Comparative Micromorphological Studies on Two Landolphia Species in North Central Nigeria

C.U. Aguoru; A. Ahemen and J.O. Olasan

Department of Biological Sciences, 
University of Agriculture, Makurdi. Nigeria

Corresponding Author: C.U. Aguoru

Abstract
Two species of Landolphia were studied in the North central axis of Nigeria using micro-morphological features with a view to exploiting the biosystematics and taxonomic importance of the features obtained. Landolphia had been known to have taxonomic complexity. Plant materials of the two species were collected from different locations within the study area and leaf epidermal layers were microscopically prepared, stained and viewed. Leaf epidermal features were characterized and compared. Results showed huge differences in the stomata types and stomata indices that are of taxonomic significance and separate the species but epidermal cell shapes were of the same dimensional pattern and affirms inclusion in the same genus. Though stomata were hardly observed on the adaxial surfaces of the two species, the abaxial surface of L. capensis possessed three types of stomata: tetracytic, anomocytic and anisocytic while L. owarenensis had two types: paracytic and anisocytic. Coupled with the differences in the number of epidermal cells, the stomata indices of L.capensis and L.owarenensis were 73.35% and 35.5% respectively. Therefore, the former species possessed more stomata complex types and stomata density than the latter. This separates the species and reinforces their being treated as separate ones. This data on the two Landolphia are maiden and available for the first time. This study therefore clearly separated the two species based on their unique epidermal characters as micro-morphological and micro-anatomical evidences and has clearly shown the taxonomic value of epidermal features in this genus.

Keywords: micromorphology, landolphia species, stomata, epidermis, taxonomy

INTRODUCTION
The genus Landolphia belongs to the family Apocyanaceae which has 40 Genera and 113 accepted groups. The genus was first discovered in 1806 in different locations in the south eastern part of Nigeria especially in Alayi (Abia state) and Owerri (Imo state) where it is now known to be commonly distributed. Landolphia is a liane climbing to 12m or more, and contains milky latex when the young bark or the unripe fruits are damaged. Some species such as (L.gentili, L.heudenlotii, L.owarenensis and L.capensis) are considered to have commercial useful amount of milky latex. Plant ecologists have long sought to classify the bewildering variety of plants species into a manageable number of functional types that could be used to represent the essential characteristics of a particular biome or vegetation of geographic areas (Wright, 2005b; Lavorel et al., 2007). Functional types have being useful in modeling the process of succession and especially in recent years, the response of vegetation to changing of climatic factors (Wright et al.,2004b ; Schnitzer and Bongers,2011).

Climbers also known as vines or lianas are plants rooted in the soil that are incapable of autonomous vertical growth above a certain height and must rely on external support. These plants have long attracted the interest of biomists because of their peculiar climbing mechanisms (Darwin, 1865), biochemical characteristics (Rowe et al., 2004; Ewers et al., 1991), extraordinary developmental plasticity (Lee and Richard, 1991) and other unusual but easily identifiable characteristics associated with this growth form. Lianas (Landolphia species) constitute a major functional type in temperate and especially in the tropical zones by their increasing presence and even dominance in disturbed vegetations and the discoveries of the multifaceted role they play in forest dynamics (Schnitzer et al., 2012, Wright et al., 2004a, Selaya et al., 2007, Schnitzer et al., 2012) as well as by the weedy nature and economic problems caused by some of these species. Over the years, it has become increasingly clear that a number of questions still need to be answered with respect to biological characterization of lianas as a group whereas external morphological and the underlying anatomical features as well as the physiology of climbing mechanisms have been extensively being investigated and reviewed.

The foliar epidermis is one of the most noteworthy taxonomic studies of a number of families are made on the basis of leaf epidermis. Although taxonomists lately realized the importance of microscopic features of the epidermis, taxonomic monographs are now considered incomplete without them (Rejdali, 1991). The role of anatomical data in traditional taxonomy
has been long recognized since the variations within the species, genera or a family is usually reflected in anatomical features as well. Leaf epidermal anatomical features such as stomata, trichomes and other characters are useful anatomical tools. Although studies conducted on grass morphology and wood anatomy of the plant have provided valuable information in the identification of the plants, identification criteria would be incomplete without forliar epidermal morphology (Kadiri, 2006). The characters, which have proven to be of systematic value, are cuticular characters, epidermis, stomata, subsidiary cells and trichomes (Ellis, 1976). This study therefore aimed at comparing two species of Landolphia in the North central part of Nigeria using leaf epidermal anatomical features as taxonomic evidences to characterize and delimit the species. This provides the biosystematics evidence for the first time on the value of epidermal features taxonomically in the genus under study. It shall also contribute in resolving the taxonomic complexity of the genus.

MATERIALS AND METHOD
Two species of Landolphia (L.owarensis and L.capensis) were identified by plant taxonomist in the Botany unit in the Department of Biological Sciences, University of Agriculture, Makurdi Nigeria. They were collected across different locations within Benue State and fresh leaves of each species were macroscopically and microscopically investigated in the Advanced Biology Laboratory of the University. Following standard methods, microscopic preparations of the epidermal layers were prepared, stained with safranin and mounted on the trinocular microscope fixed to a digital camera. Ten fields of view were observed per slide. A total of 40 slides were prepared from the leaf of each species. Epidermal parameters such as number of stomata, number of epidermal cells, type and nature of stomata, presence or absence of trichome and other features were noted. Dilcher’s (1974) method of identifying stomata complex types was adopted. Stomata indices were calculated using a standard formula. Photomicrographs were obtained and compared accordingly.

RESULTS AND DISCUSSION
The two Landolphia species studied had hypostomatic leaves, that is, they have stomata only on one leaf surface (abaxial). The only epidermal structure of taxonomic value is the stomata. In the two species, anisocytic stomata were the most dominant followed by anomocytic, paracytic and tetracytic stomata. However, L.capensis shared 3 of these stomata types (figure 1a, 2a,) whereas L.owarensis had 2 types of stomata (figure 1b, 2c). There were more stomata on the abaxial surface of L.capensis than that of L.owarensis. Coupled with the differences in the number of epidermal cells, the stomata indices of L.capensis and L.owarensis were 73.35% and 35.5% respectively (table 1). Therefore, the former species possessed more stomata complex types and stomata density than the latter. The two species lack trichomes. Epidermal cell shape on both abaxial and adaxial leaf surfaces had similar patterns of shapes ranging from 4-6 dimensional structures (figure 2b, 2d). The demarcation of species on the basis of epidermal cell shape used by Dilcher (1974) totally deviated from this report. This finding partly agrees with the report of Ogunkunle and Oladele (2000) on the characterization of Landolphia species. However, it totally aligns with reports of Olowokudejo and Pereira-Sheteolu (1988) where species of Ocimum( Lamiaceae) were partitioned and their taxonomic values were determined using epidermal characters. Aguoru and Okoli (2012) however used petiole and stem anatomical features in separating West African species of Mormodica.

Species morphological views and measurements (figure 3a and 3b) showed slight differences and thus confirms the need to explore other means of differentiating them such as comparative micromorphology as used in this work. Though floral morphology may have provided useful information in characterizing the two species, but that could not be achieved as they have different lengthy periods of flowering and fruiting.

The presence of well modified stomata types and their subsidiary cells may be of importance in the overall survival of Landolphia species since they are known to survive even in dry season as xerophytic climbers. It thus suggests that this unique characteristic may have contributed to the physiological regulation of water loss. This is because lianas have been implicated in modeling the process of succession and in the response of vegetation to changing climatic factors (Wright et al., 2004b; Schnitzer and Bongers, 2011). In view of the above findings, the two species (L.capensis and L.owarensis) are distinct species of Landolphia which have been taxonomically partitioned on the basis of their unique epidermal characters. However, it is suggested that more intensive research needs to be undertaken on other species through the adoption of more advanced taxonomic methods such as molecular and phytochemical characterization. Furthermore, the physiological mechanisms of the stomata which may account for the xerophytic adaptation of the plant need to be thoroughly investigated in the near future.
Table 1: Leaf micromorphological features of L.capensis and L.owarensis

<table>
<thead>
<tr>
<th>Species</th>
<th>Leaf surface</th>
<th>Stomatal complex</th>
<th>Stomata number</th>
<th>Epidermal cells</th>
<th>Stomata index (%)</th>
<th>Epidermal cell shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>L.capensis</td>
<td>abaxial</td>
<td>Tetracytic</td>
<td>234</td>
<td>85</td>
<td>73.35</td>
<td>4-6 dimensional shapes</td>
</tr>
<tr>
<td>L.capensis</td>
<td>adaxial</td>
<td>Absent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.owarensis</td>
<td>abaxial</td>
<td>Paracytic</td>
<td>125</td>
<td>227</td>
<td>35.5</td>
<td>4-6 dimensional shapes</td>
</tr>
<tr>
<td>L.owarensis</td>
<td>adaxial</td>
<td>Absent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig 1a: L.capensis stomata type

Fig 1b: L.owarensis stomata type

Fig 2a: L.capensis lower surface (x400) Fig 2b: L.capensis upper surface (x400)

Fig 2c: L.owarensis lower surface (x1000) Fig 2d: L.owarensis upper surface (x400)
REFERENCE


