Bioscience Research Communications
Vol. 15, No. 6, December 31, 2003
Printed in Nigeria

0795-8072/2003 $126.00 + 0.00

http://www.klobexpublishers.com

BRC 2003048/15608

Comparative leaf micromorphological characters of the Nigerian species of *Rauvolfia* Linn (Apocynaceae)

A.B. Kadiri* and A.E. Ayodele**

*Department of Botany and Microbiology, Botany Research Laboratory, University of Lagos, Lagos, Nigeria.

**Department of Botany and Microbiology, University of Ibadan, Ibadan, Nigeria.

(Received October 6, 2003)

ABSTRACT: Leaf micromophological characters of *Rauvolfia* Linn. (Apocynaceae) have been studied and compared. The leaf is usually glabrous and hypostomatic. Stomatal type is mostly paracytic but epidermal cell shape is either polygonal or irregular while epidermal cell number is lower on the abaxial surface. Mean stomatal size varies from 1.40µm x 0.60µm in *R.* macrophylla to 2.30µm x 0.60µm in *R. vomitoria* and mean cell wall thickness is either identical on both surfaces in *R. macrophylla* and *R. caffra* or dissimilar on either surface in other species. Other features that show variation are anticlinal wall pattern, stomatal and cell inclusions. Using these micro-characters, the species can be recognised even when the leaves are fragmentary. *Rauvolfia* has therapeutic properties for the treatment of neuropsychiatric disorder and it can be used as aphrodisiac and genital excitant.

Key words: Leaf morphology; Taxonomy; Apocynaceae; *Rauvolfia*

Introduction

Rauvolfia Linn. (Apocynaceae) is an economic genus containing about one hundred species in the World out of which fifteen and four species are presented in Africa and Nigeria respectively (2,6,7,8,9). The Nigerian species are *R. caffra* Sond., *R. vomitoria* Afzel., *R. macrophylla Stapf., and R. mannii* Stapf.

Evans (6) had reported that only one species – *R. serpentina* (L.) Benth. ex Kurz which is restricted to Asia, contains most of the active medicinal substances. However, further studies on the genus have revealed that the African species particularly *R. vomitoria* has the highest medicinal value than any species elsewhere (9,13,15,17),

Furthermore, other Nigerian species apart from R. *vomitoria* also contain the medicinally active ingredients but in varied concentrations. (2,6,9,17). An excellent account of the medicinal properties of the genus has been documented (2,6,9,13,15, 17). Rauvolfia contains hypotensive alkaloids which are non-toxic but have cumulative action. These alkaloids are reserpine, yohimbine, rescinamine, seredine, reserpiline, raumitorine, serpentinine, alstonine, rauvanine, ajmalicine and rauvoxine which are useful for

the elimination of schizophrenia in neuropsychatric patients, they also have a symphatholytic action and are much used in the treatment of hypertension; besides, the above compounds are used as a remedy for the opacities of the cornea, epilepsy, skin diseases, chest pains, internal disorder, restoration of hair loss, combating convulsion, as aphrodisiac and genital excitant.

Rauvolfia species are also important as avenue trees, shade bearers, for live fence and mixing drink hence its name swizzle-stick. Anatomical data have been used by various workers to show taxonomic relationship and delimit taxa (1,5,11,12,14,16). Anatomical report on Rauvolfia has been mostly on the stem and root with scanty account on epidermal morphology (6,11,12).

This study describes the significance of, an discusses the extent to which foliar epidermal characters may be used for identifying sterile plants of each species of *Rauvolfia* which until now is the form in which the medicinal ones are obtained from the local markets or collected by the herbal traders. Apart from responding to the call of Cunningham (3) and Martin (10) on the importance of wild or non-cultivated plants in the lives of a large portion of the world's populations, the study also aims at checking the adulteration of these medicinal plants. Moreso, it also suggests the need for phytochemical screening of the hitherto sterile species: *R. macrophylla* and *R. manni* for their therapeutic properties.

Material and Methods

Dried leaf material obtained from the Forestry Research Institute of Nigeria Herbarium (FHI) was used for the study. Method follows Akhil & Subhan (1), Ogundipe (14), and Olowkudejo & Ayodele (16) with some modification initiated by the author. About $2cm^2$ portion was cut out from the standard median position of the leaf lamina of each specimen and boiled in water for thirty miutes in order to revive it. Each specimen was then soaked in Concentrated Trioxonitrate (V) acid (HNO_3) in a capped specimen bottle for 10-24 hours to macerate the mesophyll. Tissue disintegration was indicated on the leaves by bubbles and the epidermides were transferred into Petri-dishes containing water. Epidermides were separated with forceps and a mounting needle and cleared of debris with soft hair brush. Specimens were washed in several changes of water and dehydrated through 50%, 70%, 90%, 100% grades of alcohol to harden the cells. The specimens were mounted in glycerin after being stained in Safranin O for five minutes. Slides were covered with cover slips and then ringed with nail vanish to prevent dehydration. Specimens were observed at X 400 and drawings of the epidermides were made from Wild M12 microscope fitted with camera lucida.

Result and Discussion

All the Nigerian species are represented in the Southern part of the country but three species are present in the middle-belt areas with only one representative in the Northern Nigeria (Fig. 1).

The epidermal cells are either irregular or polygonal on the adaxial surface but they are uniform on the abaxial surfaces of the species (Fig.2a-h),straight anticlinal wall pattern accompany the polygonal cells on the adaxial surface while the abaxial cells usually have curved to undulate anticlinal walls (Fig. 2a-h). Metcalfe & Chalk (11,12) reported crystals in the Apocynaceae. In this study, crystals are present in all species except in *R. mannii.* Raphides were recorded on the abaxial surface of *R. macrophylla* (Fig.2b) and on the adaxial surfaces of *R. caffra* and *R. vomitoria* (Fig. 2e,f) Sandy crystals were also found on the abaxial surface of *R. vomitoria* (Fig. 2h).

Metcalfe & Chalk (11,12) reported that the leaf is paracytic and pubescent in the general account of the family Apocynaceae. In the present study, the leaf was found to be hypostomatic with mostly paracytic stomata sometimes ac companied by anomocytic stomata. Epidermal cell length is longer on the abaxial surface than adaxial surface in *R. vomitoria* and *R.macrophylla* whereas it is vice-versa in other species (Table 1). Mean epidermal cell number varies from 9 and 5 in *R. mannii and R. caffra* to 21 and 15 in *R. vomitoria* on the adaxial and abaxial surfaces respectively. Usually, epidermal cell number on the abaxial surface is lower than the adaxial surface. Mean cell wall thickness is identical on both surfaces in all species except *R. mannii* and *R. vomitoria.*

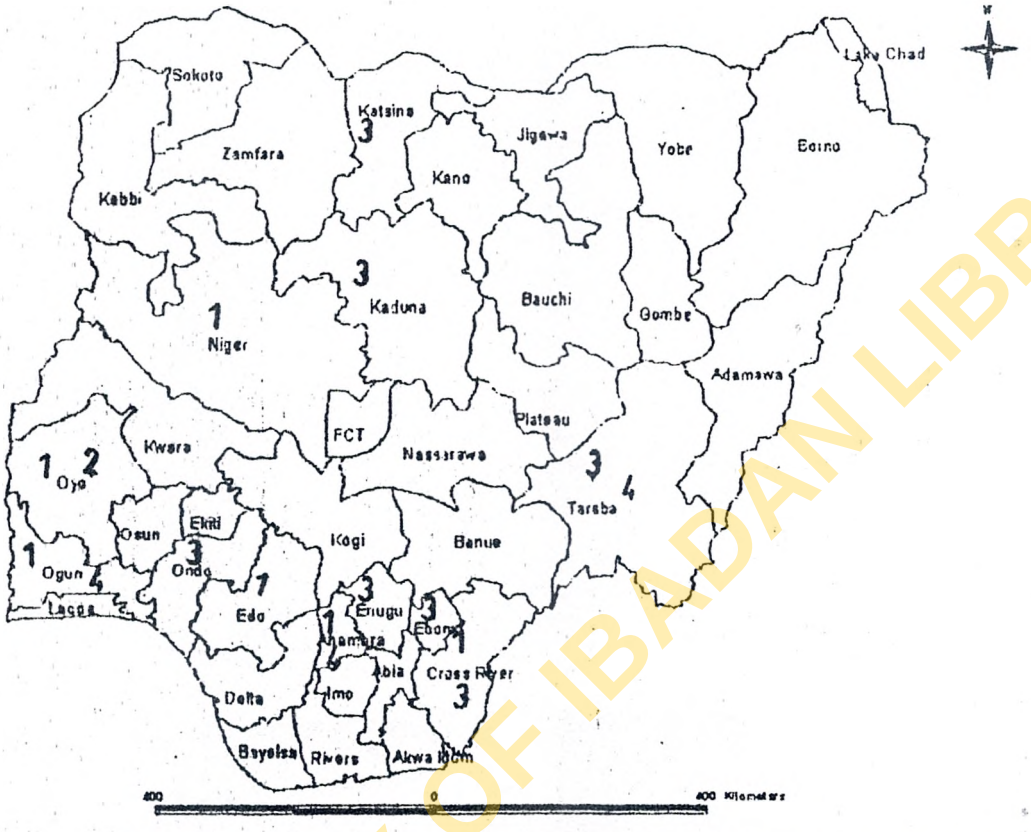

Fig. 1: Map of Nigeria showing distribution of *Rauvolfia* species

1 = *R. vomitoria* 2 = *R. mannii* 3 = *R. caffra* 4 = *R. macrophylla*

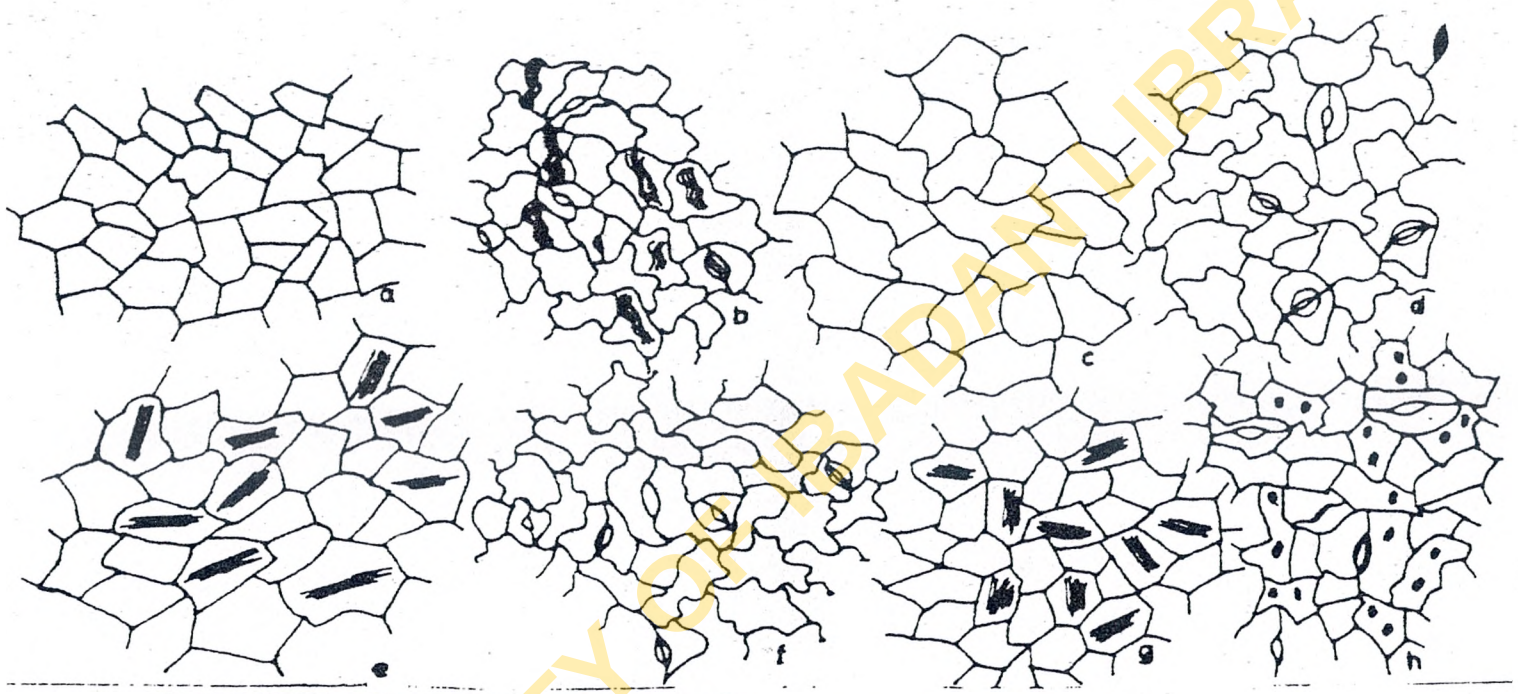

Fig. 2: Epidermides of the four Nigerian species of *Rauvolfia*

a. Drawing of adaxial surface of the leaf of *R. macrophylla* showing polygonal cells with straight anticlinal walls. Scale bar = 0.44µm
b. Drawing of abaxial surface of the leaf of *R. macrophylla* showing irregular cell with curved anticlinal walls and *paracytic* stomata. Scale bar = 0.44. µm
c. Drawing of adaxial surface of the leaf *R. mannii* showing polygonal cells with straight to curved anticlinal walls. Scale bar = 0.44 µm .
d. Drawing of abaxial surface of the leaf of *R. mannii* showing irregular cells with undulate to sinuate anticlinal walls and paracytic stomata. Scale bar = 0.44 µm
e. Drawing of adaxial surface of the leaf of *R. caffra* showing polygonal cells with straight to curved walls and raphides in some cells. Scale bar = 0.44µm
f. Drawing of abaxial surface of the leaf of *R. caffra* showing irregular cells with undulate to sinuate anticinal walls and paracytic stomata
g. Drawing of adaxial surface of the leaf of *R. vomitoria* showing polygonal cells with straight walls and containing raphides. Scale bar = 0.44µm
h. Drawing of abaxial surface of the leaf of *R. vomitoria* showing irregular cells with curved anticlinal walls, paracytic stomata and crystal oxalates. Scale bar = 0.44µm

Table 1: Epidermal features of the leaf of *Rauvolfia* in Nigeria.

Taxa		Cell Length (µm)	Cell Width (µm)	Cell Number	Cell wall thickness (µm)	Stomatal length (µm)	Stomatal width (µm)	Stomatal Number.	Anticlinal wall pattern	Epidermal cell shape
R. macrophyl la Stapf.	ad	15(25±3.1) 32	10(18.29±2.5) 23	19 (21±0.8)23	0.5(0.5±0.04)0.6	-	-	-	St	P
	ab	17(21.5±1.6)25	6(10.25±1.3)13	13(14±0.3)14	0.4(0.5±0.04)0.6	1.1(1.4±0.1)17	0.5(0.6±0.1)0.8	3(3±0.2)4	Cv	Irr
R.mannii Stapf.	ad	24(31.75± 3.7)40	20(23.75±1.5)28	8(9±0.2)9	0.4(0.5±0.04)0.6	-	-	-	St/Cv	Irr
	ab	23(27.5±2.1) 33	10(15.25±2.4)23	5(5±0.3)6	0.3(0.4±0.04)0.6	1.5(1.9±0.2) 2.3	0.5(0.5±0.03)0.6	1(2±0.1)2	Ud/Sn	Irr
R. caffra Sond.	ad	23(31.25±3.0) 40	20(22.25±0.9)25	7(9±0.6)9	0.3(0.4±0.04)0.5	-	-	-	St/Cv	P
	ab	20(25.25±2.0)30	10(15.5±1.8) 20	5(5±0.3)6	0.3(0.4±0.04)0.5	1.5(1.5±0.03) 1.7	0.2(0.4±0.1) 0.6	4(5±0.2)5	Ud/Sn	Irr
R. vomitoria Afzel.	ad	15(21.75±2.2)27	12(15±2.5)26	17(21±1.2)23	0.3(0.5±0.04)0.6	-	-	-	St	P
	ab	22(24.5±1.2) 28	5(11.75±2.8)19	13(15±0.6)17	0.2(0.3±0.03)0.6	1.8(2.3±0.2) 2.7	0.5(0.6±0.1) 0.8	2(2±0.3)3	Cv	Irr

Ud = Undulate. Cv = Curved. St = Straight. P = Polygonal. Irr = Irregular. ad = Adaxial ab = Abaxial. Sn = sinuate

The smallest mean stomata number of 2 was recorded in *R. mannii and R. vomitoria* whereas highest values of 5 was recorded in *R. caffra.* Mean stomatal width is 0.60µm in *R. macrophylla* and *R. vomitoria,* 0.50µm in *R. mannii* and 0.40µm in *R. caffra.* The longest stomata of 1.80 (2.3 ± 0.2) 2.70µm x 0.50 (0.6 ± 0.1) 0.80µm were recorded in *R. vomitoria* whereas the shortest stomata of 1.10 (1.4 ± 0.1) 1.70µm x 0.20 (0.4 ±0.1) 0.60µm was found in *R. macrophylla* (Table 1). From this study, it is revealed that the species show a remarkable affinity and a high level of interrelationship.

Evans (6) reported that *R. caffra* resembles *R. vomitoria* in its therapeutic use based on the studies of their root anatomy. Apart from *R. vomitoria* and *R. caffra* it is therefore suggested that other species discussed in this study should be screened for their therapeutic properties. Akhil & Subhan (1), Ogundipe (14), Olowokudejo & Ayodele(16).have reported that micromorphological data are a good source of taxonomic information and have been used to delimit taxa and recognise useful plants.

Key to the four Nigerian species of *Rauvolfia (Linn.)*

1. Epidermal cell shape polygonal on adaxial surface
2. Mean cell wall thickness identical on both surfaces
3. Epidermal cell number up to ..... *.R. macrophylla*
3. Epidermal cell number less than 10 .....*R. caffra*
2. Mean cell wall thickness different on either surface
4. Cell inclusions present .....*R. vomitoria*
1. Epidermal cell shape irregular on adaxial surface
4. Cell inclusions absent..... *R. manni*

References

1. Akhil, B and Subhan, C.N (1997). Foliar epidermal characters in twelve species of *Cinnamomum Schaeffer* (Lauraceae) from North Eastern India. *Phytomorphology* 47(2): 127-134.
2. Burkill, H.M (1985). *The Useful Plants of West Africa* V.I.(A-D). Whitefrairs Press Ltd. Kent. 960 pp.
3. Cunningham, A. B. (2001). *Applied Ethnobotany.* Earthscan Publication Ltd. London. 300pp
4. Dalziel, J.M. (1937). *The Useful Plants of West Tropical Africa.* Crown Agents for the Colonies. London. 612pp.
5. Davis, P.H. and Heywood, V.H. (1963). *Principles of Angiosperm Taxonomy* R.E. Kreigner Publishing Co. New York. 556pp.
6. Evans, W.C. (1996).*Trease and Evans' Pharmacognosy.* W.B. Sanders Co. Ltd. London. 612pp.
7. Heywood, V.H. (ed) (1978). *Flowering Plants of the World.* Oxford University Press. Oxford. 336pp.
8. Hutchinson, J. and Dalziel, J.M. (1963). *Flora of West Tropical Africa* Vol. 2: Crown Agentsfor Overseas Government and Administrations. London. 544pp.
9. Lambo, T.A. (1984). *Medicinal Plants in Tropical West Africa.* Cambridge University Press. Cambridge. 375pp.
10. Martin, G.J. (1995). *Ethnobotany: A methods manual.* Chapman & Hall. London 268pp
11. Metcalfe, C.R. and Chalk, L. (1950). *Anatomy of the Dicotyledons.* Clarendon Press, Oxford. 1500pp.
12. Metcalfe, C.R. and Chalk, L. (1979). *Anatomy of the Dicotyledons* (2nd ed) V.I Clarendon Press, Oxford. 276pp.
13. OAU/STRC. (1985). *African Pharmacopoeia.* OAU/STRC Scientific Publications No. 2 V.I Lagos, Nigeria. 256pp.
14. Ogundipe, O.T. (1992). Leaf Epidermal Studies in the *genus Datura Linn.* (Solanaceae). *Phytomorphology.* 42(3&4):209-217.
15. Oliver, B. (1960). *Medicinal Plants in Nigeria.* College of Arts, Science and Technology. 138pp.
16. Olowokudejo, J.D. and Ayodele, A.E. (1997). Systematic importance of leaf and epidermal characters in West Africa species of family Myrtaceae. *Bot. Soc. Brot. Ser.* 2, 68:35-72
17. Samba Murty, A.V.S.S. and Subrahmanyam, N.S. (1989). *A Textbook of Economic Botany.* Wiley Eastern Ltd. New Delhi. 875pp.
18. Thiselton-Dyer, W.T. (1904). *Flora of Tropical Africa.* L. Reeve and Co. Ltd. Kent. 646pp.