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Morphological Study of Loganiaceae Diversities in West Africa

Olusola Thomas Oduoye [1*], Oluwatoyin T. Ogundipe[2]. and James D. Olowokudejo[2].
[1]National Centre for Genetic Resources and Biotechnology (NACGRAB), PMB 5382, Moor plantation, Apata, Ibadan.
[2]Molecular Systematic Laboratory, Department of Botany, Faculty of Science, University of Lagos, Nigeria.
*E-mail: solaoduoye@gmail.com

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Abstract
Loganiaceae belongs to the Order Gentianales which consists of the families Apocynaceae, Gelsemiaceae, Loganiaceae, Gentianaceae and Rubiaceae. Several Herbaria samples were studied prior to collection from Forest Reserves and National Parks in Nigeria, Republic of Benin and Ghana – with the aid of collection bags, cutlass, secateurs and ropes. Plants parts, both vegetative and reproductive were assessed with the aid of meter rule and tape rule in their natural environment and in the laboratory. *Strychnos* species collected were 47 individuals; 35 species were adequately identified. *Anthocleista* genus consists of nine species, *Mostuea* - three species while *Nuxia, Spigelia* and *Usteria* were monotypic genera. The leaf surfaces within the family are: hirsute, pilose, pubescent, tomentose and glabrous as found in *Mostuea hirsuta, Strychnos phaeotricha, Strychnos innocua, Strychnos spinosa* and members of *Anthocleista species* respectively. Morphological characters show 10 clusters at threshold of 47 % similarity. Clusters 1, 2 and 4 revealed how *Anthocleista* and *Mostuea* species separated out from other species of Loganiaceae. West African diversities have not been fully explored, there are yet novel plant species in the wild to be conserved before they slip out of our hand and sight.
Keywords: Morphology, Loganiaceae, West Africa, cluster Analysis, dendrogram.

1.0 INTRODUCTION AND LITERATURE REVIEW

The family Loganiaceae was first suggested by Robert Brown in 1814 and validly published by Von Martius in 1827 (Leeuwenberg and Leenhouts, 1980; Frasier, 2008). The family belongs to the Order Gentianales which consists of the families Apocynaceae, Gelsemiaceae, Loganiaceae, Gentianaceae and Rubiaceae (Frasier, 2008). Among these, Loganiaceae was considered to occupy a central evolutionary position (Bisset, 1980; Leeuwenberg and Leenhouts, 1980; Backlund *et al*., 2000). Earlier treatments of the family have included up to 30 genera, 600 species (Leeuwenberg and Leenhouts, 1980; Mabberley, 1997) but were later reduced to 400 species in 15 genera, with some species extending into temperate Australia and North America (Struwe *et al*., 1994; Backlund and Bremer, 1998). Molecular phylogenetic studies have demonstrated that this broadly defined Loganiaceae was a polyphyletic assemblage and numerous genera will have to be removed from it to other families or placed in other orders as the case may be (Backlund *et al*., 2000). In the circumscription of Leeuwenberg and Leenhouts (1980), Loganiaceae consists of 600 species in 30 genera and included predominantly tropical, woody plants (Bendre, 1975; Mabberley, 1997). Cronquist (1981) reduced the circumscription of Leewenberg and Leenhouts to 21 genera in one tribe, grouped other six tribes to two families but removed three tribes completely from Gentianales. Thorne (1983) recognized 22 genera in five tribes, raised other five tribes to family level but did not accept the removal of three families from Order Gentianales. Struwe *et al.,* (1994) recognized from Leewenberg and Leenhouts circumscription three genera, raised other 15 genera to family level and commented that the remaining twelve genera were not certain where to be placed. Takhtajan (1987) recognized only one genus from the same Leewenberg and Leenhouts circumscription but raised the remaining 29 genera to nine different families and removed two completely from Gentianales. The most recent studies (Backlund *et al.,* 2000; Frasier, 2008) recognized 13 genera from Leewenberg and Leenhouts circumscription, the remaining genera were raised to nine different families but seven of them were completely excluded from Gentianales. However, Hutchinson and Dalziel (1972), in the Flora of West Tropical Africa, Loganiaceae consists of six genera which include: *Anthocleista, Spigelia, Mostuea, Strychnos, Nuxia and Usteria. Anthocleista* comprises nine species, *Mostuea* has five species, *Strychnos* has 35 species, while *Spigelia*, *Nuxia* and *Usteria* genera are represented by a single species each in West Africa. The aim of the study is to utilize morphological motifs for the elucidation and delimitation of genera and species in the family Loganiaceae in West Africa based on the record of Hutchinson and Dalziel, (1972).

2.0 MATERIALS AND METHODS

Specimens of Loganiaceae were studied in several Herbaria and samples were collected from several Forest Reserves and National Parks in Nigeria, Republic of Benin and Ghana with the aid of collection bags, cutlass, secateurs and ropes. The samples were authenticated at Forestry Herbarium Ibadan (FHI) and deposited in FHI and University of Lagos Herbarium (LUH). The material collected includes young mature leaves with short stem cut, (for further studies and herbarium preservation), fruits and/or seeds and/or inflorescence when available (Hutchinson and Dalziel, 1958). Photographs of samples were taken with digital camera at their natural environment. On-field evaluation of vegetative and reproductive parts (leaves, stem, inflorescence and fruits) was carried out on each sample in their natural environment prior to sample collection or immediately after collection for tangled climbers. The qualitative features such as leaf apex, leaf base, leaf shape, surfaces indumentums, stem colour, inflorescence type and flower colour were visually assessed. Aided magnifying lens (x10) was sometimes used for minute organs. Quantitative features such as leaf size, petiole length, leaf blade length, plant height, corolla tube length and width were determined using thread and meter rule (Radford *et al*., 1974). Descriptive statistics of mean, standard deviation, standard error and Principal Component Analysis (PCA) extraction method was used and the rotation Method was Varimax with Kaiser Normalization. Pair wise distance (similarity) matrices were computed using sequential, hierarchical and nested (SAHN) clustering option of the NTSYS-pc version 2.02j software package (Rohlf, 1993). The program generated dendrograms which grouped the *Strychnos* species according to their morphological characters using unweighted pair group method with arithmetic average (UPGMA) cluster analysis (Sneath and Sokal, 1973).

3.0 RESULTS

The exploration carried out revealed that *Strychnos* species were more than the number recorded in the Flora. Additional 12 samples of *Strychnos* were collected in their sterile state and are completely found to be different from the previously authenticated species based on their morphological features. They are termed *Strychnos* Indeterminate (SID) in this study. Some of the understory species like, *Mostuea* have depleted from the forests because of the indiscriminate, illegal and uncurbed penetration of the restricted areas. Table 1.0 represents some of the species encountered on the field with their common names and the genera they belong in the family. Table 2.0 represents some of the morphological motifs scored for the species of the family.

Habit wise; *Spigelia anthelmia* (SAT 19 – Table 1.0) is an annual herb (Plate 1.2 d); *Mostuea* genus contains perennial shrubs (Plate 1.2 a – b); species of *Anthocleista* are either trees or climbers (Plate 1.1 a-d) while most members of *Strychnos* are woody climbers and the rest are trees (Plates 1.3, a-d and 1.4, a-c). Members of the family have simple, opposite leaves, entire margin and leaf shape varies among the genera (Plates 1.1 to 1.4). The leaf surfaces encountered within the family are: hirsute, pilose, pubescent, tomentose and glabrous as found in *Mostuea hirsuta, Strychnos phaeotricha, Strychnos innocua, Strychnos spinosa* and members of *Anthocleista species* respectively (Plate 1.1 - Plate 1.4). The inflorescence type within the family is either racemose or cymose. When racemose, it would be corymb as found in *Anthocleista*, *Mostuea* and *Nuxia* genera (Plate 1.1 - Plate 1.2). The cymose type however, is usually axillary and is common among *Strychnos* (Plate 1.3). The leaf characters assessed quantitatively were subjected to Principal Component Analysis (PCA) which revealed that two components contributed about 64 % in the analysis (Table 3). When several inflorescence leaves were assessed, Loganiaceae shows a considerable variation in their leaf shapes and sizes.

4.0 DISCUSSION and CONCLUSION

Cluster analysis for 25 morphological characters (Figure 4.0) revealed the similarity among the species of Loganiaceae. The morphological evidence of 25 characters shows 10 clusters when working with a threshold of 47 % similarity (Figure 4.0). Cluster 1 and 2 clearly revealed the *Anthocleista* species separated from other species of Loganiaceae. Cluster 3 is *Spigelia anthelmia,* ungrouped within the threshold among the family. Although, Cluster 8 - *Mostuea* species were nested with *Strychno*s species but they have their root completely separated from *Strychnos* at about 31 % similarity, indicating that they are distantly related. The arid species of *Strychnos* are found nested together with *Nuxia* and *Usteria* species. This is because they are tree species and have several features in common (Figure 4.0).

In Table 3, the communality – extraction revealed that leaf length, width and petiole length have the highest value and thus the most significant characters that are useful for delimitation of Loganiaceae during field exploration. The scatter plots (Figure 2 and 3, group centroids) revealed that some genera are grouped together around the centre; example is *Strychnos* while one to nine (*Anthocleista* genus – Table 1.0) are scattered apart; outliers. This is due to unique features found in *Anthocleista* as revealed by the PCA; broad and large leaves with varying petiole length in the entire genus and massive garth when compared with strangling or liana *Strychnos.*
Figure 1 is a scree plot showing the degree of significance when variance of the characters used are represented

on a plot as revealed by PCA. The Eigen values of Component 1 and 2 were high enough to significantly delimit the entire population of Loganiaceae as revealed by the studies.

In conclusion, this study has revealed that *Anthocleista* and *Mostuea* have very low affinity with other members of the family. Hence, they are to be removed from the family and regrouped with other family or families. Therefore, this morphological studies support the molecular findings of Backlund *et al*., (2000) and Frasier, (2008). The SIDs have been sent to the Royal Botanic Garden, KEW, for further analysis and complete identification. Furthermore, West African diversities have not been totally explored, there are yet novel plant species in the wild which need attention for conservation before they slip out of our hand and sight due to increase population and attended deforestation.

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Table 1.0: The code names and the common names given to field collections

Genera	Species	Scientific name	CODE NAMES	Common name
1	1	*Anthocleista djalonensis* **A. Chev.**	ADJ1	Cabbage tree
	2	*Anthocleista liebrechtsiana* **De Wild & Th. Dur.**	ALI2	Cabbage tree
	3	*Anthocleista microphyla* **Wernham**	AMI3	Cabbage tree
	4	*Anthocleista nobilis* **G. Don.**	ANO4	Cabbage tree
	5	*Anthocleista obanensis* **Wernham**	AOB5	Cabbage tree
	6	*Anthocleista procera* **Lepr. Ex Bureau**	APR6	Cabbage tree
	7	*Anthocleista scandens* **Hook.**	ASD7	Cabbage tree
	8	*Anthocleista schweinfurthii* **Gilg**	ASF8	Cabbage tree
	9	*Anthocleista vogelli* **Planch.**	AVO9	Cabbage tree
2	1	*Mostuea batesii* **Bak.**	MBA14	N/A
	2	*Mostuea brunonis* **Didr**.	MBR15	N/A
	3	*Mostuea hirsuta* **T. Anders. Ex Benth.**	MHI16	N/A
3	1	*Nuxia congesta* **R. Br. Ex Fresen.**	NCO18	Brittle-wood
4	1	*Spigelia anthelmia* **Linn.**	SAT19	Worm weed
5	1	*Strychnos aculeata* **Solered**	SAC20	Monkey orange
	2	*Strychnos afzeli* **Gilg.**	SAF21	Monkey orange
	3	*Strychnos angolensis* **Gilg.**	SAG22	Monkey orange
	4	*Strychnos asteranta* **Leeuwenberg**	SAS23	Monkey orange
	5	*Strychnos barteri* **Solered**	SBA24	Monkey orange
	6	*Strychnos boonei* **De Wild.**	SBO25	Monkey orange
	7	*Strychnos campicola* **Gilg.**	SCP26	Monkey orange
	8	*Strychnos camptoneura* **Gilg. et Busse**.	SCT27	Monkey orange
	9	*Strychnos chromatoxylon* **Gilg.**	SCH28	Monkey orange
	10	*Strychnos congolana* **C.H. Wright**	SCO29	Monkey orange
	11	*Strychnos cuminodora* **De Wild.**	SCU30	Monkey orange
	12	*Strychnos densiflora* **Bail.**	SDE31	Monkey orange
	13	*Strychnos dinklagei* **Gilg.**	SDI32	Monkey orange
	14	*Strychnos floribunda* **Gilg.**	SFL33	Monkey orange
	15	*Strychnos gossweileri* **Exell**	SGO34	Monkey orange
	16	*Strychnos icaja* **Bail.**	SIC35	Monkey orange
	17	*Strychnos innocua* **Del.**	SIN36	Monkey orange
	18	*Strychnos johnsonii* **Hutch. *et* M. B. Moss.**	SJO37	Monkey orange
	19	*Strychnos longicaudata* **Gilg.**	SLO38	Monkey orange
	20	*Strychnos lucens* **Bak.**	SLU39	Monkey orange
	21	*Strychnos malacoclados* **C.H. Wright**	SMA40	Monkey orange
	22	*Strychnos memecyloides* **S.Moore**	SME41	Monkey orange
	23	*Strychnos nigritana* **Bak.**	SNI42	Monkey orange
	24	*Strychnos nux-vomica* **Linn.**	SNU43	Monkey orange

Table 1.0: The code names and the common names given to field collections contn'd

Genera	Species	Scientific name	CODE NAMES	Common name
	25	*Strychnos phaeotricha* **Gilg.**	SPH44	Monkey orange
	26	*Strychnos soubrensis* **Hutch. et Dalz.**	SSO45	Monkey orange
	27	*Strychnos spinosa* **Lam.**	SSN46	Monkey orange
	28	*Strychnos splendens* **C.H. Wright**	SSD47	Monkey orange
	29	*Strychnos staudtii* **Gilg.**	SST48	Monkey orange
	30	*Strychnos talbotiae* **S.Moore**	STA49	Monkey orange
	31	*Strychnos tricalysioides* **Hutch.**	STR50	Monkey orange
	32	*Strychnos urceolata* **Leeuwenberg**	SUR51	Monkey orange
	33	*Strychnos usambarensis* **Gilg.**	SUS52	Monkey orange
	34	*Strycnos chrysophylla* **Gilg.**	SCR53	Monkey orange
	35	*Strychnos ndengensis* **Pellegr.**	SND54	Monkey orange
	36	*Strychnos* indeterminate Edondon -2	SID55	Monkey orange
	37	*Strychnos* indeterminate Edondon -3	SID56	Monkey orange
	38	*Strychnos* indeterminate Erokut station -2	SID57	Monkey orange
	39	*Strychnos* indeterminate Erokut station -3	SID58	Monkey orange
	40	*Strychnos* indeterminate Edondon -1	SID59	Monkey orange
	41	*Strychnos* indeterminate Edondon -8	SID60	Monkey orange
	42	*Strychnos* indeterminate Edondon -4	SID61	Monkey orange
	43	*Strychnos* indeterminate Ipetu- Ijesha	SID62	Monkey orange
	44	*Strychnos* indeterminate J_4 -3	SID63	Monkey orange
	45	*Strychnos* indeterminate Erokut station -6	SID64	Monkey orange
	46	*Strychnos* indeterminate Edondon -6	SID65	Monkey orange
	47	*Strychnos* indeterminate ENUGU	SID66	Monkey orange
6	1	*Usteria guineensis* **Willd.**	UGU67	N/A

N/A = Not Available

Table 2.0: Morphological Assessment of some species of Loganiaceae

CODE	inflourensence type	Flower fresh colour	Leaf shape	Leaf apex	Leaf margin	Leaf hairiness (indumentum)	Petiolate/ sessile	Leaf base	Leaf arrangement
ADJ1	corymb	white	obovate	rounded	revolute & undulate	coriaceous	petiolate	rounded	opposite
ALI2	corymb	creamy	oblanceolate	rounded	entire	coriaceous	petiolate	cuneate	opposite
AMI3	corymb	white	oblong, elliptic, obovate	acuminate	entire	coriaceous	petiolate	cuneate, narrowly cuneate.	opposite
ANO4	corymb	white	obovate, oblanceolate	rounded	revolute & undulate	coriaceous	petiolate	rounded	opposite
AOB5	corymb	Yellow	lanceolate	acuminate	entire	coriaceous	petiolate	attenuate	opposite
APR6	corymb	white	oblong, obovate to oblanceolate	rounded	entire	coriaceous	petiolate	attenuate	opposite
ASD7	corymb	white	obovate	acuminate	entire	coriaceous	petiolate	attenuate	opposite
ASF8	corymb	creamy	oblong, obovate to oblanceolate	rounded	entire	coriaceous	petiolate	attenuate	opposite
AVO9	corymb	creamy or yellow	obovate	rounded	revolute & undulate	coriaceous	sessile	cuneate, auriculate.	opposite
MBR15	cymose	white	obovate	acute	entire	pilose	petiolate	rounded	opposite
MHI16	terminal cyme	white	ovate	acute	entire	hirsute	petiolate	rounded	opposite
NCO18	corymb	white	elliptic	acute	entire	glabrous	petiolate	attenuate	opposite
SAT19	corymb	white	lanceolate	acuminate	entire	glabrous	sessile	attenuate	opposite
SAC20	cymose	white	elliptic, oblong, lanceolate	acuminate, obtuse	entire	glabrous	petiolate	attenuate	opposite

The data were collected on the field as much as possible while the plant materials were still fresh.

Table 2.0: Morphological Assessment of some species cont'd

CODE	Inflorescence type	Flower fresh colour	Leaf shape	Leaf apex	Leaf margin	Leaf hairiness (indumentums)	Petiolate/ sessile	Leaf base	Leaf arrangement
SFL33	cymose; axillary	white	oblanceolate	acuminate	entire	glabrous	petiolate	attenuate	opposite
SGO 34	cymose; axillary	white	ovate, elliptic	acuminate	entire	glabrous	petiolate	attenuate	opposite
SIC35	raceme; axillary panicle	white	elliptic	acuminate, acute	entire	glabrous	petiolate	attenuate	opposite
SIN36	raceme; panicle	Yellow	elliptic, obovate.	round, obtuse	entire	pubescent	petiolate	attenuate	opposite
SJO37	cymose; axillary	white	ovate, elliptic	acuminate	entire	glabrous	petiolate	obtuse	opposite
SLO 38	axillary cymose	white	elliptic	acuminate, caudate	entire	glabrous	petiolate	attenuate	opposite
SLU39	axillary cymose	Yellow	ovate	acute	entire	glabrous	petiolate	rounded	opposite
SMA 40	axillary cymose	orange	ovate, elliptic, oblanceolate	acuminate, obtuse, acute	entire	glabrous	petiolate	attenuate, curneate	opposite
SME 41	axillary cymose	white	elliptic, oblong	acuminate, acute	entire	glabrous	petiolate	attenuate, curneate	opposite
SNI42	axillary cymose	Yellow	elliptic, ovate, obovate	acuminate, acute, mucronate	entire	glabrous	petiolate	rounded, attenuate, obtuse	opposite
SNU 43	raceme; panicle	Yellow	ovate, elliptic, oblanceolate	mucronate, acuminate	entire	glabrous	petiolate	rounded, obtuse	opposite

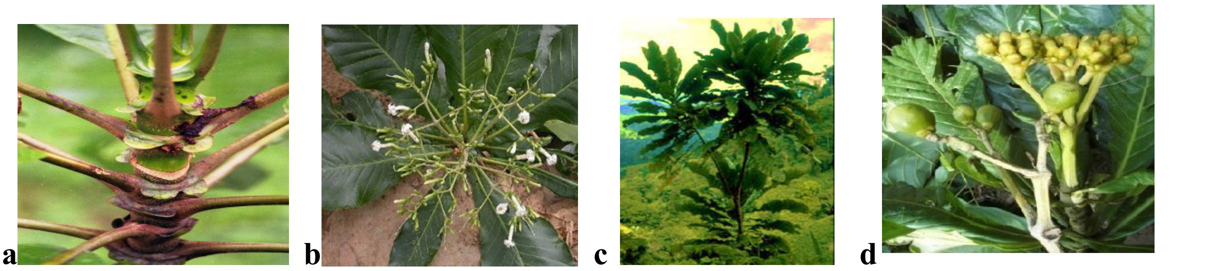

Plate 1.1: Photographs of *Anthocleista* species (a) *Anthocleista schweinfurthii* tree (b) *A. procera* inflorescence(c) *A. vogelli* tree (d) *A. vogelli* young inflorescence and fruit.

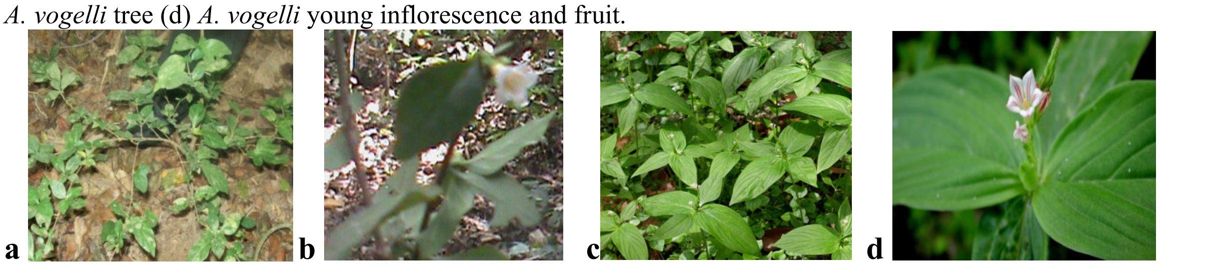

Plate 1.2: Photographs of *Mostuea and Spigelia anthelmia* species (a) *Mostuea brunonis* plant (b) *Mostuea hirsuta* inflorescence (c - d) the colonial growth and inflorescence of *S. anthelmia.*

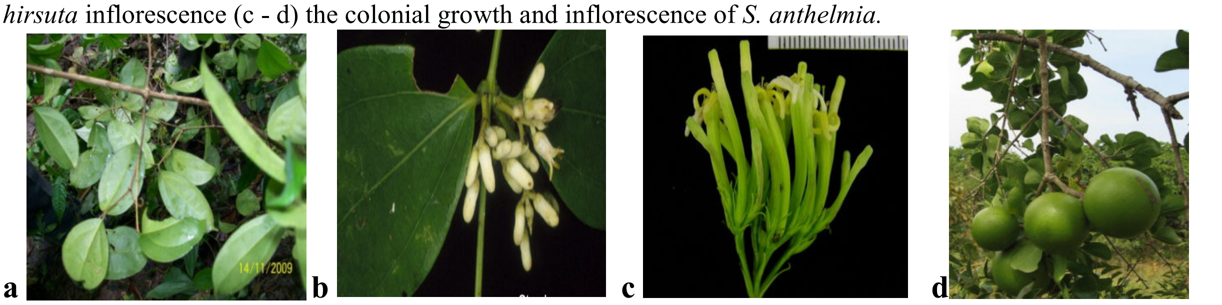

Plate 1.3: Photographs of *Strychnos* in high forest. (a) *Strychnos afzeli* (b - c) *Strychnos densiflora* and *S. dinklagei* inflorescence (d) *S. spinosa* fruit

Plate 1.4: Photographs of *Strychnos* tendril called Hook and *Usteria guineensis.* (a) Single hook in *Strychnos floribunda* (b) Paired hook in *S. camptoneura* (c) *S. nux-vomica* seed (d - e) *Usteria guineensis* tree, inflorescence and fruit.

Plate 1.1 - 1.4: Vegetative, flora and seed morphology of Loganiaceae species.
All photographs – Magnification x 0.05

Table 3.0: Principal component analysis (PCA) showing communalities and Component Matrix for Loganiaceae Morphology

Communalities			**Component Matrix**	
	Initial	Extraction	Component 1	Component 2
Leaf length	1.000	.914	.936	.194
Leaf width	1.000	.891	.944	-.016
Leaf width ratio	1.000	.308	.295	.470
Plant Height	1.000	.353	.306	.510
Petiole length	1.000	.802	.820	-.361
Apex length	1.000	.677	-.086	.818
Internode length	1.000	.527	.714	-.134

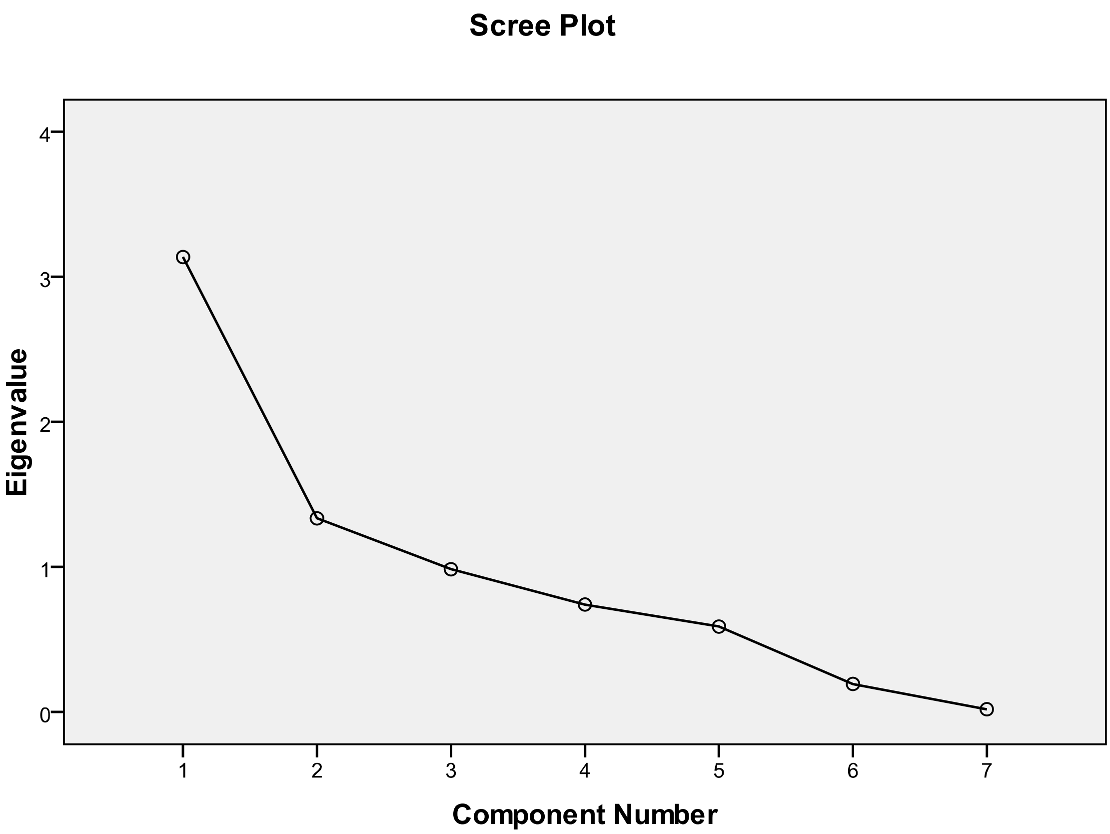

Figure 1: Principal Component analysis for Scree Plot of Eigen values for Loganiaceae Morphology.

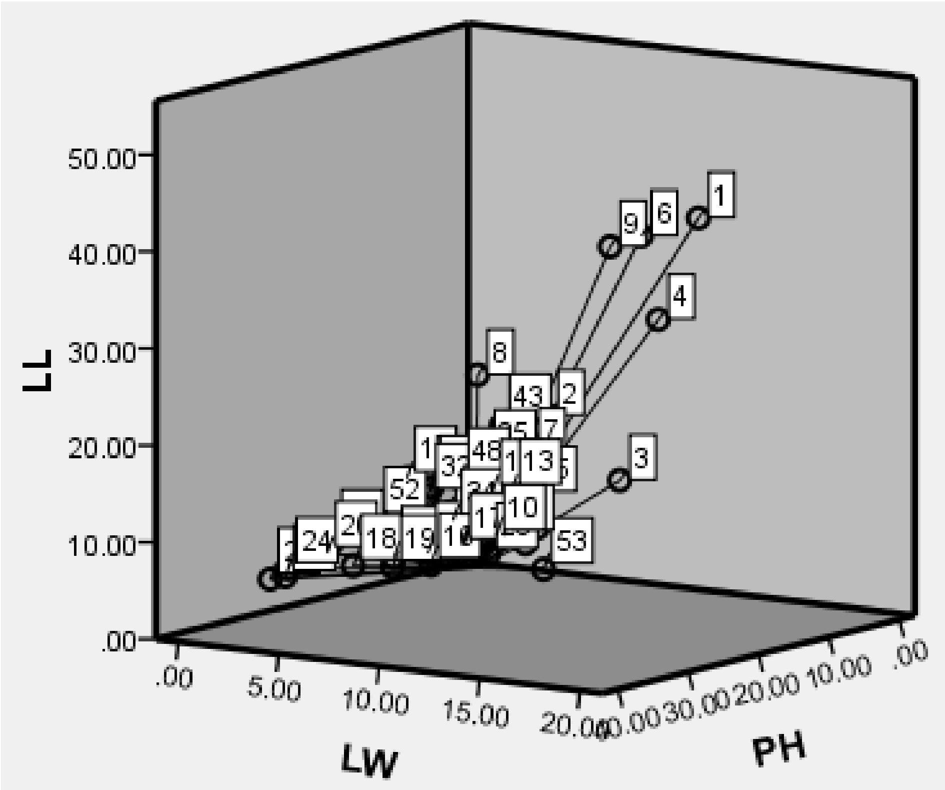

Figure 2: Scatter plot of Leaf length (LL), Leaf width (LW) and Plant height (PH) of first component obtained from PCA (group centroids).

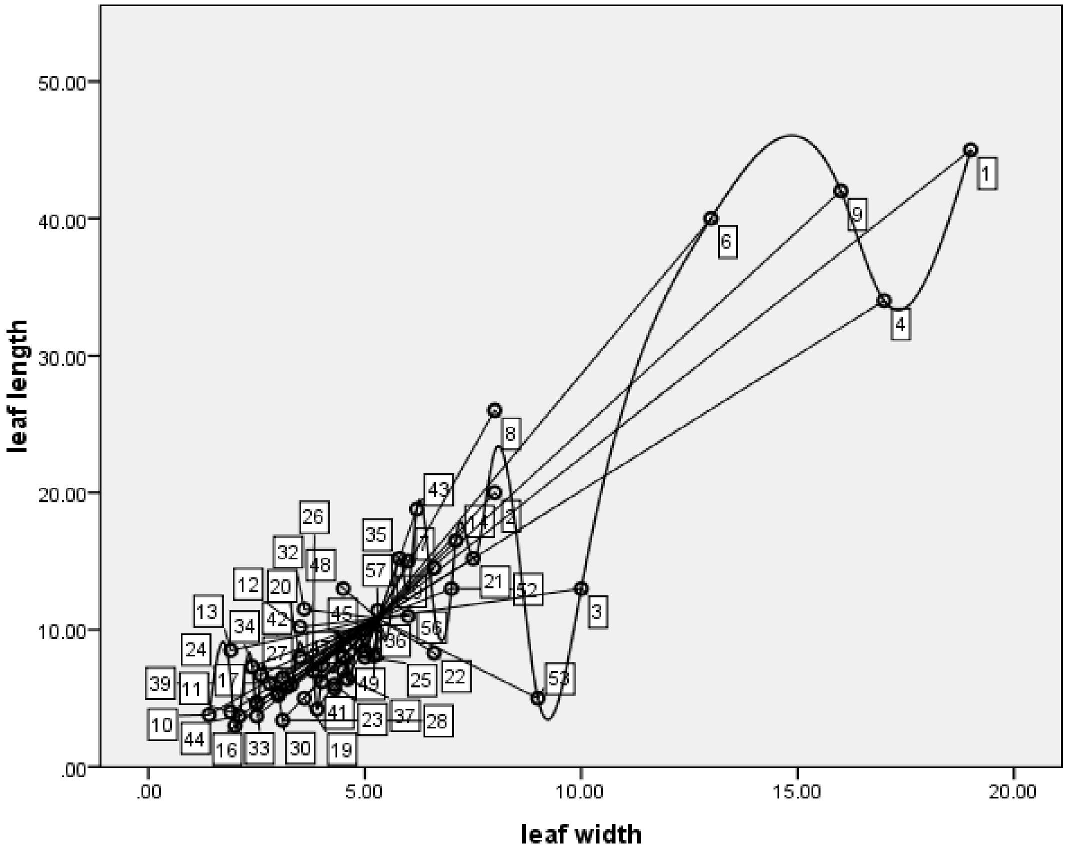

Figure 3: The scatter diagram for Leaf length (LL) and Leaf width (LW) of first component obtained from PCA (group centroids).

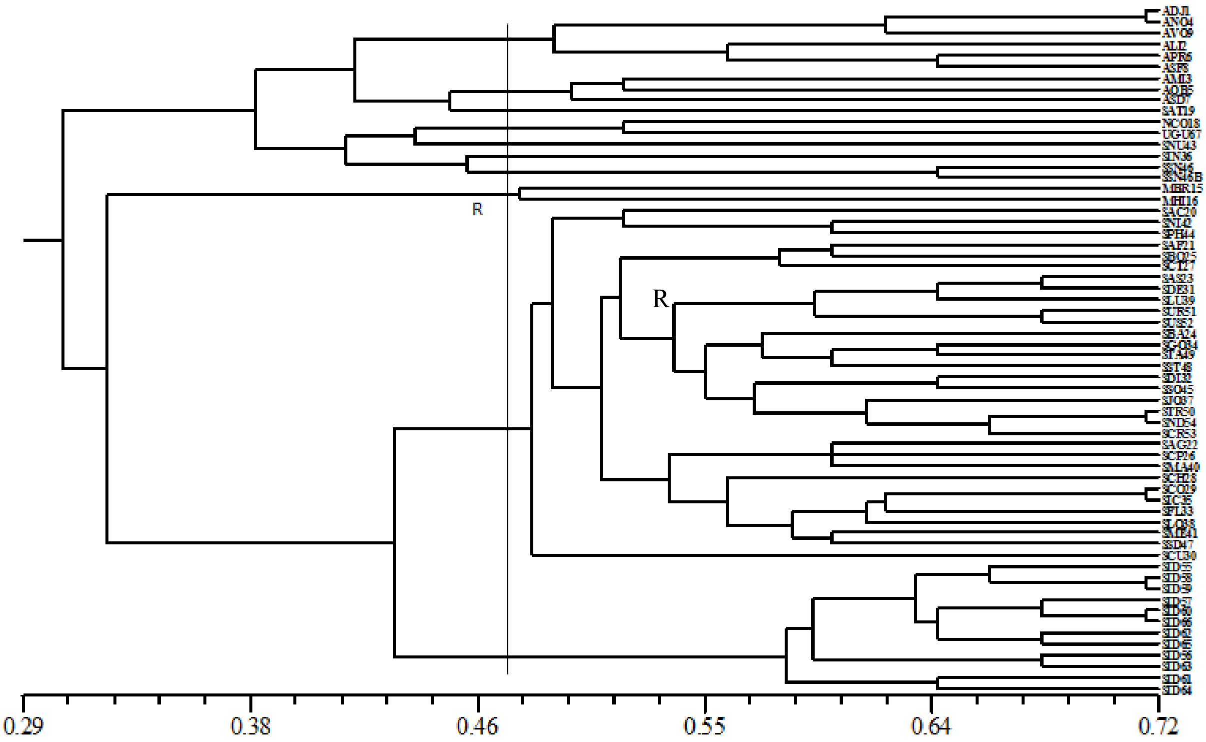

Figure 4: Pair-wise (Similarity) Analysis showing relationship within Loganiaceae based on Morphological data. (R= reference line).

Appendix 1: Some morphological descriptors and their codes used for Loganiaceae analysis

HB= habit; based on their height from the soil surface	Vegetation Zone **VZ**: from the sea level to the desert.	Bark texture **BT**: Smooth or rough.	Flower fresh colour **FC**: Based on their warmness.
Herb = 1	Mangrove = 1	Smooth = 1	White = 1
Shrub = 2	Swamp = 2	Rough = 2.	Creamy = 2
Tree = 3	Secondary forest = 3	**S**: present or absent	Creamy yellow = 3
Epiphyte =4	High forest = 4	Present = 1	Yellow = 4
Liana = 5	Savanna = 5	Absent = 2	Orange = 5
	Mountain veg. = 6		Lemon = 6

Appendix 2: Some morphological descriptors and their codes used for analysis contn'd

Leaf apex = **LA**	Leaf shape = **LS**	Branch **B**: smooth or spiny	Leaf hairiness = **LH**	Leaf base = **LB**
Acute = 1	Elliptic = 1	Smooth = 1	Glabrous = 1	Rounded =1
Acuminate =2	Oblong = 2	Spiny = 2	Coriaceous = 2	Cuneate = 2
Apiculate =3	Ovate = 3	Hook **HK**: number present	Pubescent = 3	Attenuate = 3
Caudate = 4	Obovate = 4	Nil = 1	Hirsute = 4	Obtuse = 4
Cuspidate = 5	Lanceolate = 5	Single = 2	Pilose = 5	2 or 3 character = 5
Obtuse =6	Oblanceolate = 6	Paired = 3	Others = 6	Leaf veins = **LV**
Round = 7	2 character = 7	Leaf margin = **LM**	Petiole = **P**	Bold = 1
2 characters = 8	3 or more charact. = 8	Entire = 1	Petiolate = 1	Faint = 2
3 or more =9		Revolute & undulate = 2	Sessile = 2	

Appendix 3: The herbaria collections assessed for this study

Name of plant specimens	**Place of Collection**	**Accession no**	**Collector**
Anthocleista *liebrechtsiana*	Republic of Benin	FHI 30254	Onochie, C.F.A
A. obanensis	Iyekorhiomwon, Sapoba Forest R.	FHI 61734	Emwiogbon, J.A
A. procera	Abidjan, Ivory coast	FHI 30679	Leeuwenberg, A.J.M.
A. schweinfurthii	Republic of Benin	FHI 95075	Onochie, C.F.A
A. scandens	Cameroun	FHI 40516	Daramola, B.O
A. nobilis	Abidjan, Ivory coast	FHI 13655	Leeuwenberg, A.J.M.
A. vogelli	Forestry garden	FHI 107911	Daramola, B.O
Mostuea *brunonis*	Awi Forest	FHI 101156	Daramola, B.O
M. hirsuta	Zaria, Jamaa Nimbia	FHI 104567	Anders, T.
M. *batesii*	Yaoundé	FHI 69486	Leeuwenberg, A.J.M.
Mostuea thomsonii	West of Premises town, steep forest floor.	GCH 1802	Monton, J.K
Nuxia *congesta*	Victoria, cameroun mt.	FHI 40507	Daramola, B.O
N. *congesta*	Amed yote, Togo.	GCH 2871	Dewit and Morta.
Strychnos aculeata	Omo Sawmil, Ijebu-Ode	FHI 50221	Leeuwenberg, A.J.M.
S. afzeli	Owena river edge, Ondo state.	FHI 23012	Olorunfemi J.
S. angolensis	Oban F.R. Calabar	FHI 37221	Daramola, B.O
S. asterantha	Nigritana game Reserve, Plateau	FHI 10674	Gbile & Daramola
S. barteri	Nigritana game Reserve, Plateau	FHI 25601	Daramola, B.O
S. boonei	Benin city	FHI 25554	Olorunfemi J.
S. campicola	N/A	FHI 22110	Daramola, B.O
S. chrysophyla	Oban, CRNP	FHI 33768	Olorunfemi J.
S. congolana	Okeigbo, ondo state	FHI 15388	Onochie, C.F.G
S. densiflora	Ankasa Forest Reserve	GCH 3912	Enti, A.A
S. dinklagei	Abijan, Ivory Coast	FHI 13564	Leeuwenberg, A.J.M.
S. innocua	Igbeti- Ilorin road	FHI 89699	Ibhanesebhor, Adejimi
S. melacoclados	Ukpe-sobo Forest reserve	FHI 34792	Imwinogbon, J.A