leaves are simple, entire, elliptic to ovate in shape, smooth, variable, petiolate and larger at the lower region of stem and narrowing to smaller almost sessile and oblanceolate towards the apical regions which are alternately arranged and acrescently structured from the top to the base upto 3.7 ± 1.5cm long and 2.4±0.6cm wide. The inflorescence is a panicle of 15 or more flowers occurring at stem terminal.The flowers are whitish tubular structures measuring up to 1.0±0.2cm in length and 0.1cm in diameter. The petals are whitish up to 0.9 ±0.2cm in length and sepals are greenish up to 0.1cm in length. The berry fruit is greenish when unripe and pale yellowish when ripe up to 0.3±0.1cm in diameter. The seeds are blackish and spherical or triangular shaped with rough edges measuring up to 0.1cm in diameter. The epidermal studies reveal anomocytic stomata whereas the trichomes are simple uniseriate forms wth bulge heads. 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. The cytological studies showed a diploid chromosome number of 2n = 24 and n = 12 for the haploids. Alkaloids, saponins, tannins, phlobatannins, flavonoids, combined anthraquinones, free anthraquinones and cardiac glycosides are present.

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***KEYWORDS*:** Morphological, Anatomical, Cytological, Phytochemical, Studies.

Introduction

Schwenckia americana Linn. is an annual weed which belongs the family Solanaceae, the egg-plant family comprising about 95 genera (Watson and Dallwitz, 1992; Hutchinson and Dazliel, 1958). A leafy decoction of *Schwenckia americana* Linn. is given to pregnant women when the foetus develops too slowly and is taken by breast-feeding women to prevent diarrhea of the baby. A root decoction of *Schwenckia americana* Linn. is given to babies as a purgative (Bosch, 2008). *Schwenckia americana* Linn. is a 2-valved capsule (Hutchinson and Dalziel, 1958). The basic chromosome number for members of Solanaceae is x = 12 and diploids of 2n = 24 (Okoli, 1983).

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

MATERIALS AND METHODS

*Collection of Plant Material***:** The materials used for this study were collected from the wild and raised from seeds.

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

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particular area under investigation. Likewise trichomes

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

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 Johanson (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.

*Cytological study***:** Healthy root-tips for mitotic study was obtained from seeds of *Schwenckia americana* Linn. grown in petri dish containing 110mm Whatman filter paper wetted with water for a period of three days to one week. Whereas for meiotc study, early formed buds were used in the same way as the mitotic, except that no statmokinetic agent was used. The early germinated roots were transferred to solution of 0.002M of 8-hydroxyquinoline for 3 hours specifically to suspend the spindle fibres or to accumulate chromosomes at metaphase between 8 and 10 a.m. The roots were treated with Carnoy's fluid (3:1 ethanol/acetic acid v/v) for 12 to 24 hours aimed at killing the cells, hydrolyzing in 9% HCl for 6 minutes and passing them through 70% ethanol for 10 minutes. 1mm length of root tip was excised from the apex and squashed in a drop of FLP Orcein stain under a coverslip and examined under a light microscope following the method of Okoli (1983). Microphotographs were taken from good preparation.

*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 saponins 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 saponins. 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 saponins.

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) and Trease et al. (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 hydroxyanthraquinones.

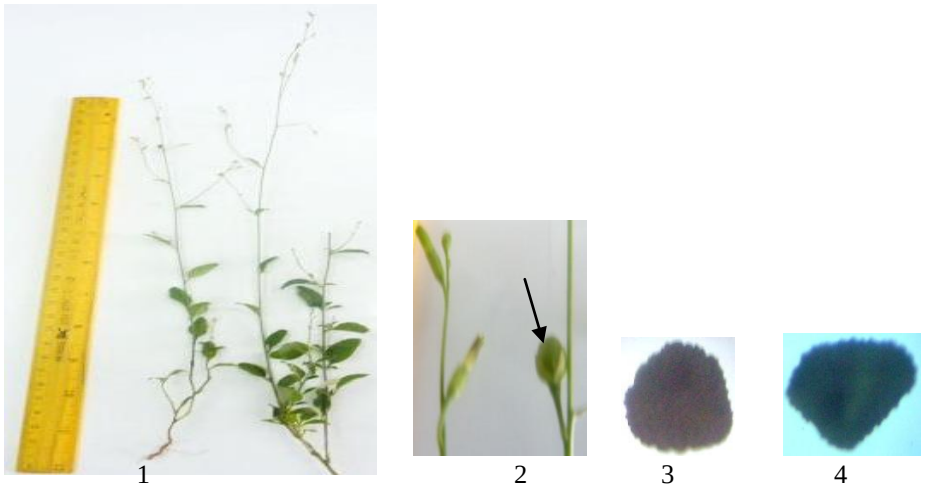
For combined anthraquinones, 5g of each plant extract was boiled with 10ml aqueous sulphuric acid and filtered while hot. The filtrate was shaken with 5ml of benzene, the benzene layer separated and half its own volume of 10 per cent ammonia solution added. A pink, red or violet coloration in the ammonia 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 until a colour change from violet to blue to green indicated the presence of a steroidal aglycone portion of the cardiac glycoside (Shoppee, 1964).

RESULTS AND DISCUSSION

***Morphological Characteristics*:** The geographic location of the parent plant studied was $04^{0}52^{1}3351^{11}$N and $006^{0}54^{1}864^{11}$E at 17m altitude. The plant attains barely up to 45cm or more in height. Plate 1. The leaves are petiolate, simple, entire, elliptic to ovate in shape, smooth, variable and larger at the lower region of stem while narrowing to smaller almost sessile and oblanceolate towards the apical regions which are acrescently structured from the top to the base up to 3.7 ± 1.5cm long and 2.4 ±0.6cm wide with alternate phyllotaxy. The inflorescence is a panicle of 15 or more flowers occurring at stem terminal. Plate 2. The flowers are whitish tubular structures measuring up 1.0±0.2cm in length and 0.1cm in diameter.The petals are whitish up to 0.9 ±0.2cm in length and sepals are greenish up to 0.1cm in length The berry fruit is greenish when unripe and pale yellowish when ripe up to 0.3±0.1cm in diameter. The seeds are blackish and spherical or triangular shaped with rough edges measuring up to 0.1cm in diameter. Plates 3 and 4.



1 2 3 4

Plate 1: *Schwenckia americana* Linn., Plate 2: Inflorescence is a panicle and arrow revealed the fruit. Plates 3: Spherical shaped seed of the plant, Plate 4: Triangular shaped seed of the plant.

Observation on vegetative and floral features of *Schwenckia americana* Linn. revealed the habit of the species as annual weed as supported by Watson and Dallwitz (1992) and Hutchinson and Dalziel (1958). The structure of the stamens and carpels, especially their basi fixed nature, are of taxonomic relevance in delimitations at the generic and species level. *Schwenckia americana* Linn. is a 2-valved capsule.

Epidermal Study: The foliar epidermal investigation showed the presence of anomocytic stomata for both upper and lower epidermis. Plate 5 and 6. The study revealed an average number of 3 stomatal cells and those of epidermal cells as 45 with stomatal index of 6.25% for adaxial layer and average abaxial stomatal cells of 15 with those of epidermal cells as 45 having 25% stomatal index. The stomatal characteristics showed adaxial stomatal length of 13.4±1.78µm and width of 8.9±1.45µm; abaxial stomatal length of 13.0±2.58 and width of 8.7±1,57. Whereas the trichomes are simple uniseriate forms which revealed average number of adaxial trichome cells of 30 and average of 300 epidermal cells with trichome index of 9.09% whereas the average number of abaxial trichomes is 30 and 320 for epidermal cells with trichome index of 8.57%. The stem epidermal layer also revealed anomocytic stomata and uniseriate trichomes. Plate 7.

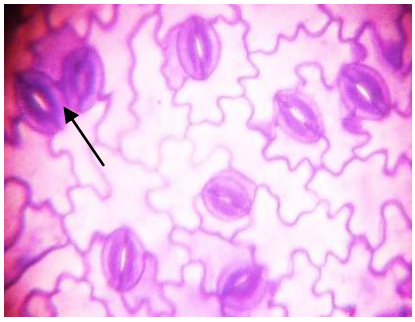


Plate 5: Abaxial epidermal layer

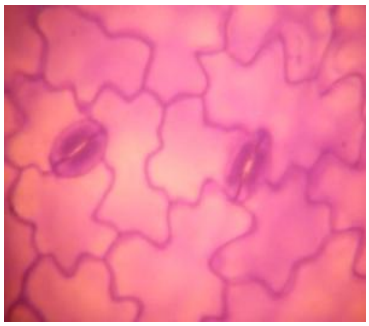


Plate 6: Adaxial epidermal layer

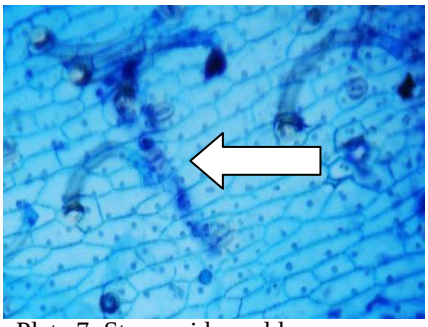


Plate 7: Stem epidermal layer

Arrow showed contiguous cells in *Schwenckia americana* Linn., white arrow revealed the trichome.

*Anatomical Study***:** The anatomy of mid-ribs and petioles showed bicollateral vascular system. There are 3 vascular traces and the petioles are associated with 2 rib traces at primary growth while the secondary phase revealed vascular arcs. Plate 8. 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 endodermoid layer is made of a layer of barrel-shaped cells. The pericycle is multilayered. The pith region is made of large parenchymatous cells which is replaced with a central hole at maturity. The stem has rings of open vascular system. Plate 10. The node is unilacunar. Plate 11. 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.

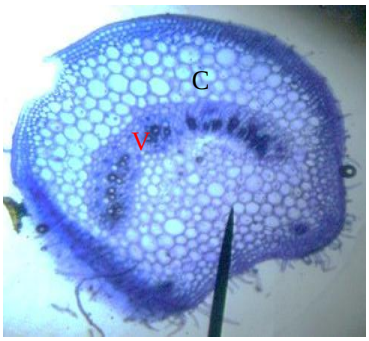


Plate 8: The petiole anatomy;
Arrow revealed the position of the pith.

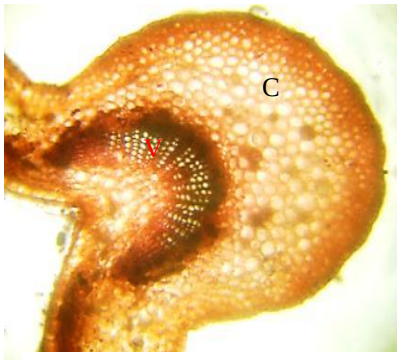


Plate 9. The mid anatomy V represents the Vascular system

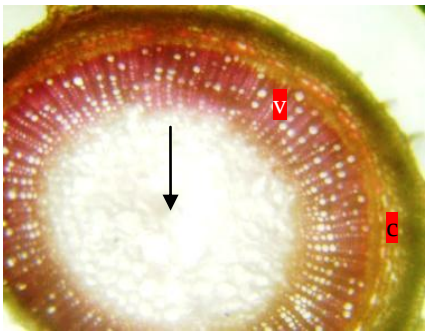


Plate 10. The stem anatomy, C showed the general cortex of *Schwenckia americana* Linn.

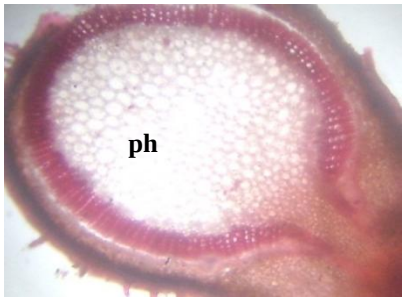


Plate 11:The nodal anatomy;

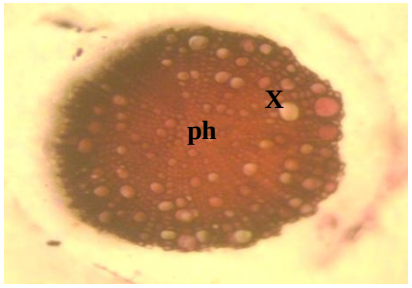
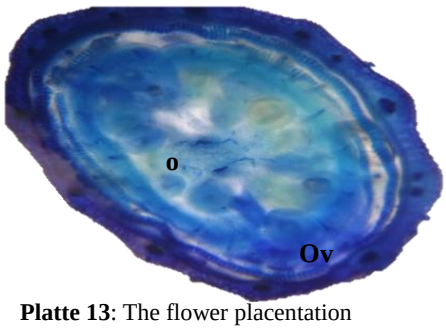


Plate 12 *:* The root section.



Platte 13: The flower placentation

X showed xylary rays, ph revealed the pith. O represents the ovule (which produces the seeds) and Ov represents the ovary which produces the fruits of *Schwenckia americana* Linn.

Schwenckia americana Linn. is a 2-valved capsule. The species is bisexual, hypogynous and placentation is axile

*Cytological Investigation***:** Cytological Study of *Schwenckia americana* Linn. showed the meiotic chromosome number as n=12 at metaphase. Plate 14.

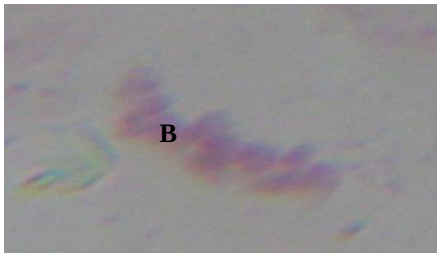


Plate 14: *S. americana* Linn. meiotic chromosome at metaphase. B represents bivalent(12 bivalents in all)

Cytologically, the basic chromosome number for members of Solanaceae is x = 12 as also supported by Okoli(1983) and diploids of 2n = 24.

Phytochemical Studies: Qualitative analysis carried out revealed the presence of the following phytochemical constituents: alkaloids, saponins, tannins, flavonoids, combined anthraquinones .and cardiac glycosides

*Conclusion***.:** *Schwenckia americana* Linn. is useful in tradomedicine. 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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