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Comparative Anatomy of *Abrus* Adanson Species in Parts of Tropical West Africa

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Abstract: Comparative anatomical studies of three *Abrus* Adanson species (*A. precatorius*, *A. pulchellus* and *A. canescens*) and a new collection identified as *Abrus* sp. were undertaken by simple microtomy. Parts of each species (seed, stem, root, leaf, pulvinus and petiole) were sectioned after fixation and wax embedding with a LEITZ 1512 rotary microtome at 20 to 24 μm thickness and observed with a LEITZ DIAPLAN photomicroscope. The seed coat in the species possesses five distinct layers, which varied in thickness. Similarities were observed in the arrangement, differentiation and distribution of cells and tissues in the investigated organs with characteristic pubescence in all organs of *A. canescens*. However, the number of layers of these cells and tissues (collenchyma, pericyclic parenchyma, sclerenchyma, pith parenchyma and the vascular cells) occasionally differed and could be harnessed for taxonomic purposes. The study aims at providing detailed comparative anatomical information for the genus, which is hitherto unavailable among the West African species. These will complement the morphological descriptions, which always overlap.

Key words: *Abrus*, anatomy, petiole, phloem, pulvinus, taxonomy, xylem

INTRODUCTION

Abrus Adanson is a member of the tribe Vicieae in the sub-family Papilionoideae of the Leguminosae. In West Africa Hutchinson and Dalziel (1958) and Burkill (1995) briefly described three species, which occur in Nigeria. These are *A. canescens* Welw. ex Bak., *A. pulchellus* Wall. ex Thw. and the widespread *A. precatorius* L. The species are climbing, twining or scrambling slender sub-woody liana with pinnate leaves, rachis ending in a bristle, stamens connate in a sheath with racemose flowers. Medicinal, pharmacological and toxicological properties and uses are ascribed to the species (Bouquet and Debray, 1974; Burkill, 1995). The vegetative parts (leaves and stems) of the species are very variable and plastic (Agbagwa and Okoli, 2005a, 2006), showing marked overlap in their characteristics, thereby making their usage in species identification difficult. This is exacerbated by the fact that floral characters used by Hutchinson and Dalziel (1958) to describe the two common species, *A. precatorius* and *A. pulchelus*, did not match with fresh collections made in Nigeria between 1998 and 2002. Hutchinson and Dalziel (1958) descriptions were probably based on herbarium specimens, which might not have been properly documented by the initial collectors. Also we were unable to make fresh collections of *A. canescens* in the course of this study after several field trips; thus only herbarium samples from Forestry Herbarium Ibadan (FHI) and University of Ibadan Herbarium (UIH) were used. The re-emergence of medicinal plants as healthcare alternatives (Hoareau and DaSilva, 1999) calls for greater interest into poorly utilized plant genetic resources as these. In the face of increasing threat to these resources (*Abrus* species exist in jungles, galleried forests and sacred groves, which are fast disappearing due to deforestation), any effort at better understanding and proper documentation of the individual species is worthwhile.

There have been recent taxonomic treatments of the genus *Abrus* dealing with micromorphology (Teixeira and Diniz, 2003; Agbagwa and Okoli, 2005a, 2006). Apart from Cutler (1978) who gave an anatomical overview of the stem of *A. precatorius*, no other known report on the anatomy of *Abrus* exists to the knowledge of the authors. The internal parts and structure of plants was suggested by Stace (1980) to be useful in the taxonomic delimitation of plants since they are less affected by environmental changes and therefore, highly conservative in taxonomic variations. The deposition of sclerenchyma, arrangement and formation of vascular bundles, differentiation of epidermal long and short hairs and other anatomical characters have been reported and utilized at different systematic levels for taxa elucidation or applied to resolve taxonomic conflicts (Metcalfe and Chalk, 1979; Stace, 1980; Kiew and Ibrahim, 1981; Fahn, 1990; Ndukwu and Okoli, 1992; Agbagwa and Ndukwu, 2004). Comparative

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and systematic studies on the anatomy of the leaf (including petiole and pulvinus), seed coat, stem and root of species of *Abrus* occurring in tropical West Africa is being presented for the first time. This study is aimed at providing a description of the anatomical features of the individual species on one hand and making anatomical comparison between the species for the purposes of taxonomic delimitation. The anatomical identity of a new collection, which is undergoing confirmation and simply referred to in this study as *Abrus* sp. is also presented. Systematic information on this medicinal genus is scanty with species facing extinction (*Abrus* species exist in jungles, galleried forests and sacred groves, which are fast disappearing due to deforestation), it is hoped that the overall results of the study will help in filling the gap in their taxonomy and stimulate interest in further studies leading to their conservation.

MATERIALS AND METHODS

The study was carried out in the Taxonomy and Biosystematics Research Lab, Department of Plant Science and Biotechnology, University of Port Harcourt.

Fresh materials collected during field trips and preserved materials from Forestry Herbarium Ibadan (FHI) and University of Ibadan Herbarium (UIH) were used (Table 1).

Fresh seed, stem, leaves, petiole and pulvinus of *A. precatorius*, *A. pulchellus* and *Abrus* sp. were fixed in Formal-Acetic-Alcohol (FAA) for 48 h, washed in several changes of distilled water, dehydrated through alcohol series (30, 50, 70, 95 and 100%), 2 h in each solution and embedded in wax. All samples of *A. canescens* used were herbarium materials. These were first soaked in water for upwards of 24 h to revive the samples before fixing in FAA for 48 h. Sections in each case were cut on a Leitz 1512 rotary microtome at thickness between 20 and 24 μm. The sections were dewaxed with pure xylene and rehydrated in alcohol series following Cutler (1978) with modifications. Staining was achieved by dipping the slides in 1% alcian blue for about 5 min, washed with distilled water and counter stained with 1% safranin for 2 min. The stained sections were dehydrated through alcohol series and mounted permanently in DPX (Dee Pex). Photomicrographs of the anatomical sections

Table 1: Sources of plant materials used for the study

Taxa	Collector and accession/ herbarium No.	Collection date	Locality	Remarks
Abrus precatorius	Agbagwa 001 UPH*	17/5/98	Emeabiam, Owerri West L. G. A., Imo State	
	Agbagwa 010 UPH*	2/8/99	Forestry Research Institute of Nigeria (FRIN), Ibadan	
	Agbagwa 005 UPH*	16/1/99	69 Independence Layout, Enugu.	In private compound
	Williamson, R. UIH 15402	14/12/73	Kaiama, Kolokuma Area Yenegoa Division	
	Magaji FHI 17962	15/9/67	Seven Miles on 6/7 range Runka Forest Reserve, Katsina. On savanna woodland	
	FHI 98709	17/9/77	Northern Province, Karonga District, Mali Vinthukhutu 2 miles North of Chilumba 1800ft	Republic of Mali
	Adam FHI 84029	21/1/48	M'Bao, Rufisque District, Senegal. Rep	Republic of Senegal
Abrus pulchellus	Agbagwa 003 UPH*	21/12/98	Emeabiam, Owerri-West L. G. A., Imo State	
	Agbagwa 007 UPH*	1/3/99	Botanical Garden University of Calabar, Nigeria	
	Agbagwa 012 UPH*	29/11/2000	High Secondary forest, opposite IITA office, Onne Station	Det. As fruiticulosus wall. Ex wight et Arn. and *A. pulchellus* wall respectively at Kew.
	Gbile, Olorunfemi, Binuyo FHI 20588	7/2/69	Ogbesse River Bank Ogbesse-Owo Rd; Owo Ondo. Det. As *A. pulchellus* Wall 6/3/69, *A. fruticulosus* Wall. Ex. W. and A. 1/11/61; *A. pulchellus* Thro. spp. 1/4/71.	
	Jones FHI 6359	11/10/43	Oyo	Seen for revised edition of FW TA
	Emwiogbon FHI 43539	14/11/61	Shasha F.R, Oyo, Ife District	
Abrus canescens	Latilo FHI 64726	3/12/71	North East, Bauchi about 10 miles east of Aliya village in Ngeji village	
	Eimunjeze and Oguntayo FHI 71358	8/10/74	Savanna-woodland, beside a stream, Omu-Aran, Kwara State.	
	Daramola and Adebisiyi FHI 38433	14/10/58	On the line 15, Savanna woodland area, Bunu District, Kabba	
	Latilo FHI 73554	10/11/75	Baissa-Mararraba Road, North Eastern State.	Savanna area
	Mullenders FHI 42593	1/4/47	Kaniama-Haut Lomani (Congo Belge)	Specimen from Ex Herbario HortiBotaniciYangambiensis. (Congo Belge)
	Amshoff FHI 31707	1972	Near Sindou, 5 11Wo, 10 49No, Upper Volta	Presently Burkina Faso Specimen from Plantae Upper Volta. exsiccatae Herbarium vadense
	Adams and Akpabla FHI 53186	18/12/50	Climbing on shrubs near swamps	Ghana Herbarium; Cited FWTA ed. 2, 1.574
	Morton FHI 14626	14/11/65	Kameron to Kuruboula, about 2 miles from Kameron	In damp savanna in Kameron.
Abrus sp.	Agbagwa 013 UPH*	1/12/2000	Taylor Greek area, Biseni, Bayelsa State	High tropical rainforest area.

UPH*: Fresh specimens deposited at the University of Port Harcourt Herbarium

were taken with a Leitz Diaplan photomicroscope fitted with Leica WILD MPS 52 camera at X10 microscopic objective lens. Microscope measurements of the sizes of cells and tissues in stem, leaf and seed were made at X10 microscope objective lens following Radford *et al.* (1974). Samples of the same age were used for the comparative studies in *A. precatorius* and *A. pulchellus*.

RESULTS

Observations and measurements made on the species are presented in Table 2-4 while Fig. 1-6 are photomicrographs of the various anatomical sections.

Stem: The same tissue types were observed in the species with slight differences in layers and arrangement (Fig. 1-5 and Table 2-4). The single-layered stem epidermis in *A. precatorius* is followed by angular collenchyma, sclerenchyma (brachysclereids), parenchyma (pericycle) and the vascular bundle. In *A. pulchellus*, the stem (Fig. 1b) epidermis is replaced by 3-5 layers of columnar shaped periderm or cork cells. The single-layered stem epidermis observed in *A. canescens* is piliferous and preceded by 2-3 layers of angular collenchyma. In the new collection *Abrus* sp. (Fig. 1c), the stem possesses a thick layer of outer cuticle followed by a single layer of flat epidermal cells. Stele in all species is siphonostele.

Table 2: Summary of Stem Anatomical features in *Abrus* species

Taxa	Epidermis	Cortex	Vascular bundle	Pith
A. precatorius	Single layer of flat cells 5.30 μm thick; cuticle present	2-3 layers of angular collenchyma. 3-4 layers of sclerenchyma (brachysclereids).	Phloem with inflated rays; broad intrusion of phloem into xylem. Tracheids 29-37 in a row; vessels solitary 1-10 in a row	Sclerified; 12-18 cells thick
A. pulchellus	Epidermis replaced by 3-5 layers of periderm	3-4 layers of angular collenchyma. 3-4 layers of scherenchyma (brachyschreids)	Vascular bundle similar to *A. precatorius*. Tracheids 30-32 cells in a row vessels 1-15 cells in a row.	Sclerified; 7-11 cells thick
A. canescens	Piliferous single-layered epidermis (5.30 μm thick). Thick cuticle.	2-3 layers of angular collenchyma. 3-4 layers of sclerenchyma (brachyschereids)	Vascular bundles as in *A. precatorius*	Pith degenerates leaving a central hollow
Abrus sp.	Sing layered, flat, isodiametric and rectangulr, with thick cuticle.	4-5 layers of collenchyma 3 layers of loose parenchyma. 2-4 layers of sclerenchyma (brachy-schereids).	Phloem fibres in clusters of 1-4 cells. Vessels 3-10 cells in a row. Tracheids 31-36 cells in a row.	Pith degenerates leaving a central hollow.

Table 3: Summary of anatomical features of the leaf, pulvinus and petiole of *Abrus* species

	Taxa			
Characters	*A. precatorius*	*A. pulchellus*	*A. canescens*	*Abrus* sp.
Leaf anatomical symmetry	Dorsiventral	Dorsiventral	Dorsiventral	Dorsiventral
Leaf vascular bundle (VB)	At the centre of the midrib; almost concentric with xylem internal.	At the centre of midrib. VB almost forming an arc.	At the centre of midrib; phloem almost forming an arc	Central VB forms an arc with phloem around xylem
Nature of leaf abaxial and adaxial epidermis	Uniseriate and flat	Uniseriate, irregular to oval with straight anticlinal wall	Uniseriate and piliferous	Uniseriate, irregular to rectangular shaped
Size of leaf upper Length	43.20±9.11	40.10±18.47	34.10±11.20	60.10±20.98
epidermis (μm) Width	48.50±18.70	39.10±19.96	37.47±9.41	87.20±33.67
Size of leaf lower Length	37.90±10.19	36.00±13.44	31.30±14.10	58.10±18.78
epidermis (μm) Width	47.60±7.55	36.00±13.44	33.20±7.47	85.10±33.64
Palisade mesophyll length range (μm)	53.00-84.00	42.00-84.00	32.00-64.00	53.00-126.00
Palisade mesophyll mean length (μm)	66.50±11.06	65.30±11.98	48.90±14.29	94.80±24.20
Nature of spongy mesophyll	Oval, 2-3 layers of parenchyma	Oval to round; 2-3 layers of loosely arranged parenchyma	Oval to round; 2-3 layers of parenchyma	Oval to round; 2-4 layers of parenchyma
Nature of vascular bundles in the pulvinus	VB at the centre with phloem surrounding the xylem. Central pith	5-10 layers of sclerefied phloem cells. Xylem with prominent vessels and tracheids. VB at the centre.	About 95% of the internal section is covered by well developed and prominent phloem fibres xylem vessels and tracheids.	VB confined to the centre with prominent xylem and phloem. parenchymatous pith.
Nature of vascular bundles in the petiole	Phloem forms an arc around the xylem given off two rib bundles	Phloem forms an arc around the xylem. xylem with prominent vessels and tracheids.	Phloem almost forms an arc around xylem. Xylem enclosing a parenchymatous pith	VB takes up more than 95% of the tissue, forms a circle. Xylem and phloem almost merging together and given

Table 4: Summary of mean thickness of the seed coat (mm) of *Abrus* species studied

Taxa	Cuticle thickness range	Mean cuticle thickness	Palisade layer thickness range	Palisade layer mean thickness	Subepidermal layer thickness	Subepidermal mean thickness range	Chlorenchyma parenchyma layer	Aleurone endosperm layer	No. of layers
A. precatorius	5.29-5.30	5.30	189.00-210.00	197.60±8.34	53.00-84.00	72.70±12.41	Present	Present	5
A pulchellus	3.19-3.20	3.20	53.00-74.00	67.50±7.47	16.00-21.00	20.00±2.11	Present	Present	5
A. canescens							Present	Present	5
Abrus sp.	1.09-1.10	1.10	84.00-126.00	102.00±11.02	21.00-42.00	25.20±8.85	Present	Present	5

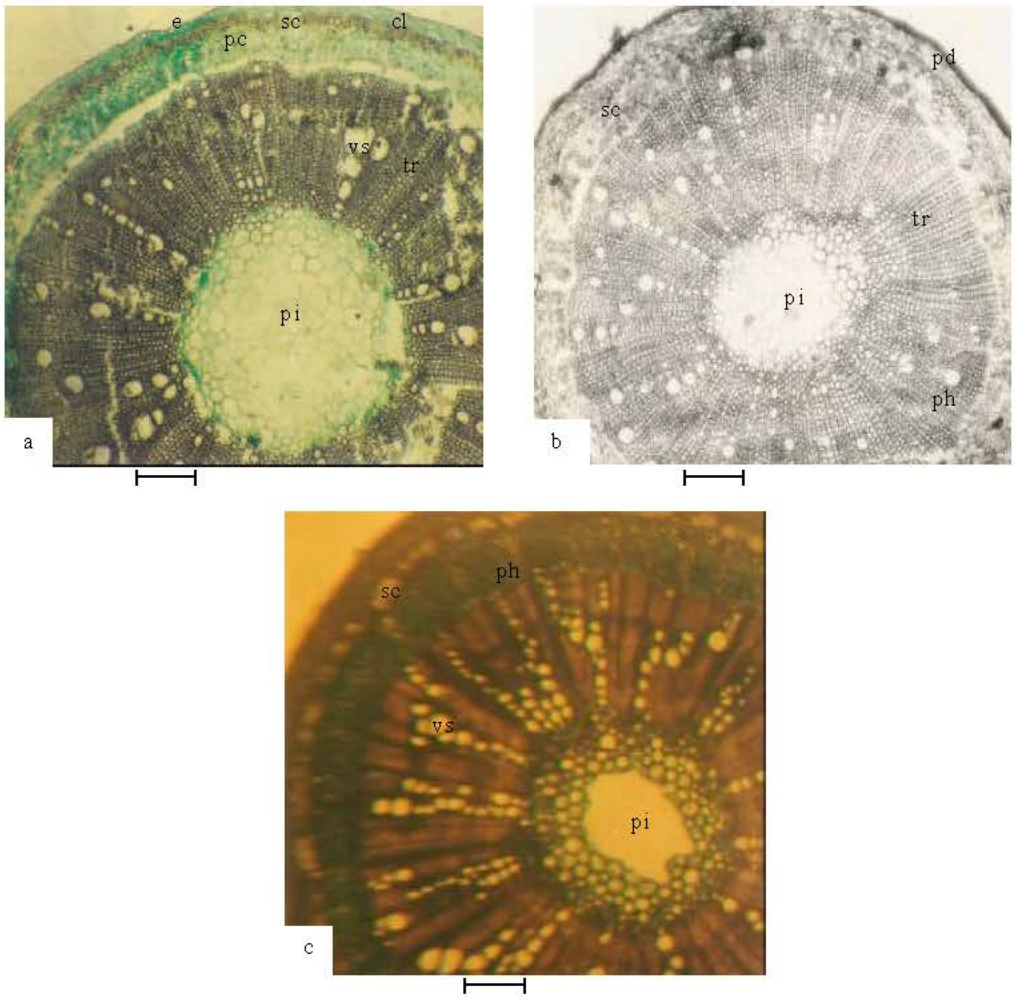

Fig. 1: Showing stem anatomy of *Abrus* species (1a-*A. precatorius*; 1b-*A. pulchellus*; 1c-*Abrus* sp.). e-epidermis, cl-collenchyma, sc-sclerenchyma, pc-pericyclic parenchyma, pi-pith, tr-tracheids, vs-vessels, pd-periderm, ph-phloem (Bar: 100 μm)

Root: Differences were observed in the number of layers of tissues. In *A. precatorius*, the root anatomy (Fig. 2a) begins with a thick layer of cork followed by 3 cell layers of irregularly shaped and thick walled periderm cells, 3-4 layers of cortical cells and 1-2 layers, thick walled endodermal cells with rays. Several layers of sclerified phloem fibres are buried in the tissues with some obliterating the endodermis. Xylem occurs towards the centre. The pith is characterized by sclerified parenchyma and some metaxylem cells. In *A. pulchellus,* the root anatomy (Fig. 2b) consists of an outer layer of cork cells followed by 5 cell layers of compactly arranged, isodiametrical and rectangular periderm cells, 3 layers of cortical cells, 1-2 layers of thick walled endodermal cells with rays. Phloem fibres occur in clusters around the phloem area; 2-22 cell clusters of phloem fibres

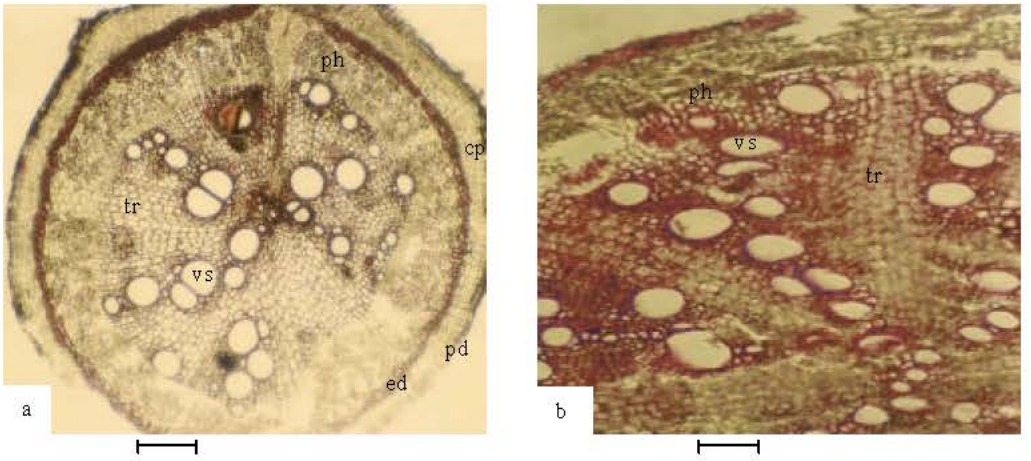

Fig. 2: Showing root anatomy of *Abrus* species (2a-*A. precatorius*; 2b-*A. pulchellus*). cp-cortical parenchyma, ed-endodermis (Bar: 100 μm)

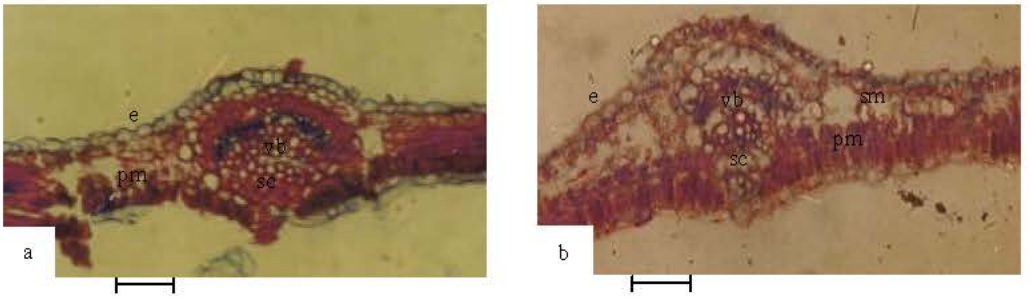

Fig. 3: Showing cross-section of leaf of *Abrus* species (3a-*A. canescens*; 3b-*A. pulchellus*). e-epidermis, pm-palisade mesophyll, sm-spongy mesophyll, sc-sclerenchyma, vb-vascular bundle (Bar: 65 μm)

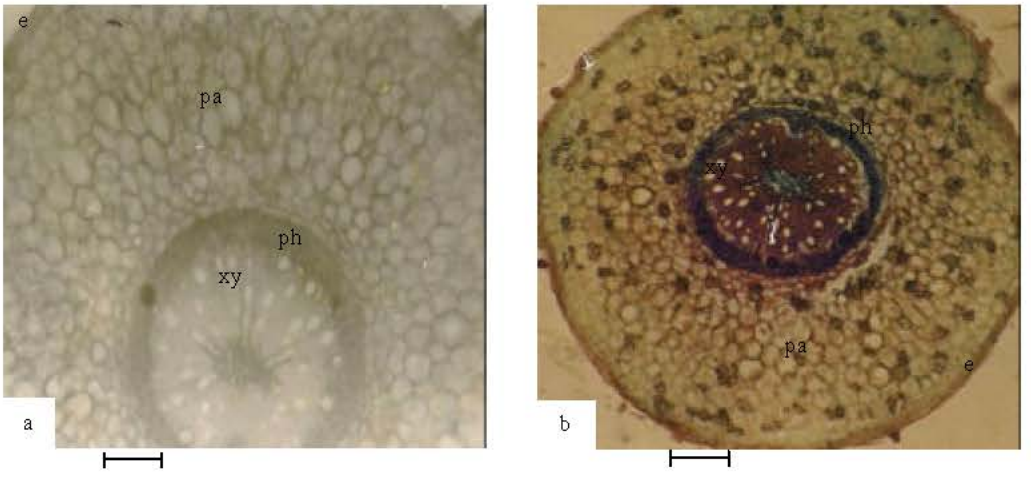

Fig. 4: Showing cross-section of pulvinus of *Abrus* species (4a-*A. pulchellus*, 4b-*A. precatorius*). e-epidermis, pa-parenchyma, ph-phloem, xylem (Bar: 100 μm)

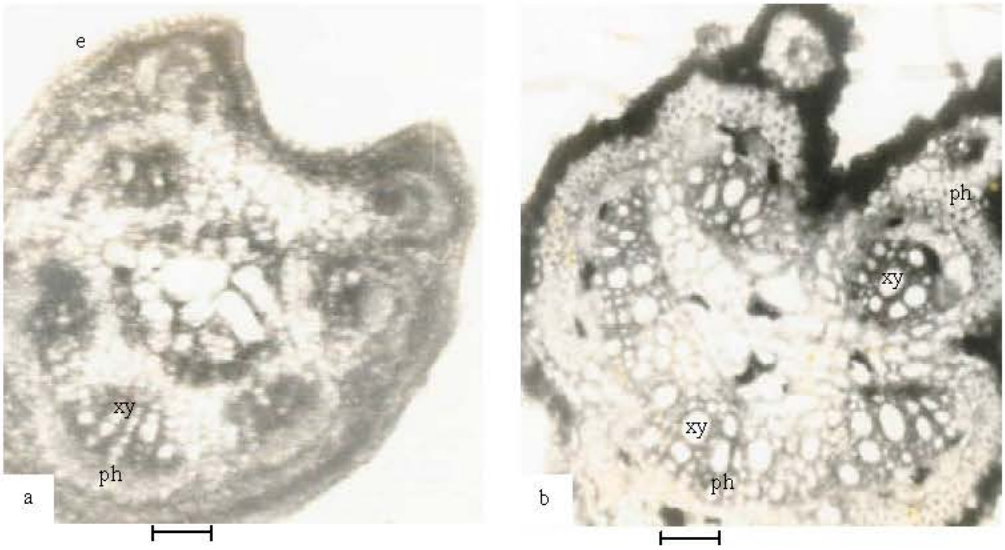

Fig. 5: Showing cross-section of petiole of *Abrus* species (5a-*A. precatorius*, 5b-*A. canescens*). xy-xylem, ph-phloem (Bar: 100 μm)

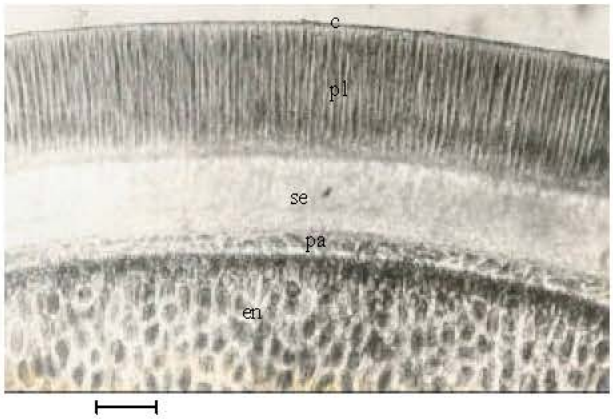

Fig. 6: Showing cross-section of seed coat of *Abrus* species (*A. precatorius*). c-cuticle, pl-palisade (macrosclereid) layer, se-supepidermis (lagenosclereid), pa-seed parenchyma, en-endosperm (Bar: 120 μm)

occasionally obliterate the endodermis. In the new collection *Abrus* sp., 5 layers of periderm cells, 4 to 6 layers of cortical cells and 2 to 3 layers of large and thick walled endodermal cells with rays were observed.

Leaf: Observations on the leaf anatomy (Fig. 3a and b) show that the three species and the new collection are dorsiventral, with uniseriate and irregularly shaped epidermal cells. The epidermis is uniseriate in *A. canescens*. Two layers of palisade mesophyll cells were observed in all species with those in *A. precatorius* open in arrangement. Apart from in the new collection *Abrus* sp., where 2-4 layers of spongy mesophyll cells were observed, others had 2-3 layers. Collenchyma and sclerenchyma layers around the vascular bundles differed: 2-4 layers in *A. precatorius*, 2-5 layers in *A. pulchellus*, 2-4 layers in *A. canescens* and 2-9 layers in the new collection *Abrus* sp.

Pulvinus and petiole: The pulvinus in *A. precatorius* (Fig. 4a and Table 3) consists of a single layer of occasionally raised and cutinized epidermis followed by 4-7 layers of parenchyma and a central vascular bundle. Pith is present. The vascular bundle of the pulvinus continues into the petiole (Fig. 5a and Table 3). The petiole also has a layer of round to ovoid epidermal cells

and 4-6 layers of collenchyma. In *A. pulchellus*, the pulvinus (Fig. 4b) has a single layer of isodiametric, flat and cutinized piliferous epidermis preceded by 9-10 layers of thin-walled parenchyma cells. 1-3 layers of collenchyma cells surround the vascular bundle. Pith is present. The petiole possesses a layer of irregularly shaped, round to ovoid epidermal cells, 3-4 layers of parenchyma and collenchyma cells. Xylem and phloem are separated by interfascicular cambium.

In *A. canescens*, the vascular system of the pulvinus pushes a few layers of parenchyma and collenchyma cells close to the epidermis. The single piliferous cutinized epidermis of the petiole (Fig. 5b) is followed by 2-3 layers of parenchyma. In the new collection *Abrus* sp., the petiole has a single layer of cutinized epidermis followed by 2-4 layers of collenchyma.

Seed coat: The seed-coat (Fig. 6) in all the species have 5 tissue layers; cuticle, followed by a palisade layer of long macrosclereids, a sub-epidermal layer of columnar to flask-shaped lagenosclereids, chlorenchymatous parenchyma and finally an area of aleurone endosperm.

DISCUSSION

The evidence from anatomical studies shows that variations exist among the species of *Abrus* studied. The taxonomic value of such variations in anatomical features between species has been reported (Stace, 1965, 1980; Tateoka, 1969; Carlquist, 1961; Esau, 1977; Metcalfe and Chalk, 1979; Ndukwu and Okoli, 1992; Agbagwa, 2001; Agbagwa and Ndukwu, 2004).

The stem anatomy of *A. precatorius*, *A. pulchellus* and *A. canescens* were observed to be similar (Table 2, Fig. 1a and 1b) to the outline description of Cutler (1978) for *A. precatorius*. A major difference is the replacement of the epidermis in *A. pulchellus* by 3-5 layers of columnar shaped peridermal or cork cells. Other variations were observed to be due to the number of layers of certain tissues like collenchyma, pericyclic parenchyma, sclerenchyma and pith cells. The number of tracheids and the large solitary vessels occurring in radial chains, which are similar to those reported by Cutler (1978), varied between species. A distinct anatomical feature of *A. canescens* stem is the possession of epidermal hairs and degeneration of the pith cell pushing outwards the parenchymatous pith cells and leaving a prominent central hollow. Whether this is an adaptive anatomical modification or a phylogenetic advancement is subject to confirmation. Though the anatomy of the new *Abrus* sp. is generally similar to the other species, it characteristically has well cutinized epidermis and a 3-layered parenchymatous region between the collenchyma and scherenchyma instead of between the sclerenchyma and the vascular regions as was observed in the other species. This re-arrangement demonstrates the relevance of these anatomical features in taxonomic delimitation of the species.

Comparative anatomy of the leaf, petiole and pulvinus of the species revealed similarity and overlap in certain features. Though similarity of characters where they occur, connote relatedness of species, observed differences in vascular bundle arrangement, number of layers of sclerotic cells surrounding the vascular bundles, number of layers of parenchyma and collenchyma cells, length of the palisade cells and thickness of upper and lower leaf epidermis, offer useful parameters for delimiting the various taxa in this genus. Such anatomical differences have been previously utilized in taxa elucidation (Agbagwa and Ndukwu, 2004). For instance, the piliferous epidermis of the stem, leaf, petiole and pulvinus of *A. canescens*, a feature observed only in this species, distinguishes it from the other species. It was also observed that the upper and lower leaf epidermal cells of the species varied in thickness. The new collection *Abrus* sp. (60.10±20.98×87.20±33.67 μm for upper epidermis and 58.10±18.78×85.10±33.64 μm for lower epidermis) had the highest values for leaf epidermal thickness. In all the species the upper leaf epidermal layers were thicker than the lower epidermises; a feature associated with the greater exposure of the upper epidermis to sunlight and the need to guard against water loss (Esau, 1977; Chen and Wen, 2005; Agbagwa and Okoli, 2006). While the longest palisade cells were observed in *Abrus* sp., the closeness of length of palisade mesophyll cells in *A. precatorius* and *A. pulchellus* is noteworthy. The leaf vascular bundles of *A. canescens* and *Abrus* sp. are quite similar with the phloem forming an arc around the xylem. Thus there is an obvious variation in affinities of taxonomic features within species.

The arrangement of tissues in the pulvinus of the four species is the same and uniquely conforms to the description given by Esau (1977) on *Mimosa pudica* L., another legume. It is possible that this arrangement of cells is a characteristic of pinnate members of the leguminosae that respond to touch stimuli. The petiole anatomy of the species, which is characterized by the phloem forming an arc around the xylem and giving off 2 rib bundles at the periphery, differed in the new collection *Abrus* sp. The vascular systems of *Abrus* sp.

almost form a central circle with seven vascular bundles. The cambium in each group separates the xylem innermost and the phloem outermost. This difference in the arrangement of the petiolar vascular bundles can be exploited at the species level for the separation of the new collection *Abrus* sp.

The seed coat anatomy of the four species (Fig. 6 and Table 4) only differed in the thickness of the five identified layers. The value of such differences in thickness in taxa elucidation has been highlighted by Esau (1977) using *Crotolaria intermidia* a leguminous plant. The fact that the thickness of the cuticle, palisade and subepidermal layers were all highest in *A. precatorius* (Table 3) may be connected with the very hard, tough and impenetrable seeds of the species (Agbagwa, 2001). The hard seed coat may have developed from the deposition of several cuticular materials and presence of special types of sclerotic cells. These features confer hardness on this species and thus separate its seeds from the other *Abrus* species.

The observed anatomical similarities among the *Abrus* species studied indicate phyllogenetic relatedness of the taxa. Although, Bailey (1951, 1953 and 1957) had suggested that similarities in structural specialization do not necessarily imply close relationship but may be the result of parallel and convergent evolution. However, previous studies involving other lines of taxonomic evidence (Agbagwa, 2001; Agbagwa and Okoli, 2005a, b, 2006) clearly indicate that the species of *Abrus* studied belong to different taxa. Therefore, the anatomical differences observed in each species must have evolved with that particular species to confer heritable variation that could be exploited for taxonomic purposes. The current study is an attempt to provide anatomical data on the three *Abrus* species earlier described by Hutchinson and Dalziel (1958) and the new collection from southern Nigeria. These will complement the morphological descriptions, which always overlap.

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