Pharmacognostic standardization of *Andrographis paniculata*. Nees. (Acanthaceae)


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Abstract

*Andrographis paniculata* Nees. is an annual herb used in traditional medicine for the treatment of gastrointestinal and upper respiratory infections, fevers, herpes, sore throat and a variety of other chronic and infectious diseases. The plant is also used as an anti-inflammatory, hepatoprotective, antiviral and immune boosting herbal medicine. Microscopical and chemomicroscopical studies were carried out on powdered leaves, anatomical sections and floral parts of the plant to determine its pharmacognostic profile. These investigations revealed the presence of characteristics distribution of cystoliths (specialized cells containing chemical constituents) on both epidermal layers; a layer of palisade cells below the upper epidermis containing oil globules, paracytic stomata, uniseriate trichomes, glandular trichomes, non-granular pollen grains, and cutin. These findings could serve in the identification and preparation of a monograph on the plant.

Keywords: Pharmacognostic standardization, *Andrographis paniculata*. Plant anatomy.

Introduction

The plant *Andrographis paniculata* Nees, family Acanthaceae, is an annual, erect herb growing between 0.5 to 1 meter in height. It is indigenous to Southern Asia but has been successfully domesticated in Nigeria. It grows in evergreen and deciduous forests as well as in soil type where almost no other plant can be cultivated. The plant has been used for centuries in China and Thailand where it is extensively cultivated. In traditional medicine, the plant is used as an anti-tuberculosis, analgesic, anti-inflammatory, antiviral, immune enhancer, hepatoprotective and antimicrobial herbal medicine. 12345 Reported phytochemical screening of the plant indicated presence of arabinogalactan proteins, paniculide, 14-deoxy-11-dehydroandrographolide, andrographolide 6,7. Macroscopical, microscopical and chemomicroscopical studies were carried out on the powdered, anatomical sections of the leaves and floral parts of the plant grown in Nigeria, to determine its pharmacognostic profile, with the aim of producing a monograph on it.

Materials and method

Plant collection and identification

The leaves and floral parts of the *A. paniculata* were collected in April 2004 from the medicinal plant garden of the National Institute for Pharmaceutical Research and Development (NIPRD) Abuja. The plant was identified and confirmed by Mrs. A. J. Ibrahim of the Institute’s herbarium unit, with a deposited voucher specimen.
Macroscopic investigation
The macroscopic description of the plant was according to the terms outlined in African Pharmacopoeia (8).

Macroscopic investigation
Anatomical sections and powdered samples of the leaves and floral parts of the plant were prepared and examined to determine the diagnostic profile of the plant. Quantitative leaf microscopy was also carried out to determine some physical leaf constants.

Chemomicroscopic investigation
Chemomicroscopic investigations were carried out on powdered leaf samples of the plant as well as anatomical sections to determine the presence or absence of various chemical constituents.

Results

Macroscopic investigation
The following are description of the observable features of the plant:

<table>
<thead>
<tr>
<th>Stem</th>
<th>(i) Height of the whole plant: 50-100cm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(ii) Shape: Angular</td>
</tr>
<tr>
<td></td>
<td>(iii) Surface: Green in color and glabrous</td>
</tr>
<tr>
<td></td>
<td>(iv) Growth direction: Upwards/Erect</td>
</tr>
<tr>
<td>Leaf</td>
<td>(i) Arrangement: Opposite and decussate</td>
</tr>
<tr>
<td></td>
<td>(ii) Type: Simple</td>
</tr>
<tr>
<td></td>
<td>(iii) Petiole: Sessile</td>
</tr>
<tr>
<td></td>
<td>(iv) Shape: Lanceolate to narrowly elliptic</td>
</tr>
<tr>
<td></td>
<td>(v) Size: 5.0-7.5cm long; 1.0-1.5cm broad</td>
</tr>
<tr>
<td></td>
<td>(vi) Margin: Entire</td>
</tr>
<tr>
<td></td>
<td>(vii) Apex: Acute</td>
</tr>
<tr>
<td></td>
<td>(viii) Base: Cuninate</td>
</tr>
<tr>
<td></td>
<td>(ix) Venation: Reticulate</td>
</tr>
<tr>
<td></td>
<td>(x) Surface: Green (upper surface darker than lower). Glabrous to touch.</td>
</tr>
<tr>
<td>Flowers</td>
<td>(i) Inflorescence: arising from leaf/axils in panicles white and tinted purple</td>
</tr>
<tr>
<td></td>
<td>(ii) Color: 2cm long (small and pedicellate)</td>
</tr>
<tr>
<td></td>
<td>(iii) Size: Gamosepalous, 5 divisions</td>
</tr>
<tr>
<td></td>
<td>(iv) Calyx: Gamopetalous, 4 divisions</td>
</tr>
<tr>
<td>Fruits:</td>
<td>(i) Kind: Simple</td>
</tr>
<tr>
<td></td>
<td>(ii) Dimension: 2cm long</td>
</tr>
<tr>
<td></td>
<td>(iii) Shape: Flattened</td>
</tr>
<tr>
<td></td>
<td>(iv) Insertion: Superior</td>
</tr>
<tr>
<td></td>
<td>(v) Dehiscence: Dehiscent capsule</td>
</tr>
</tbody>
</table>
(vi) Pericarp colour  
(vii) Seeds  
Green  
About 12 in number and small

**Organoleptic Features**
- Leaf taste: Very bitter
- Leaf odour: Pleasantly characteristic

**Microscopic Investigation**

**Leaf**
The epidermal strips of the leaf show presence of roughly polygonal epidermal cells on the upper surface; few short uniseriate trichomes with a rounded base towards the lamina and a few glandular trichomes with labiates (multicellular) head. The lower surface indicated presence of markedly wavy anticinal cells with abundant paracytic stomata (nearly 1 stomata to 3 epidermal cells), specialized oblong cells (Cystoliths) scattered throughout the leaf surface with more on the lower surface, along with glandular trichomes.
The transverse section of the leaf across the midrib indicated presence of a cutin layer on both epidermis, a layer of palisade cells below the upper epidermis, abundant distribution of oil glands scattered in the palisade layer; sub-epidermal layers of collenchyma tissues below both epidermis in the midrib region; and a diffuse layer of mesophyll below the lower epidermis. The leaf anatomy also indicated lignified proto and metaxylem veins and veinlets made up of lignified spiral vessels; sieve plates; a circular calcium oxalate crystals in the parenchmatous cells of the stem pith.

**Flower**
The anatomy of the floral parts presented a corolla lobe made up of a variety of trichomes. This include long thin-walled, whip like multicellular clothing trichomes with labitate heads; short thin walled, whip like, unicellular and multicellular clothing trichomes without heads, with all the trichomes containing oil glands and occasional short stalked glandular trichomes.
The calyx is made up of anticinal epidermal cells on both surfaces; parasitic stomata; abundant characteristic warty walled mono and bicellular covering trichomes (all pointing upwards); a fair distribution of glandular trichomes; oil glands a few long whip-like multicellular trichomes with labitate heads.

**Anther**
The anther wall of the bi-lobed pollen sac is made up of a fibrous layer in surface view, enclosing numerous spherical to ellipsoidal, pollen grains with a nearly smooth exine surface. The grains posses a network of fine pits (radiating from the poles); a relatively uniform size 32-35 μm in diameter; a triple furrow and pore, lacking spines. The anther is suspended by a pair of filaments made up of polygonal cells; a cluster of long whip-like unicellular trichomes, with wide lumen; double stranded non-branching spiral vessels on each side of the filament; oil glands and a characteristic distribution of short stalked thin walled trichomes with enlarged round base occurring towards the base of the filament. The epidermis of the style has elongated polygonal cells along with thin walled multicellular clothing trichomes. Also occurring at the base of the filament are few distinguishing unicellular thin walled spiral trichomes occurring along side short stalked multi-cellular...
glandular trichomes.

**Chemomicroscopic investigation**

**Table 1: Result of chemo microscopic investigation of *A. paniculata* leaf**

<table>
<thead>
<tr>
<th>Test Reagent</th>
<th>Observation</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phloroglucinol + cone.HCl</td>
<td>Xylem vessels showed Red coloration</td>
<td>Lignin present</td>
</tr>
<tr>
<td>Sudan IV solution</td>
<td>Abundant oil glands in the palisade layer of the leaf calyx, corolla and floral components like trichomes turned red</td>
<td>Oil present</td>
</tr>
<tr>
<td>Picric acid solution Tannins</td>
<td>No yellow colour observed</td>
<td>Aleurone grains absent</td>
</tr>
<tr>
<td>Ferric chloride solution</td>
<td>No greenish-black Colour observed</td>
<td>Tannins absent</td>
</tr>
<tr>
<td>80% cone. H₂SO₄</td>
<td>Disappearance of needle like acircular crystals in the pith of the stem.</td>
<td>Calcium oxalate crystals present</td>
</tr>
<tr>
<td>Few drops of Sudan red Solution</td>
<td>Red coloration on the epidermises of the leaf</td>
<td>Cutin present</td>
</tr>
</tbody>
</table>

**Photomicrographs of *Andrographis paniculata*.**

![Upper Epidermis](image1)

![Lower Epidermis](image2)
Fig. 1: Epidermal Micromorphology of Andrographis paniculata x 400

Calyx
- Labiate Head
- Warty cell wall
- Cell wall
- Lumen

Corolla
- Unicellular wall

Fig. 2: Floral Micromorphology of A. Paniculata X 400

Aerial Part of Corolla
- Antirrhinum Epidermal cells

Base Part of Corolla
- Polygonal Epidermal cells

Surface view of Corolla
- Oil globules
- Trichomes
Discussion

The plant *Andrographis paniculata* is a plant that is being intensively investigated for new plant drugs for the treatment of disease conditions; cancers, malaria, cardiovascular diseases, tuberculosis, and HIV/AIDS amongst other debilitating diseases. This is attested to by the volume of research findings on the plant involving determination of its active ingredient (andrographolide); mechanism of actions, safety level, contraindications and confirmation of its efficacy.  

It is therefore obvious, that the establishment of the Pharmacognostic profile on the plant towards its standardization is a necessity. More so as the plant is being cultivated in different regions of the world including Nigeria, apart from its indigenous environment.  

*A. paniculata* from our investigations has dorsiventral leaf arrangement, with a layer of palisade tissue below the upper epidermis. The deposition of Calcium carbonate in elongated...
ovoid cells (cystoliths) on both epidermis confirms the classification of the plant in the
Acanthaceae family, to which Hypoestes species also belong as Cystoliths are common
occurrence in the family.
The calyx (sepal) and to a lesser extent corolla (petal) exhibited typical leaf structure
yielding elements such as stomata, glandular and covering trichomes, mesophyll, oil glands,
etc; while epidermal cells of the corolla lack the typical papillose structure. The different
types of trichomes, their distribution and oil contents as found in A. paniculata are of major
diagnostic value. The determination of these diagnostic features amongst other parameters
is of importance in judgment of identity, purity and often general quality of the plant as it is
an introduced plant. This is the first time of reporting the results of pharmacognostic analysis
of the plant and these are needed towards the standardization of the plant which is currently
gaining relevance in plant drug research.

Acknowledgment

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