

MACRO-MORPHOLOGICAL STUDY ON SEVEN SELECTED SPECIES OF EUPHORBIACEAE IN THE NIGER DELTA REGION OF NIGERIA

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Abstract

A comparative study on seven selected species of the family Euphorbiaceae found in the Niger Delta region of Nigeria was carried out using macro-morphological features. These seven species were selected from four genera of the family Euphorbiaceae which includes: genus Acalypha – A. hispidia Burm. f. and A. wilkesiana Mull. Arg., genus Euphorbia – E. heterophylla L. and E. hirta L., genus Jatropha – J. curcas L. and J. gossypifolia L. and genus Manihot – M. esculenta Crantz. The macro – morphological features based on quantitative and qualitative investigations were both examined and compared with the aim of characterizing and validating these taxa. Macro-morphological study involved visual observation of the vegetative and reproductive parts of the species and measurement of quantitative plant parts using a meter rule and measuring tape. All species studied were observed to possess an actinomorphic floral symmetry, but were distinguished by other characters such as Phylotaxy of the leaf, Leaf type, presence / absence of petals, type of bracts, arrangement of flowers, leaf surface, presence / absence of stipules, sexuality of plant, flower color, leaf type, leaf shape, leaf apex, leaf base, plant height, leaf length and width. Numerical taxonomy (morphometric technique) was also used to analyze characters obtained from the morphological line of evidence and result gotten validated previous systematics, as all operational taxonomic units (OTUs) belonging to same genus were grouped together indicating that they are more related to each other. Recommendation for further research to be carried out with other lines of evidence with a larger number of species from other genus in this family was made.

Keywords: Macro-morphology, Euphorbiaceae, Niger Delta, Nigeria.

Introduction

The family Euphorbiaceae- the spurge family is a large family of flowering plants. Most spurges such as *Euphorbia heterophylla* are herbs, but some especially in the tropics are shrubs (*Jatropha gossipifolia*) or trees (*Hevea brasiliensis*) and some like Cactus (*Euphorbia canariensis*) are succulent because of convergent evolution (Natasha, 2014). Euphorbiaceae family ranges from 3000 to 8910 species (Bingtao et al., 2008) organized into 300 genera, 37 tribes & 300 subfamilies (Takhtajan, 2009). The species of this family are cosmopolitan in distribution, having plants that are both new and old. The family Euphorbiaceae is characterized by the production of milky sap, possession of unisexual flowers, Superior and trilocular ovary, axile placentation with a collateral ovule, pendulous and ventral raphe, usually carunculate (Sangha and Gayatri, 2014).

In the plant kingdom, members of the family Euphorbiaceae are seen as one of the top 25 economically important plants, existing in different variety of forms which has great ethnomedicinal value. The therapeutic property of Euphorbiaceae is as a result of its possession of secondary metabolites (phytochemicals) such as alkaloids, steroids, flavonoids, anthocyanin, tannins, glycosides etc. (Sangha and Gayatri, 2014).

The genus *Acalypha* comprises of a large proportion of weeds while the others are ornamental plants (Awe et al., 2013). *Euphorbia* is among the largest of the genera of flowering plants characterized by milky juice (Kumar et al., 2010). The genus *Jatropha* are not typically used for food purposes but can help supply a portion of the current fuel demand sustainably with minimum environmental impact (Emergara, et al., 2018). One of the important tribes of the Euphorbiaceae family is Manihotae, represented by the genus *Manihot* and most plants in this genus are shrub types or tall grasses (CIAT, 1983).

Currently, cassava is a crop of great importance in all tropical regions of the world, not only for the consumption of fresh roots as a subsistence crop but also for its agro industrial use (CIAT, 1983). A number of species of Euphorbiaceae family are of great economic importance; used as food, ornamental & for medicinal purposes (Warda, 2014). In Nigeria, members of this taxon are well distributed across free and forest reserved areas especially the southern part of the country. Nigerians make use of a number of these species of Euphorbiaceae for various purposes in both crude and processed forms. The usage can basically be classified into food and fodder, medicine, hedges, landscape and beautification, timber, superstitious use and others (Akobundu and Agyakwa, 1998).

The main subject of discussion among Plant taxonomist and Systematists for years now is the challenge of accurate plant identification and classification (Abdulrahman et al., 2010). Over the years, many plants are classified based on their flora and fruits which are considered as

external morphological structures whose production are usually seasonal in nature, hence limiting their availability for study and proper identification (Abdulrahman and Oladele, 2008).

The problem of identification and classification also abounds in the family Euphorbiaceae as different classification and counter classification exist. Taxonomists have always disagreed in terms of classification of members of this family into sub families, tribes, and genera (Webster, 1994). For instance, the genus *Phyllanthus* currently have been suggested and treated as an independent family; Phyllantaceae, and many more disagreement based on research findings are still ongoing (Abdel et al., 2019).

Detailed macro-morphological research work, including numerical taxonomy has not been carried out on the species in this study which will further enable easy identification of the species under study. Numerical taxonomy provides faster and precise way of determining relationship among closely related species in plant families. Members of the family Euphorbiaceae are of great economic importance to our country Nigeria, as they are found useful in terms of medicine, formation of hedges, landscape and beautification, production of timber, provision of food and fodder etc. They are found in the Niger Delta region and the entire southern part of Nigeria. Its distribution is spread across many regions of Nigeria and West Africa. The result of this research study will lead to easy identification of all the plants studied to avoid adulteration and confusion. The main aim of this research was to taxonomically characterize selected members of the family Euphorbiaceae in the Niger Delta region of Nigeria using macro-morphological line of evidence.

Materials and methods

Collection and identification of plant materials

Fresh and healthy samples of selected plants from four different genera in the family Euphorbiaceae were collected in separate bags from Rivers, Delta, Abia, Bayelsa and Imo States all from the Niger Delta region of Nigeria. The collection sites ecological conditions like Altitude, Longitude, and Latitude were taken. Other information taken includes name of collector, collection site, collection number and date of collection (Table 1). The plant specimens were identified at the herbarium of the Department of Plant Science and Biotechnology, University of Port Harcourt, Rivers State. Identified pressed plant samples were deposited at the UPH Herbarium for reference and further studies.

Table 3.1: Data Collection from some States in the Niger Delta Area of Nigeria

S/N	Names of Plant	Collection Location	Latitude	Longitude	Altitude	Date of Collection
1	<i>A. Hispida</i>	Ofrima building- Uniport Obio/Akpor PH, Rivers State	4°54'3.6"N	6°55'22.8" E	13.20m	14 th Dec., 2018
2	<i>A. wilkesiana</i>	Umuezike Ofeme- Umuahia North L.G.A, Abia State	5°39'57.6"N	7°25'19.2"E	71m	16 th Dec., 2018
3	<i>E. heterophylla</i>	Ihube- Okigwe, Imo State	5°50'58.28"N	7°22'56.93"E	203m	17 th Dec., 2018
4	<i>E. hirta</i>	College of health sciences NDU, Bayelsa State	4°58'7.9"N	6°5'40.5"E	3m	13 th Dec., 2018
5	<i>J. curcas</i>	Oleh, Delta State	5°29'2.219"N	6°12'19.9"E	4m	11 th Dec., 2018
6	<i>J. gossipifolia</i>	Oyigbo, Rivers State	4°52'52"N	7°7'94"E	11.07m	14 th Dec., 2018
7	<i>M. esculenta</i>	Agric. Farm, Uniport, PH Rivers State	4°54'14.4"N	6°55'22.8"E	11.40m	14 th Dec. 2018

Macro-Morphological Methods

Examinations on the macro - morphological features of selected species of the family Euphorbiaceae which are of taxonomic importance were done in matured living plants samples. References were also made to several books and Floras including Floras of West tropical Africa (Hutchinson and Dalziel, 1954), useful Plants of West Africa (Burkill, 1999).

Morphological studies involved visual observation of the vegetative and reproductive parts of the species. Quantitative morphological studies included the measurement of the leaf length, leaf width, petiole length and plant height using a meter rule and measuring tape (Ajuru, 2018).

Qualitative morphological plant features studied include the leaf shape, leaf base, leaf apex, leaf margin, leaf type, leaf venation, Presence/absence of petals, phyllotaxy and plant habit. Others include flower symmetry, terminal flower, flower color, stipules, sexuality and type of bracts. Also photographs of relevant morphological features were taken using XSZ-N107 Microscope with (MA88-900) camera.

Numerical taxonomy

Taxonomic characters obtained from the morphological investigations of the seven selected species of the family euphorbiaceae from four different genera were grouped by cluster analysis using the single linkage method based on similarity matrix of Euclidean distances of quantitative and qualitative characters. This statistical analysis was done using the Paleontological statistics (PAST) software.

Results

Important Macro - morphological differences and similarities observed in the seven selected species of Euphorbiaceae studied are summarized in tables 1 and 2 and Figure 1, while the pictures of the studied species showing distinguishing features are presented in Plates 1-4.

Table 1: Summary of important morphological features of the Species studied

S/N	Characters	<i>A. hispida</i>	<i>A. wilkesiana</i>	<i>E. heterophylla</i>	<i>E. hirta</i>	<i>J. curcas</i>	<i>J. gossipifolia</i>	<i>M. esculenta</i>
1	Leaf Shape	Cordate	Cordate	Obovate/Lanceolate	Oblong/Lanceolate	Cordate	Cordate	Lanceolate
2	Leaf Apex	Acuminate	Acuminate	Acute	Acute	Acute	Acuminate	Acute
3	Leaf Base	Cuneate	Cuneate	Cuneate	Round	Cordate	Cordate	Cuneate
4	Leaf Margin	Dentate	Dentate	Entire	Dentate	Entire	Entire	Lobed
5	Leaf length	Up to 20 cm long	Up to 12 cm long	Up to 8 cm long	Up to 3 cm long	Up to 12cm long	Up to 9 cm long	Up to 15.cm long
6	Leaf width (Broadness)	15 cm broad	7 cm broad	5 cm broad	And 1.5 cm broad	and 10 broad	and 8 cm broad	and 13.0cm broad
7	Petiole length	Up to 15 cm long	Up to 60 cm long	Up to 1.5 cm long	Up to 0.6 cm long	Up to 16cm long	Up to 6 cm long	Up to 20 cm long
8	Plant height	450 cm long	350 cm long	80 cm long	60 cm long	300 cm long	220 cm long	300 cm long
9	Phyllotaxy	Alternate	Alternate	Alternate	Opposite	Whorled	Whorled	Alternate
10	Leaf	Present	Present	Absent	Present	Absent	present	Absent

pubescent

11	Habitat	Cultivated	Cultivated	Wild	Wild	Cultivated	Cultivated	Cultivated
12	Habit	Shrub	Shrub	Herb	Herb	Shrub	Shrub	Shrub
13	Venation	Reticulate	Reticulate	Reticulate	Reticulate	Reticulate	Reticulate	Reticulate
14	Sexuality	Dioecious	Monoecious	Monoecious	Dioecious	Monoecious to Andromonoecious	Monoecious	Dioecious
15	Stipules	Absent	Absent	Absent	Present	Absent	Absent	Absent
16	Leaf type	Compound	Compound	Simple	Simple	Compound	Compound	Compound
17	Types of bract	Bracteate	Bracteate	Leafy-bracted inflorescences	Leafy-bracted inflorescences	Bracteate	Bracteate	Bracteate
18	Terminal flower	Indeterminate	Indeterminate	Determinate	Determinate	Determinate	Determinate	Indeterminate
19	Presence/Absence of petals	Absent	Absent	Absent	Absent	Present	Present	Present
20	Floral symmetry	Actinomorphic	Actinomorphic	Actinomorphic	Actinomorphic	Actinomorphic	Actinomorphic	Actinomorphic
21	Flower colour	Reddish	Reddish	Greenish-yellowish	Greenish	Yellowish-green	Purple red	Golden yellow



Plate 1a-1b: (1a) Photograph of *A. hispida*, (1b) leaf morphological features of *A. hispida*



• Plate 2a-2b: (2a) Stand of *E. heterophylla*, (2b) leaf morphological features of *E. heterophylla*



Plate 3a-3d : (3a) Stand of *J. curcas* (3b) leaf morphological features of *J. curcas* (3c) Stand of *J. gossipifolia* (3d) leaf morphological features of *J. gossipifolia*



Plate 4a : (4a) Stand of *M. esculenta*

Table 2: Numerical characters of studied species used in multivariate analysis with their method of scoring.

S/N	CHARACTERS	STATE	CODE
1	Leaf Shape	Ovate	1
		Obovate	2

		Lanceolate	3
		Oblong	4
		Cordate	5
2	Leaf Apex	Acute	1
		Acuminate	2
		Obtuse	3
3	Leaf Base	Cuneate	1
		Cordate	
		Rounded	2
			3
4	Leaf Margin	Entire	1
		Crenulate	2
		Dentate	3
		Lobed	4
5	Leaf length	1 -5cm	1
		6 -10cm	2
		11 -15cm	3
		16 – 20cm	4
6	Leaf width (broadness)	1 – 5cm	1
		6 – 10cm	2
		11 – 15cm	3
7	Petiole length	1 – 5cm	1
		6 – 10cm	2
		11 – 15cm	3
		16 – 20cm	4
8	Phylotaxy	Alternate	1
		Opposite	2
		Whorled	3
9	Venation	Reticulate	1
		Palmate	2
		Cross – Venulate	3
10	Leaf pubescent	Present	1
		Absent	0
11	Habitat	Wild	1
		Cultivated	2
12	Habit	Herb	1
		Shrub	2
		Tree	3
13	Leaf type	Compound	1

		Simple	2
14	Plant height	50 – 150cm	1
		160 – 260cm	2
		270 – 370cm	3
		380 – 480cm	4
15	Stipules	Present	1
		Absent	0
16	Sexuality	Monoecious	1
		Dioecious	2
		Hermaphrodite	3
17	Type of bract	Ebracteate	0
		Bracteate	1
		Leafy- Bracteate inflorescence	2
18	Presence/absence of petals	Present	1
		Absent	2
19	Flower symmetry	Actinomorphic	1
		Z y gomorphic	2
20	Terminal flowers	Determinate	1
		Indeterminate	2
21	Flower color	Green	1
		Yellowish green	2
		Purple red	3
		Crimson red	4
		Red	5

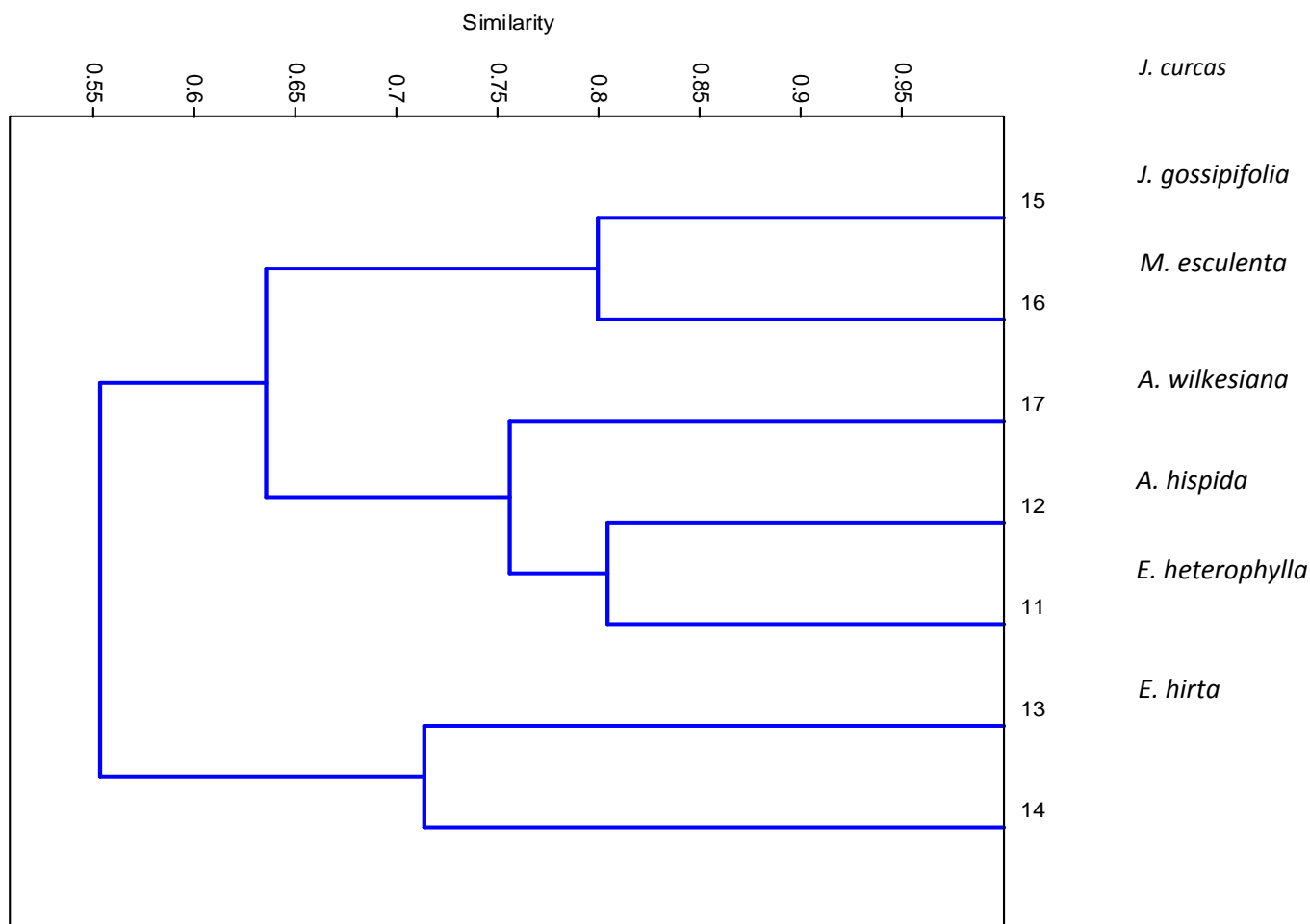


Fig 2: Dendrogram of seven selected species of euphorbiaceae famil

Discussion

Observations of the vegetative and reproductive parts of the species studied in terms of qualitative and quantitative measurements made are presented in Table 1 and Plate 1a - 4a. All the seven species studied were observed to possess an actinomorphic floral symmetry, but can only be distinguished by some qualitative characters like: Phylotaxy of the leaf, Leaf type,

presence / absence of petals, type of bracts, terminal flower, leaf pubescent, stipules, sexuality of plant, flower color, leaf type, leaf shape, leaf apex and leaf base as well as some quantitative characters studied ranging from plant height to leaf length and width.

Morphological characters among all the Euphorbiaceae species had been reported by Sangha and Gayatri, (2014). In this study, species belonging to the same genus share same characteristics such as leaf shape, leaf apex, leaf type, phyllotaxy, leaf base, leaf margin, flower position and presence/absence of petals and correspond to the report made by Natasha, (2014). The variation in flower color might be due to genetic factors manifested in biochemical pathways resulting in production and accumulation of different chemicals in the petals.

The results of the dendrogram (morphometric technique) from the twenty one morphological characters used in analyzing the studied species produced three groups at 0.7 along the similarity indices metre. The first group consists of the genus *Jatropha* with *J. curcas* and *J. gossipifolia* which branched at phenolic line 0.8 while the second group consist of the genus *Acalypha* and *Manihot.A. hispida* and *A. wilkesiana* branched earlier at the phenolic line at 0.815 while a distant *M. esculenta* joined at 0.75 along the similarity indices metre. The third group consists of the genus *Euphorbia*: *E. heterophylla* and *E. hirta* joined further along the similarity distance indices meter at 0.715. The result from the dendrogram validated previous systematics on this taxa (Euphorbiaceae), as all operational taxonomic units (OTUs) belonging to same genus grouped together, which is an indication that they are more related to each other. This finding is in agreement with that of other researchers who demonstrated how morphometric techniques can be used to analyze data for biosystematics studies (Onyeweaku *et al.*, 2020; Ozimede *et al.*, 2019).

In conclusion, the seven selected species from the family Euphorbiaceae studied although showed some similar characteristics but these similarities in their morphological attributes are not enough to group them into same genus. The dendrogram buttresses this fact because, it classified species belonging to the same genus on same group as classified originally, thereby validating the existing systematics. Based on this study, it is recommended that the different species studied be left in their original genus since their characteristics conform to other research works but further research should be carried out with other lines of evidence using larger number of species from other genera in this family.

Acknowledgments

The authors wish to acknowledge Rivers State University for providing the enabling environment and well equipped laboratory for the research work.

Reference

- Abdel, A.F, Mohamed, S.A, Mona, H. (2019): Taxonomic evaluation of Euphorbiaceae sensu lata with special reference to Phyllantaceae as a new family to Flora of Egypt. *Biological Forum: An International Journal*, 11 (1): 47 – 64.
- AbdulRahaman, A.A, Aluko, T.A, Oladele, F.A. (2010): Canopy Characteristics, stomatal anatomy and transpiration rate in some shade plants. *Journal of Biological Sciences and Bioconservation*, 2: 20-36.
- AbdulRahaman, A.A, T.A, Oladele, F.A. (2008): Global warming and stomatal complex types. *Ethnobotanical Leaflets*, 12: 553-556.
- Ajuru, M.G. (2018): Morpho-Anatomical Studies of *Gnetum africanum* Welw and *Gnetum buchholzianum* Engl. (Gnetaceae Lindley) in Nigeria. *Journal of Applied Life Sciences International*, 18(4): 1-8.
- Akobundu, I.O, Agyakwa, C.W. (1998): A hand book of West African weeds. (2nd ed.). Ibadan, Nigeria: International Institute of Tropical Agriculture, pp 564.
- Awe, F.A., Giwa-Ajeniya, A.O., Akinyemi, A.A., Ezeri, G.N.O. (2013): Phytochemical analysis of *Acalypha wilkesiana*, *Leucaena leucocephala*, *Pepperomia pellucida* and *Senna alata* leaves. *International Journal of Engineering Sciences*, 2(9): 41-44.
- Awomukwu, D.A., Nyananyo, B.L., Uka, C.J., Okeke, C.U. (2015): Identification of the genus *Phyllanthus* (Family Phyllanthaceae) in Southern Nigeria using comparative systematic morphological and Anatomical studies of the vegetative organs. *Journal of Plant Science*, 3(3): 137-149.
- Bingtao, L., Huaxing, Q., Jin-Shuang, M., Huza, Z., Michael, G., Gilbert, E., Stefan, D., Petra, H., YNN, J., Marig, V., Gordon, D. (2008): Flora of China, Vol. 11 pp 163.
- Burkill, H.M. (1994): The useful plant of west tropical Africa. *Kew, UK: Royal Botanical Gardens* 2: 636.
- CIAT – Centro Internacional de Agricultura Tropical (1983): Morphology of cassava Plant. Google Books, pp 1-49.

- Emergara, U., Balogun, O., Alabi, O. (2018): Economics of physic nut (*jatropha curcas* L.) as influenced by propagation methods, nitrogen levels and weed control at Samaru, Nigeria. *FUDMA Journal of Science*, 2 (2): 244 – 250.
- Hutchinson, J., Dalziel, J.M. (1954): Flora of West Africa (2nd ed.). Kew London, UK: Royal Botanic Garden, pp 137.
- Kumar, S., Malhotra, R., Kumar, D. (2010): Euphorbia hirta: its chemistry, traditional and medicinal uses, and pharmacological activities. *Pharmacognosy Review*, 4 (7): 58 – 61.
- Mike, O., Mubo, A., Temitope, O. (2008): Phytochemical and morphometric analysis of the genus *Acalypha* Linn. (Euphorbiaceae). *Journal of Applied Science*, 8 (17): 3044 – 3049.
- Natasha Nguyen (2014): Convergent evolution of Cacti and Euphorbias. Retrieved: 25-07-2018. [www.plantconvergentevolution..weebly.com/convergent-evolution.html](http://www.plantconvergentevolution.weebly.com/convergent-evolution.html)
- Onyeweaku, G.C., Nyananyo, B.L., Ozimede, C.O. (2020): Taxonomic study on the genus *Cissus* L. (Vitaceae) present in Obio Akpor local government area of Rivers State, Nigeria. *Journal of Applied Sciences and Environmental Management*, 24 (1) 139 – 145.
- Ozimede, C.O, Obute, G.C., Nyananyo, B.L. (2019): Morphological and anatomical diversity study on three species of Amaranthus; namley A. hybridus L, A. viridis L and A. spinosus from Rivers State Nigeria. *Journal of Applied Sciences and Environmental Management*, 23 (10): 1875-1880.
- Sangha, B., Gayatri, M.C. (2014): Ethnomedicinal properties of Euphorbiaceae family – A comprehensive review. *International Journal of Phytomedicine*, 6 (2): 144 – 156.
- Takhtajan, A. (2009): Flowering plants. 2nd edition. Spring publishing.
- Warda, M.D. (2014): A phytochemical and pharmacological study of *Acalypha wilkesiana* var. *macafeana* hort. (Euphorbiaceae JUSS.): Antioxidant and antibacterial analyses.
- Webster G. L. (1994). Classification of Euphorbiaceae. *Annals of the Missouri Botanical Garden*, 81, 3 – 32.