

Morphological and Epidermal Studies on Certain Species of *Napoleona* P. Beauv. (Lecythidaceae) in Nigeria

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Abstract A comparative study of the morphological and foliar epidermal characteristics of three species of *Napoleona* Beauv., *N. imperialis* P. Beauv., *N. vogelli* Hook. and Planch and *N. gossweileri* Baker f. was carried out by simple light microscopy. While *N. imperialis* and *N. vogelli* are shrubs, with the bark, smooth, shallow and fibrous, *N. gossweileri* is a woody climbing liane, with thick-barked stem. Significant variations in leaf size, flower colour, fruit shape and colour when ripe and stomatal type which could be exploited for taxonomic purposes were observed among the species. The study aims at contributing morphological and epidermal information on the scanty literature available on the species which have potentials for medicinal, ornamental and food purposes.

Keywords Epidermal Characteristics, Lecythidaceae, Morphology, *Napoleona*

1. Introduction

The family, Lecythidaceae is a small tropical family that grows in all regions of Nigeria[1]. The plant, *Napoleona*, is commonly known as *nkpodu* among the Igbo tribe of Nigeria. The sweet pulp around the seeds is eaten especially by children. The genus, named in honour of Emperor Napoleon 1 comprises mostly shrubs with some species being lianes[1]. The leaves are completely glabrous, entire, acuminate with a cuneate base. The leaf margins have distinctive shallow glands at irregular intervals, but this character is rather variable and in some species, the glands are confined to the leaf base[2]. The flowers are multi-coloured and often conspicuous. Petals are united into a disc and measure up to 5cm in diameter with ragged edges, two rows of staminal teeth spread out flat, the inner forming a cup with upright petaloid teeth. The fruits are crowned by the persistent calyx, deeply lobed and more or less globose, yellowish or reddish when ripe and slightly warted. There are several large seeds shaped like the segments of an orange and surrounded by a gelatinous pulp[2].

The three species of *Napoleona* studied, *N. imperialis* P. Beauv., *N. vogelli* Hook. & Planch and *N. gossweileri* Baker f. are economically important. They are significant as medicinal plants and sources of food but no detailed comparative work on these species has been done to date.

This paper forms part of a research carried out on various aspects of the biosystematics of the genus aimed at providing basic morphological and micro-morphological data on these species for taxonomic and breeding purposes.

2. Materials and Methods

Studies were made on living plant materials collected during field trips to various parts of Nigeria. Materials from plants raised from seeds and cuttings nurtured in the University of Port Harcourt Botanical Garden were also used. Morphological studies were made from observations of live specimens and quantitative measurements of vegetative and floral parts were taken. For epidermal studies, the middle portion of some of the fresh leaves obtained were cut out and soaked overnight in sodium hypochlorite. The material was then carefully picked from the container using fine forceps and placed in a watch-glass containing distilled water. The material was rinsed in three changes of distilled water and adhering cells on the epidermis were dusted off using camel hair brush. The strip of epidermis required was stained in 1% safranin and mounted in glycerine. Photographs of good preparations were taken using a Leitz Diaplan photomicroscope fitted with Leica WILD MPS 52 camera. Voucher specimens were deposited in the University of Port Harcourt Herbarium.

3. Results

3.1. Morphological Characters

The habit, vegetative and floral morphology of the three

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species of *Napoleona* P. Beauv. studied is summarized in Table 1 and shown in Figures 1- 6. *N. imperialis* thrives on the under-storey of forest, thus, it is often found in abundance in the forest, especially in a primary forest. It is a shrub of about 6m high. The leaves are large, reaching $27-30 \pm 1.5\text{cm}$ in length and $8-11.5 \pm 0.8\text{cm}$ in width; glabrous, oblong-elliptic, simple, entire, elongated, abruptly acuminate, rounded at the base, glossy, "Figure 1". The glands at the base of the acumen conspicuously stand out as small teeth. The petiole is $1.0\text{cm} - 1.2 \pm 1.0\text{cm}$ long and $0.2 - 0.4 \pm 0.3\text{cm}$ wide. The bark of the stem is grey, smooth, slash whitish, shallow and fibrous. Branches are whorled. The showy flowers often occur on the main branches and trunk as well as among leaves. They are solitary, $4.5 - 5.0 \pm 0.5\text{cm}$ long and $5.0 - 5.5 \pm 0.6\text{cm}$ wide. The flowers are variable in colour, petals are cream-yellow with purple lines, dark red at the base, white staminodes with leathery calyx, valvate, glabrous, with about five triangular teeth. The stigma is pink; the calyx tube is $4.0-5.0 \pm 0.5\text{cm}$ long. The fruit is brown with white spots, flattened globose with a depressed centre, $4.0-4.5 \pm 0.5\text{cm}$ in diameter, a berry, woody and fleshy, Figure 2". The seeds are brownish in colour, 5 – 10 in number, embedded in the fruit pulp, $1.5 \pm 0.2\text{cm}$ by $1.0 \pm 0.1\text{cm}$ wide. The seed mucilage is intensely sweet to taste and edible.



Figure 1. Vegetative and Floral macro-morphological features of *N. imperialis*, Arrow shows open flower at maturity

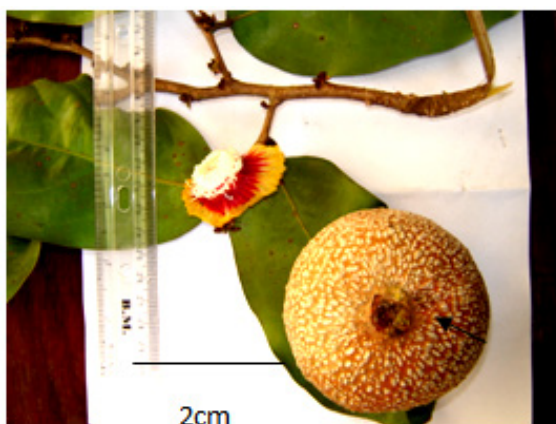


Figure 2. *N. imperialis* showing the mature fruit



Figure 3. Leaves and flower of *N. vogelli*

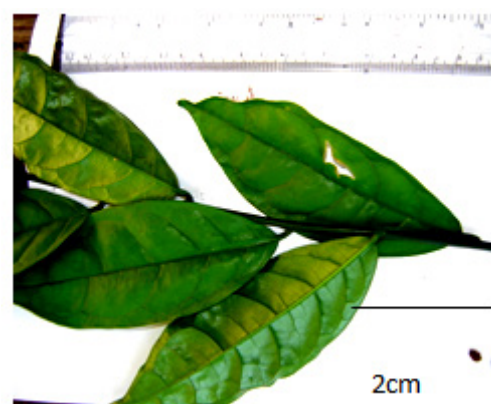


Figure 4. Leaves of *N. gossweileri*



Figure 5. Roots of *N. gossweileri*

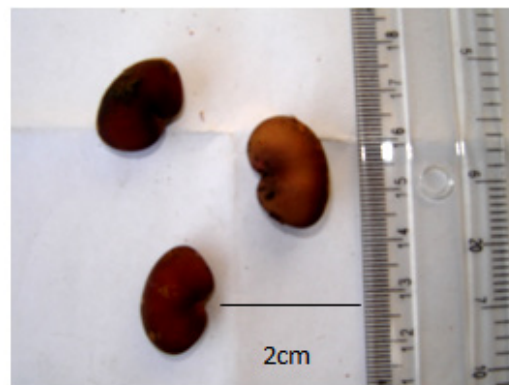


Figure 6. Seeds of *Napoleona* species

N. vogelli is a water-loving plant. Thus, it is often found in abundance by streams and close to the seashore[3]. It is a shrub of about 6m high. The leaves are shortly acuminate, oblong - elliptic, shortly cuneate at the base, $13.0 - 15.0 \pm 1.2$ cm long, $5.0 - 7.5 \pm 0.5$ cm wide, glabrous, closely reticulate beneath, lateral nerves ascending within the margin, "Figure 3". The petiole is $0.6 - 0.8 \pm 0.4$ cm long and 0.1 ± 0.01 cm wide. Flowers are solitary, $4.0 - 4.5 \pm 0.5$ cm long and $4.5 - 5 \pm 0.6$ cm wide and brilliantly attractive. The fused petals are cream-yellow at the apex and dark-red at the apex with two whorls of staminodes forming a floral crown with leathery calyx, glabrous, with about five triangular teeth of. The calyx is $3.5 - 4.0 \pm 0.4$ cm long and five in number. The flower is bisexual. The fruit of *N. vogelli* is a berry, orange brown with white spots, sub globose with a depressed base, and $3.0 - 4.0 \pm 0.3$ cm in diameter. The five - twelve seeds are surrounded by a sweet, edible pulp.

N. gossweileri is a woody climbing liana, rhizomatous, up to 14.0 ± 1.1 m high, with several shoots from the base, forming dense colonies in woodland. The root is soft wooded

with thick bark. It is used to cure fevers and arrow poisons are reportedly produced from the bark[4]. The stem slash and roots have strong pungent smell. The leaves are acuminate, simple, elliptic, cuneate at the base, $7.5 - 14.0 \pm 1.0$ cm long and $2.5 - 5.5 \pm 0.6$ cm wide, glabrous, lateral nerves ascending within the margin, "Figures 4 & 5". The petiole is $0.6 - 0.8 \pm 0.4$ cm long and 0.1 ± 0.01 cm wide. The flowers are solitary, $4.0 - 4.5 \pm 0.7$ cm long and $4.5 - 5.0 \pm 0.8$ cm wide, cream - yellow at the apex, purple at the base, white to milky staminodes with leathery calyx, which is 5 in number and free. Calyx tube is $4.0 - 4.5 \pm 0.5$ cm long. Flowers are bisexual with sweet scent. The fruit is a red berry and conically shaped and $3.5 - 4.0 \pm 0.2$ cm long and 4.0 ± 0.2 cm wide. When ripe, it is reddish in colour but covered by grayish - green scales on the surface. It is warty, irregular, globose and many-seeded. The seeds are three - eight in number and are embedded in the fruit pulp. They are 1.5 ± 0.2 cm by 1 ± 0.1 cm in size, and covered by mucilage which is intensely sweet to taste. The seed kernel is slightly sweet to taste, "Figure 6".

Table 1. Vegetative and Floral Characteristics of *Napoleona* Species

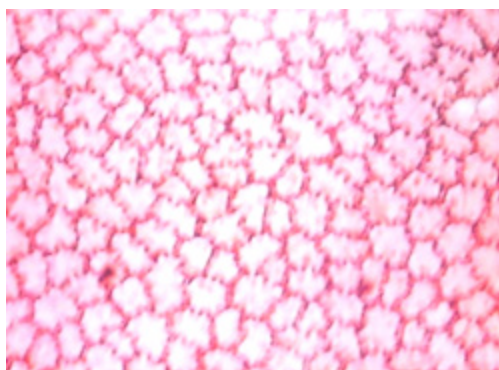
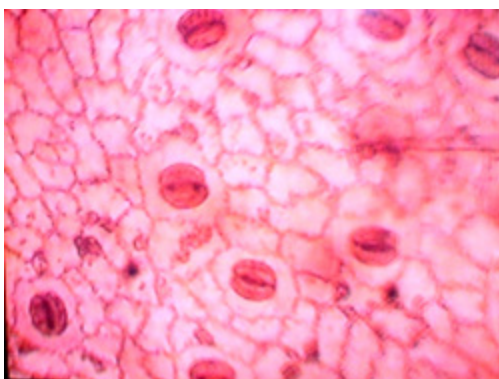
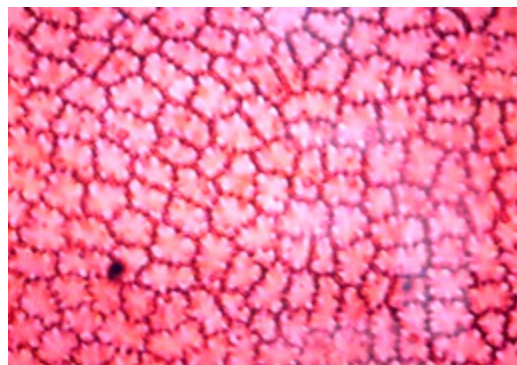
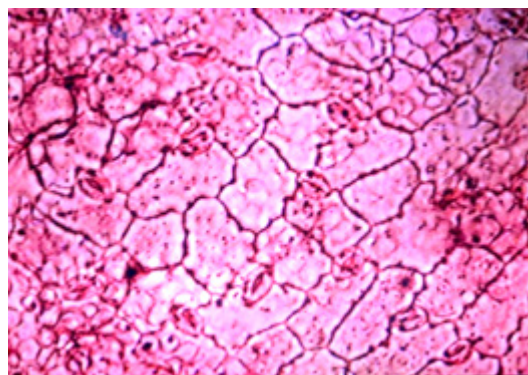
Character	<i>N. imperialis</i>	<i>N. vogelli</i>	<i>N. gossweileri</i>
Plant duration	Perennial	Perennial	Perennial
Habit	Shrub	Shrub	Lianes
Stem	Branched low down	Branched low down	Rhizomatous
Bark colour	Grey and slashed white	Grey and slashed white	Grey and slashed white
Leaf type	Simple	Simple	Simple
Leaf form	Broadly elliptic	Broadly elliptic	Elliptic
Leaf apex	Acuminate	Acuminate	Acuminate
Leaf base	Cuneate	Cuneate	Cuneate
Leaf arrangement	Alternate	Alternate	Alternate
Leaf surface	Glabrous	Glabrous	Glabrous
Leaf venation	Reticulate	Reticulate	Reticulate
Petiole	Present	Present	Present
Inflorescence	Usually solitary	Usually solitary	Solitary
Inflorescence position	Axillary	Axillary	Axillary
Flower colour	Cream-yellow at the apex with purple lines, dark red at the base	Cream - Yellow at the apex, dark red at the base	Cream - yellow at the apex, purple at the base
Position of ovary	Inferior	Inferior	Inferior
Sexuality of flower	Bisexual	Bisexual	Bisexual
Flower size	$4.5 - 5.0 \pm 0.5$ cm long and $5 - 5.5 \pm 0.6$ cm wide	$4.0 - 4.5 \pm 0.5$ cm long and $4.5 - 5.0 \pm 0.6$ cm wide	$4.0 - 4.5 \pm 0.7$ cm long and $4.5 - 5.0 \pm 0.8$ cm wide
Fruiting period	April - June	May - July	Dec. - Feb.
Aestivation	Imbricate	Imbricate	Imbricate
Fruit colour	Brownish with white spots	Orange brown with white spots	Reddish but covered with grayish - green scales
Fruit size	$4.0 - 4.5 \pm 0.5$ cm in diameter	$3.0 - 4.0 \pm 0.3$ cm in diameter	$3.5 - 4.0 \pm 0.2$ cm in diameter
Androecium type	Basifixed	Basifixed	Basifixed
Placentation type	Axillary	Axillary	Axillary
Fruit type	Berry	Berry	Berry
Seed size	1.5 ± 0.2 cm by 1.0 ± 0.1 cm wide	1.5 ± 0.2 cm by 1.0 ± 0.1 cm wide	1.5 ± 0.2 cm by 1.0 ± 0.1 cm wide

Table 2. Epidermal Cell Characteristics of the *Napoleona* Species Studied

	<i>N.imperialis</i>	<i>N.vogelli</i>	<i>N. gossweileri</i>
Epidermal Cell Shape:			
Adaxial	Highly wavy	Wavy	Wavy
Abaxial	Highly wavy	Slightly wavy	Slightly Wavy
Anticlinal wall	Highly sinuous on both surfaces	sinuous	Sinuous
No. of epidermal cells per view	515	522	489
Stomatal index	36.80	34.91	29.02
Stomatal type	Anisocytic	Anomocytic	Anisocytic

3.2. Micro-morphological Characters

The epidermal cell shape is wavy / irregular in both surfaces of *N. gossweileri* and *N. vogelli*, “Figures 7-10” but highly irregular in *N. imperialis*, “Figures 11&12”. The anticlinal wall is sinuous on the adaxial surfaces of the three species but quite significantly so on both the abaxial and adaxial surfaces of *N. imperialis*. The distribution of stomata is hypostomatic in the three species. The stomatal type in *N. imperialis* and *N. gossweileri* is anisocytic. *N. vogellii* has anomocytic stomata. The guard cells in *N. imperialis* and *N. vogelli* are raised while in *N. gossweileri*, the guard cells are on the same level with the adjacent epidermal cells. In general, the stomata are longer than they are wide in all the collections studied.

**Figure 7.** Adaxial epidermis of *N. gossweileri* showing sinuous anticlinal walls**Figure 8.** Abaxial epidermis of *N. gossweileri* showing anisocytic stomata**Figure 9.** Adaxial epidermis of *N. vogelli***Figure 10.** Abaxial epidermis of *N. vogelli* showing anomocytic stomata**Figure 11.** Adaxial epidermis of *N. imperialis* showing sinuous anticlinal walls

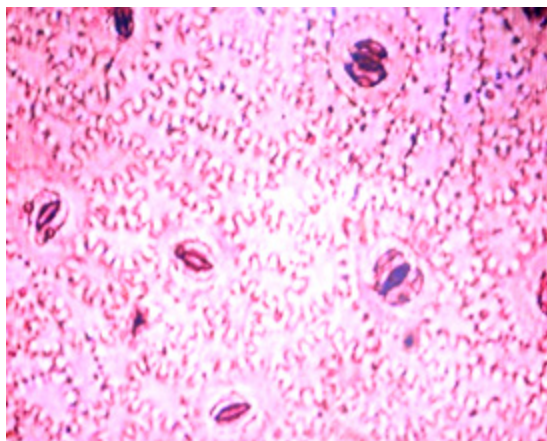


Figure 12. Abaxial epidermis of *N. imperialis* showing anisocytic stomata and highly sinuous anticlinal walls

4. Discussion

Our observations indicate that there are no significant morphological differences between *N. imperialis* and *N. vogelli* even though *N. imperialis* has longer and wider leaves than *N. vogelli*. This may be due to environmental effect on the plants. The two species in general have similar epidermal features. Differences observed have to do with the degree of waviness of the epidermal cells and in *N. imperialis* possessing anisocytic stomata while the stomatal type in *N. vogelli* is anomocytic. The closeness in character is so much that the two species may now be considered as constituting a *Napoleona imperialis-vogelli* complex. More studies involving, for example, cytogenetics and phytochemistry would, however, throw more light on their precise relationship. In contrast, the variation between them and *N. gossweileri* is big. In the first place, *N. gossweileri* is a liane while *N. imperialis* and *N. vogelli* are shrubs. The morphological differences between *N. gossweileri* on one hand and *N. imperialis* and *N. vogelli* on the other hand are thus significant enough to warrant their being considered distinct species. This position is further buttressed by the significant differences in their stomatal indices as shown in Table 1. The importance of stomatal index in delimiting species within a genus had been highlighted by [5] as well by [6] in their study of the genus *Abrus* and [7] on *Telfairia*.

The marked absence of trichomes, both covering and glandular types on leaves of all three species must be considered not only diagnostic but also of ecological significance. It is hardly surprising though since they are found nearly exclusively in the rain forest regions of the

country.

Further studies on these little known species with a view to optimally exploiting their medicinal, ornamental and nutritive potentials are highly recommended.

5. Conclusions

The closeness in character between *N. imperialis* and *N. vogelli* is so much that the two species may now be named *Napoleona imperialis-vogelli* complex. Further investigations especially in cytogenetics and phytochemistry may provide relevant information to authenticate the classification of these species.

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