



**Government of the Union of Myanmar
Ministry of Forestry
Forest Department
Forest Research Institute**



**Studies on the Macroscopic and
Microscopic Characters of some Leaves
used in Indigenous Medicine of Myanmar**

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မြန်မာ့တိုင်းရင်းဆေးတွင် အသုံးပြုသော အရွက် (၁၂)မျိုး၏ ပြင်ပနှင့်အကျကြည့်လက္ခဏာများကိုလေ့လာခြင်း

ဒေါ်ခင်ဝင်းမြင့်၊ M.Sc. (Ygn.)၊ သုတေသနအရာရှိ
ဦးကျော်ဝင်းမောင်၊ B.Sc. (Bot.) (Ygn.)၊ သုတေသနလက်ထောက်
သစ်တောသုတေသနဌာနခွဲ

စာတမ်းအကျဉ်းချုပ်

ဤစာတမ်းသည် မြန်မာ့တိုင်းရင်းဆေးတွင် ဆေးဝါးအာနိသင် ထက်မြက်မှုကြောင့် အသုံးပြုသော အရွက်များမှ (၁၂)မျိုးကို လေ့လာတင်ပြထားပါသည်။ မြန်မာ့ဆေးဖော်စပ်ရာတွင် အခြောက်ခံအမှုန့်ကြိတ် ပြီးမှ ဖော်စပ်မှုသည် အဓိကလုပ်ငန်းတစ်ရပ်ဖြစ်ပါသည်။ ထိုသို့အမှုန့် အခြေအနေတွင် အရောင်အဆင်း ပုံသဏ္ဍာန်သည်တူနေတတ်သောကြောင့် အခြားဈေးနည်းသောဆင်တူရိုးမှားပစ္စည်းများကို ရောနှောသုံးထား တတ်ပါသည်။ ဤစာတမ်းတွင် အရွက်တို့ကို လတ်ဆပ်သော ပြင်ပရုပ်သွင်အနေအထား တွေ့မြင်ရပုံ၊ အရွက်ကို ကန့်လန့်ဖြတ်ပိုင်းတွင် အတွင်းအင်္ဂါများဖွဲ့စည်းထားပုံနှင့် အမှုန့်အခြေအနေတွင် တွေ့မြင် ရသည့်ဆဲလ်များ ထူးခြားသောဝိသေသလက္ခဏာများကို လေ့လာတင်ပြထားပါသည်။ ဤနည်းအားဖြင့် အရောအနှော အတူအပများကို ခွဲခြားဖော်ထုတ်နိုင်မည် ဖြစ်ပါသည်။

Studies on the Macroscopic and Microscopic Characters of some Leaves used in Indigenous Medicine of Myanmar

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Abstract

This paper presents the macro and microscopic characters of the leaves of 12 medicinal plants which are noted to possess a high medicinal value and used in Myanmar traditional medicine. Identifications were made through macro and microscopic studies on the genuine parts. The aim of this work is to find out the outstanding characters both in intact and powdered form. In this way the adulterations and substitutions of the commercially important raw material, could be detected.

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1. Introduction

Plant wealth of a country is in some manner an index of its prosperity and the only way to assess it, is by the thorough botanical surveys of its various parts, which is both an assiduous and time consuming job. However, the results of such studies are of great scientific and commercial value.

Nature has blessed Myanmar with a great variety of medicinal plants that constitute a basic component in the traditional system of medicine and pharmacy. They are both a source of medicament for the country's own requirement and a valuable export commodity.

Though there are a few publications on medicinal plants of Myanmar, only the morphology and its uses, are mentioned in it, observations through microscopic studies on the genuine parts are excluded.

Most people do not realize that microscopic characters sometimes prove very helpful for individual identification; for example, microscopical methods are of great value in establishing the identity of herbarium specimens which are not accompanied by flowers or fruits. Microscopical methods are also often necessary to establish identity of commercial samples of medicinal plants, timbers, fibers.....etc., and may play an important role in checking adulterants, substitutions and fraud.

Thus an attempt has been made to undertake a comprehensive study on the microscopical characters of the genuine parts of leaves used in Myanmar indigenous medicine, both in intact and powdered forms.

In this paper 12 materials of medicinal plants with their leaves as genuine parts were identified through microscopical characters by studying the cells of upper and lower epidermis, transverse section of the mid vein and also the macerated components. The outstanding characters were analysed and recorded for use as an authentic proof in the identification, adulterations and as well as substitutions of these 12 medicinal plants.

2. Materials and Methods

The materials studied in this work were: -

- | | | |
|------|--------------------------------------|-------------------------------|
| (1) | <i>Andrographis paniculata</i> Nees. | (Say-Kha-Gyi) |
| (2) | <i>Adhatoda vesica</i> Nees. | (Mu-Yar-Gyi) |
| (3) | <i>Aloe barbadensis</i> Miller. | (Sha-Zaung-Let –Pat) |
| (4) | <i>Alysicarpus vaginalis</i> (L) DC. | (Thunmanaing –Kyauk manaing) |
| (5) | <i>Boerhaavia diffusa</i> Linn. | (Pa-Yan-na-Wah) |
| (6) | <i>Cinnamomum camphora</i> Linn. | (Pa yoke) |
| (7) | <i>Croton oblongifolius</i> Roxb. | (Thet-Yin-Gyi) |
| (8) | <i>Datura stramonium</i> Linn. | (Pa-Daing) |
| (9) | <i>Jatropha multifida</i> Linn. | (Say-Ma-Khan) |
| (10) | <i>Leonotis hepatifolia</i> R.Bn. | (A-Me-Ta-Sota) |
| (11) | <i>Orthosiphon stamineus</i> Benth. | (Tha-Gyar-Ma-Gike) |
| (12) | <i>Phyllanthus rheedii</i> Wight | (Ma-Shawt) |

All these plants were collected from the Myanmar traditional medicine practitioners and was recommended that the genuine parts were leaves which possess great medicinal properties. The macro and microscopical characters were studied by hand sections and the macerated components were undertaken, by using equal volume of hydrogen peroxide and acetic acid.

Microscopic slides were done by hand sections and photographic slides were also presented in this paper.

Observations on macro and microscopical characters of 12 specimens

1. **Scientific Name** - *Andrographis paniculata* Nees.
Myanmar Name - Say-Kha-Gyi
Family - Acanthaceae

Macroscopical Characters

Leaves simple, opposite, petiolate, exstipulate, shape lanceolate, margin entire, apex acuminate, base cuneate, venation reticulate, upper surface dark green when young, red shades on mature basal leaves, lower surface light green, both surfaces glabrous; texture papery. Odourless, taste strongly bitter.

Microscopical Characters

Surface View of Lamina

Upper epidermal cells polygonal, thin-walled, smooth, compact. Cystolith of various shapes and sizes, numerous, (1) solitary, rounded, cystoliths about 25 μm across: (2) double cystoliths length about 55 μm breadth about 30 μm : (3) solitary elongated cystoliths with one end pointed length about 115 μm , breadth about 30 μm : (4) solitary elongated cystoliths with both ends pointed, length about 150 μm , breadth about 30 μm : (5) solitary elongated cystoliths with blunt extremities, length about 90 μm , breadth about 45 μm . Lithocyst present. (6) Minute sandy crystals present in the lithocyst and in surrounding epidermal cells. (7) Secretory cells appear as bright dots scattered, numerous. (8) Hairs absent. Lower epidermal cells slightly sinuous; (1) Cystoliths of various shapes and size similar to the upper epidermal cells (2) Lithocyst absent; (3) Stomata diacytic confined only to the lower epidermis. (4) Abundant small prismatic crystals present in Stomatas and in some cells. (5) Bright dots present. (6) Hairs absent.

Transverse Section of the Mid rib

Dermal tissue system

In transverse section, the outline of a mid rib reveals a very distinctive form with 2 lobes on the upper side and flat or angular like on the lower, epidermal cells mostly ovoid outerwalls convex, cuticle thin, wavy, some epidermal cells contain cystoliths.

Ground Tissue System

Collenchymatous cells of the upper side 2-3 layered, the layers 50-70 μm thick. Lower side 1-2 layers, the layers 25-50 μm thick, cells of both side oval to rounded. The remaining tissue parenchymatous, cells of both sides about 6 layered, the layers about 165 μm thick, cells large, rounded, compact; cystoliths occur in some cells of the adaxial side.

Vascular Tissue System

Vascular bundle collateral, crescent in outline, length about 450 μm , thickness about 120 μm ; xylem strands, about 18, protoxylem pointing towards the adaxial surface, 3-4 celled per strand about 100 μm thick; phloem about 25 μm thick.

Macerated Components

The most outstanding components observed were: -

(1) Presence of large cellulosic parenchyma cells. (2) Vessels long slender, thickening spiral, helical, scalariformly pitted, tail present or absent, some with blunt ends, length 250-600 μm breadth do not exceed more than 20 μm (3) Acicular fibers present, long, thick walled, straight, pointed to both ends, length 425-1375 μm , breadth 5-25. (4) Short stalk glandular hairs numerous, 20-30 μm across; (5) Large funnel - like cells numerous; (6) Prismatic crystals present; (7) Sandy crystals present abundantly in the mesophyll cell. (8) Numerous cystoliths variable in shaper and size.

Uses

The leaves posses antibacterial, anti-inflammatory and immuno suppressive properties; they are used in treating dysentery, diarrhoea, common cold, toncelitis, boils, wound infection, cough, sore throat, bronchitis; and hypertension. It is used as a bitter tonic and stomachic in general debility and in convalescence after fevers.

2. **Scientific Name** - *Adhatoda vesica* Nees.
 Myanmar Name - Mu-yar-gyi
 Family - Acanthaceae

Macroscopical Characters

Leaves simple, alternate, petiolate, exstipulate, shape ovate lanceolate, margin entire, apex acuminate, base obtuse, venation reticulate, upper surface dark green, lower pale, both surface glabrous. Odourless, tasteless.

Microscopical Characters

Surface View of Lamina

Upper epidermal cells walls slightly sinuous, thin, compact. Lower epidermal cell 5-6 sided, walls straight or slightly wavy thin, compact. (1) Both surfaces bears stomata trichomes and cystoliths but more abundant at the lower surface. (2) Stomata diacytic type; (3) Hairs uniseriate 2-4 celled, slightly curve or straight, length 110-150 μm , breadth about 10 μm ; (4) Glandular hairs with short staller, rounded with four lobes about 25 μm across.

Transverse Section of the Mid rib

Dermal tissue system

In transverse section, upper and lower epidermal cells mostly similar in shape, oval to rounded, outer walls convex, cuticle thin, wavy.

Ground Tissue System

Underlying collenchymatous cells of the upper side 4 - 6 layered, the layers 75-150 μm thick. Lower side 4-6 layered 50-75 μm thick. The remaining ground tissue parenchymatous, cells on the upper side 8-11 layered, the layers 250-360 μm thick, lower side 10-12 layered, the layers 300-360 μm thick, cells large, rounded, compact, intercellular spaces minute, cystoliths occur in some cells, solitary, rounded, 30.0-37.5 μm across.

Vascular Tissue System

Vascular bundle single collateral, curve, accompanied by two small accessory bundles on either side of the main bundle arms, the main bundle length about 450 μm , thickness about 150 μm ; xylem strands, about 20 μm , 3-4 celled per strand phloem about 50 μm thick. Two accessory bundles about 125 μm across.

Macerated Components

The most outstanding components observed were :-

(1) Solitary rounded cystoliths about 30 μm across. (2) Uniseriate 2-4 celled hairs. (3) Minute crystals appears as bright dots or in clusters. (4) Presence of glandular hairs with 4 lobes about 25 μm across.

Uses

The juices of the leaves in used for diarrhoea and dysentery. It is considered especially useful in haemoptysis and bleeding in dysentery, refrigerant in fever.

3. **Scientific Name** - *Aloe barbadensis* Mill.
 Myanmar Name - Sha zaung let put
 Family - Liliaceae

Macroscopical Characters

Leaves simple, closely alternate or crowned on the short stem, shape lanceolate; tip acute with strong spine at the apex prickly at the margins, leaves fleshy, strongly cuticularized; when the leaves are cut the aloetic juice flow out from the cut surface. Odour and taste unpleasant.

Microscopical Characters

Surface View

Both epidermal surface similar in shape, size and arrangement; cells polygonal, 5-6 sides, length 55-75 μm , breadth about 35 μm ; (1) stomate occur on both surface, numerous, large, oval in outline, length about 35 μm , breadth about 50 μm , tetracytic type. (2) Minute sandy crystals occur as clusters in the epidermal cells. (3) Numerous acicular crystals scattered, length 100-320 μm , breadth about 2.5 μm . (4) Trichomes absent.

Transverse Section

Dermal tissue system

Epidermal cells 4-5 sided, outer walls flat, inner walls convex, radial walls straight, length 37-50.0 μm . Trichomes absent.

Ground Tissue System

Composed of parenchyma cells only, rounded, compact, intercellular spaces minute, chloroplast numerous, cells about 12 layered, the layer about 850 μm thick. A central region, which occupied $\frac{3}{4}$ of the diameter of the leaf consists of large, mucilage-containing parenchyma cells when the aloetic juice flow out. Bundles of acicular crystal present, length about 320 μm . Sandy crystals presents in parenchyma cells.

Vascular Tissue System

A double row of vascular bundles lie at the junction of two zones.

Vascular bundle collateral, ovate in shape, length 30-60 μm breadth 50-100 μm , bundles small, xylem only one or two celled per bundle; pericycle parenchymatous, large about 50 μm across, endodermis distinct, parenchymatous bundle sheath present.

Macerated Components

The most outstanding components were: -

(1) Clusters of minute prismatic crystals occur in polygonal cells, (2) Acicular crystals in bundles about 400 μm long, (3) Mucilaginous parenchyma cells large, various shapes and sizes, cell wall vary thin, containing minute crystals.

Uses

Aloes is employed as purgative, its mucilage prepared as cream and use as cosmetic to protect sun burns. The fresh juice is said to be cathartic, cooling and useful in fevers, splun and liver diseases. The pulp of the leaves applied to boils, powerfully on the uterus and as emmenagogue.

4. **Scientific Name** - *Alysicarpus vaginalis* DC.
 Myanmar Name - Thun ma naing kyauk ma naing
 Family - Papilioneceae

Macroscopical Characters

Leaves simple, alternate petiolate, stipulate, shape elliptic lenceolate, margin entire, apex acute, base slightly cordate, venation reticulate upper surface and lower surface light green; Trichomes abundant unicellular, tips straight on curve, length 37.5 to 62.5 μm breadth 7.5-10.0 μm . Odourless and tasteless. Texture rough, fibrous.

Microscopical Characters

Upper epidermal cells polygonal 4-6 sides, thin-walled, smooth. Lower epidermal cells polygonal, or wavy (1) Stomata present on both surface but more confined to the lower surface, paracytic, oval in outline. (2) Numerous prismartic crystals present on all veinlets, rod shape or, minute crystals. (3) Trichomes unicellular, slightly curve at acute tips, length 30-55 μm , breadth about 5 μm .

Transverse Section of Mid rib

In transverse section epidermal cells of both surfaces oval to rounded. tangentially flattened upper epidermal cells a little larger than the lower; cuticle thin.

Ground Tissue System

Collenchymatous tissue occur on both sides 1-2 layered 12.50 –25.0 μm thick. Underlying parenchymatous cells of the lower side 2-3 layered, 62.5-75.0 μm thick mostly rounded, large, intercellular spaces minute compact.

Vascular Tissue System

Vascular bundle single, bicollateral large, oval in outline, occupy more than half of the mid rib area, length about 215 μm , breadth about 200 μm ; Sclerenchymatous bundle cap flank on both sides of the phloem groups. Sclerenchyma cells 4 -5 layered on the abaxial side, about 40 μm thick, strongly thickened at the adaxial side close to the epidermal cells, about 110 μm thick. Xylem strands about 7, 2-3 celled per strand. Phloem about 25 μm thick.

Macerated Components

The most outstanding components were: -

(1) Fibers of various shapes and sizes, smooth walled fibers, one sided wavy wall, both side wavy, forked, branch fibers. (2) Numerous prismatic crystals scattered (or) attached to the veinlets and fiber walls. (3) Short hairs with blunt tips or curved at the tips.

Uses

The decoction of the plant is used in the removal of stone in kidney and urinary tract infections.

5. **Scientific Name** - *Boerhaavia diffusa* LInn.
 Myanmar Name - Pa yan na wah
 Family - Nyctaginaceae

Macroscopical Characters

Leaves simple, opposite, petiolate, extipulate shape deltrid, margin smooth but slightly wavy, apex acuminate, base cordate, venation reticulate, upper surface green, lower pale green, both surfaces glabrous, texture fleshy. Odourless, tasteless.

Microscopical Characters

Surface view

Upper and lower epidermal cells sinuous, thin walled smooth, compact, chloroplast present; (1) Acicular crystals numerous, length 50-55 μm ; (2) Minute sandy crystals clustered in the center of epidermal cells; (3) Stomata anomocytic, present on both side but more confine to the lower; (4) Trichomes uniseriate, multicellular, 5-12 celled, tip blunt or glandular or curved, length 100-200 μm , breadth about 20 μm .

Transverse Section of Mid rib

Dermal Tissue System

In transverse section epidermal cells of both surfaces mostly similar in shape and size, oval or rounded, outerwall convex, cuticle thin, warty.

Ground Tissue System

Underlying ground tissue collenchymatous 1-2 layered the remaining tissue parenchymatous, 6-7 layered, cells large, rounded, intercellular spaces minute, compact, a few chloroplast present.

Vascular Tissue System

Vascular bundle collateral, about four bundles of various size; large bundle consist of 7-12 xylem cells, small bundles 3-4 xylem cells. Phloem hot distinct. Trichomes more confine to the adaxial surface, uniseriate, 6-10 celled, blunt terminal cells 120-200 µm long.

Macerated Components

The most outstanding components were: -
Polygonal cells containing minute crystal in cluster, containing varying quantities of crystalline granules; bundles of acicular crystal numerous, scattered, length about 250µm. Trichomes present, uniseriate multicellular hair with blunt terminal cells.

Uses

It is used in the treatment of asthma, heart diseases and diuraitic. A poultice of the leaves is reported to be useful in abscesses.

6. **Scientific Name** - *Cinnamomum camphora* Linn.
Myanmar Name - Pa yoke
Family - Lauraceae

Macroscopical Characters

Leaves simple, alternate, petiolate, exstipulate, shape elliptic or obovate, margin undulate, apex acuminate, base obtuse, reticulate, upper surface bright dark green, lower, surface pale bluish green, both surfaces glabrous, waxy; texture leathery. Odour aromatic, taste a little pungent.

Microscopical Characters

Surface view

Epidermal cells of both surfaces similar in shape, size and arrangement, polygonal, 5-6 sided walls thick. Stomata confined to the lower surface, paracytic, oval shape. Hairs absent.

Transverse Section of Mid rib

Dermal Tissue System

In transverse section upper and lower epidermal cells mostly similar, cells oval to rounded outer wall convex; cuticle thick about 5 μm , wavy.

Ground Tissue System

Collenchymatous tissue underlying the epidermis. 5-7 layered cells large, rounded. On the lower side collenchyma cells 4-5 layered; the remaining tissue parenchymatous, cells large, mostly rounded, intercellular spacer-small.

Vascular Tissue System

Vascular bundle single, collateral large. Semilunar shape, length about 600 μm , thickness about 300 μm , occupying nearly half of the mid rib area. Sclerenchymatous bundle sheath encircling the bundle, 3-4 layered. Xylem strands about 16, 4-8 cells per strand. Phloem about 60 μm thick.

Macerated Components

The most outstanding components were : -
4-6 sided polygonal cells; (1) Fibers numerous, long slender fibers, length about 1300 μm , walls about 5 μ thick; (2) Forked fiber present; (3) Fiber walls one sided wavy or both sides, tips acute; (4) Prismatic crystals abundant in the mesophyll or in parenchyma cells.

Uses

It is effective for fever, sore throat and has antibacterial, demulcent and anodyne properties. It is applied externally as an antiseptic, boil and rheumatism.

7. **Scientific Name** - *Croton oblongifolius* Roxb.
Myanmar Name - Thet yin gyi
Family - Euphorbiaceae

Macroscopical Characters

Leaves simple, alternate, petiolate, exstipulate, shape lanceolate (or) elliptic lanceolate, margin undulate to crenate, apex acuminate, base obtuse, venation reticulate, upper surface green, lower slightly yellowish green; texture leathery. Odourless, tasteless.

Microscopical Characters

Surface view

Upper epidermal cells slightly sinuous, 3-6 sided (or) polygonal. Lower epidermal cells distinctly sinuous. (1) Stomata on both surfaces, paracytic confine more on the lower surface; (2) Multicellular stellate hairs present, about 300 μ m across; (3) Druses and minute crystals present, rare.

Transverse Section of Mid rib

Dermal Tissue System

In transverse section lower and upper epidermal cells mostly similar in shape and size, oval to rounded, cells very small, cuticle thin, wavy.

Ground Tissue System

Composed of two types of tissues, outermost collenchyma and underlying parenchyma. Collenchymatous tissue on the adaxial side 8-10 layered, about 350 μ m thick. Abaxial collenchyma 3-4 layered about 100 μ m thick. The remaining ground tissue parenchymatous, 6-9 layered cells mostly rounded, druses occur in some cells of adaxial ground tissue.

Vascular Tissue System

Vascular bundle collateral, arrange in a continuous ring; xylem strands numerous, 2-5 celled per strand. Xylem thickness 100-300 μ m. Phloem in a form of continuous ring about 50 μ m thick. Crystals in a form of druses, occur in phloem.

Macerated Components

The most outstanding components were: -

(1) Numerous druses 10-20 μ m across, scattered, (or) attached to the fiber wall; (2) long fibers length 1200- 1850 μ m, breadth 15-20 μ m lumen wide walls wavy; (3) fiber tracheids of various length, and breadth.

Uses

Powered leaves are applied on sores and decoction is used in dysentery.

8. **Scientific Name** - *Datura stramonium* Var. *tatula*.
 Myanmar Name - Pa daing
 Family - Solanaceae

Macroscopical Characters

Leaves simple, alternate, petiolate, exstipulate, shape ovate (or) triangular ovate, margin entire, slightly wavy at mature leaves, tip acuminate, base oblique, venation reticulate, upper surface dark green, lower pale green, both surfaces, puberulent. Odour unpleasant, taste bitter.

Microscopical Characters

Surface view of Lamina

Upper and lower epidermal cells sinuous, thin-walled (1) Stomata present on both surfaces, more confine to the lower side, anisocytic; (2) Druses numerous, scattered; (3) Trichomes uniseriate clothing hairs, 3-5 celled, length 150-300 μm , breadth the about 20 μm ; (4) glandular hair present, head about 30 μm stalk about 30 μm long.

Transverse Section of Mid rib

Dermal Tissue System

In transverse section epidermal cells of both surface mostly similar in shape and size, oval to rounded, outer walls convex cuticle thin, wavy, occasional uniseriate clothing hairs present on both sides more confine to the upper.

Ground Tissue System

Collenchyma cells of upper surface 5-6 layered, the layers 100-150 μm thick, lower surface 3-4 layered, 80-100 μm thick. The remaining tissue parenchymatous, cells of about 15 layered, thickness 700 μm on the upper side 5-7 layered, thickness 280-320 μm on the lower side cells large, rounded, intercellular spaces minute, compact.

Vascular Tissue System

Vascular bundle single, bicollateral, curved arc, length about 20 μm thickness about 200 μm ; endodermis distinct.

Macerated Components

The outstanding components observed were : -

Crystals of various shapes and sizes. (1) Druses (2) Rod shape (3) Tetragonal shape (4) Rectangular shape (5) Shady crystals in clusters (6) Secretary cells appear as bright dots (7) Uniseriate 2-3 celled clothing hairs slightly curve with warty walls: (8) Glandular hairs present.

Uses

It is use in ophthalmic to dilate the pupil of the eye and also as sedative.

9. **Scientific Name** - *Jatropha multifida* Linn.
 Myanmar Name - Say - ma - khan
 Family - Euphorbiaceae

Macroscopical Characters

Leaves simple, alternate, long petiolate, stipulate, stipules hair like, palmately divided into lobes, lobes lanceolate-acute, margin deeply cut, tips acute, upper surface green intermingling with yellow shades, lower whitish green, both surface globrous, texture smooth, leathery like. Odourless, taste acrid.

Microscopical Characters

Surface view of Lamina

Epidermal cells of upper and lower surface mostly similar in shape and size, cells polygonal 4-6 sided, thin-walled, smooth, compact. (1) Clusters of minute crystal present in some cells. (2) Stomata paracytic, confined only to the lower surface. (3) Oily cells appeared as bright dots numerous, scattered.

Transverse Section of Mid rib

Dermal Tissue System

Epidermal cells of both surfaces mostly similar, oval to rounded, tangentially flattened, outer walls convex. Cuticle thick about 5 µm, smooth wavy.

Ground Tissue System

Outermost collenchymatous cells 4-7 layered, 60-100 µm thick on the upper side, 2-3 layered, 35-50 µm thick. The remaining ground tissue parenchymatous, 7-14 layered the layers 250-400 µm thick on the lower side, 10-14 layered the layers about 350 µm thick on the upper side, large, rounded, intercellular spaces minute, compact.

Vascular Tissue System

Vascular bundle single, collateral, strongly curved arc, length about 800µm, thickness about 150 µm. Xylem strands about 18,2-3 celled per strand, about 100 µm thick. Phloem about 50 µm thick.

Macerated Components

The most outstanding components were : -

(1) Numerous druses 20-60 µm across (2) Secretary cells with only contents appearing as bright dots numerous, scattered (3) Absence of fibers and hairs.

Uses

The leaves are used for scabies and as purgative. The latex of the plant is applied to wounds and ulcers.

10. **Scientific Name** - *Leonotis hepaticifolia* R.Bn.
Myanmar Name - A-me-ta-soe
Family - Labiatae

Macroscopical Characters

Leaves simple, alternate, petiolate, exstipulate, shape ovate, margin crenate-serrate, apex acute, base obtuse, upper and lower surface tomentose, upper surface green, lower a little pale green; texture velvety. Odour slight, taste bitter.

Microscopical Characters

Surface view of Lamina

Epidermal cell of both surfaces similar in shape size and arrangement walls sinuous, thin, compact, chloroplast present. (1) Stomata diacytic, occur on both surfaces, more confine to the lower, (2) Glandular hairs numerous, head (3) Celled, stalk short 25-50 μm across; (4) Uniseriate 2-3 celled hairs a more abundant on the veins and veinlets, hairs straight or curved, length 100-15 μm breadth about 10 μm .

Transverse Section of Mid rib

Dermal Tissue System

In transverse section both epidermal cells mostly similar in shaped, oval to rounded, upper epidermal cells slightly larger than the lower. Trichomes abundant on both surfaces of the mid rib, uniseriate 2-3 celled, length 100-220 μm , breadth 10-20 μm , hairs curve or straight

Ground Tissue System

Underlying collenchymatous cells of the lower surface 2-3 layered, about 60 μ thick, upper surface 4-5 layered, about 75 μm thick; the remaining ground tissue parenchymatous, 8-12 layered at the upper surface, about 7 layered at the lower side cells large, rounded, intercellular spaces minute, compact.

Vascular Tissue System

Vascular bundle single, collateral, crescent shape, length about 650 μm , thickness 250 μm ; Xylem strand about 20, 2-3 celled per strand, xylem thicken about 200 μm . Phloem about 50 μm thick.

Macerated Components

The most outstanding components were: -

(1) Numerous short needle –like crystals, length 7.5-10.0 μm . (2) Numerous glandular hairs, head 8-20 μm stalk very short. (3) Numerous uniseriate 2-3 celled hairs, curve or straight, length 125-150 μm , breadth 7.5-10.0 μm , walls warty.

Uses

The plant is reported to be used in skin infections. A decoction of the leaves is used as tonic and febrifuge. It is also used in the treatment of rheumatic infections.

11. **Scientific Name** - *Orthosiphon stamineus* Benth.
Myanmar Name - Tha-gya-ma-gike
Family - Labiatae

Macroscopical Characters

Leaves simple, opposite short petiolate exstipulate, shape ovate, margin coarsely toothed, apex acuminate, base attenuate, venation reticulate, upper surface dark green, lower pale green, both surface glabrous, texture papery. Odourless, taste a little bitter.

Microscopical Characters

Surface view of Lamina

Upper and lower epidermal cells deeply sinuous, thin-walled compact, (1) Stomata occur on both surfaces, more on the lower side, diacytic. (2) Secretary cells, recognizable as bright dots (3) Short stalk glands with unicellular heads, 30-50 μm .

Transverse Section of Mid rib

Dermal Tissue System

Upper and lower epidermal cells mostly similar in shape and size, rounded to oval, cuticle thin. Trichome present on both surfaces, unicellular 1-3 celled, length 40-80-150 μm .

Ground Tissue System

Collenchymatous cells occur on both surfaces, 3-5 layered, the layer 60-120 μm thick. Underlying parenchymatous, about 5 layered on the adaxial surface 6-7 layered on the abaxial side, all mostly rounded large, intercellular 5 spaces minute, chloroplast present.

Vascular Tissue System

Vascular bundle two, collateral, separated by 2-4 celled parenchyma, thus appearing as two groups, the two disconnected bundle slightly in outline. Xylem about 9 strand, 3-4 celled per strand, xylem thickness 37.5-75 μm . Phloem thickness about 50 μm .

Macerated Components

The outstanding characters observed were: -

- (1) Uniseriate 2-4 celled hairs, length 50-100-250 μm breadth at the base 25-30 μm .
- (2) Numerous secretary cells appear as bright dots about 5 μm across.
- (3) Large glandular hairs, 25-50 μm across with short stalk.

Uses

Possesses diuretic properties and is used in treating urinary lithiasis, oedema, eruptive fever, influenza, rheumatism, hepatitis, jaundice and biliary lithiasis. It lower the blood sugar in diabetic patients.

12. **Scientific Name** - *Phyllanthus rheedii* Wight.
Myanmar Name - Ma shawt
Family - Euphorbiaceae

Macroscopical Characters

Leaves simple, alternate, petiolate, stipulate, shape elliptic oblong, 6-13 cm long, 2-4 cm broad margin entire, apex acute base obtuse or cuneate, sometime a symmetrical, oblique slightly. Upper surface dark green, pale below, both surfaces glabrous; texture coriaceous. Odourless, tasteless.

Microscopical Characters

Surface view of Lamina

Epidermal cells of both surfaces similar in shape size and arrangement, cell walls sinuous, smooth. (1) Stomata paracytic, confined to the lower surface only. (2) Druses numerous, scattered, 10-20 μm across. (3) Irregular shape and size of minute crystals and (4) Secretary cells, appear as bright dots. Components more confined to the lower surface.

Transverse Section of Mid rib

Dermal Tissue System

Epidermal cells of both surfaces mostly similar in shape and size, cells irregularly oval or rectangular, minute crystals present in some cells, cuticle wavy longitudinal striations, thickness about 3.75 μm . Rarely presence of papillose projections mostly on the lamina.

Ground Tissue System

Collenchyma cells occur on both surfaces, 2-3 layered, thickness 15-30-55 μm ; the remaining ground tissue parenchymatous 8-12 layered, the layers 125-285 μm thick cells large, rounded, intercellular spaces minute, compact. Druses scarcely present about 25 μm across minute crystals present in some cells.

Vascular Tissue System

Vascular bundle single, collateral, length about 540 μm , breadth about 220 μm . Xylem strands about 16, 4-6 celled per strand, xylem thickness about 150 μm ; phloem 50-70 μm . 2-3 layered of discontinuous sclerenchymatous bundle sheath over-arching the phloem. Druses occur in some phloem cells.

Macerated Components

The most outstanding components observed were: -

(1) Numerous druses scattered, some arrange in rows along the veinlets intermingling with few prismatic crystals. (2) Minute crystals and idioblast appears as bright dots. (3) Fibers rare, if present thick walled.

Uses

The Ma-shawt leaves posses a high medicinal value in curing poisons, such as snakebites and can releif the narcotic effects.

3. Discussion

Twelve materials studied in the paper were collected from the practitioners from their gardens, which they recommended as a real authentic ones. Macroscopical study of the genuine parts were refered to a few publication of Myanmar, Wealth of India (1950) Treasa and Evans (1966), Medicinal Plant of China (1989) and Medicinal Plants of Vietnam (1989). The microscopical characters of the leaves were found to be in agreement with Metcalfe and Chalk (1953) whereas some are not. The outstanding characters of each leaves were observed as follows: (1) *Andrographis paniculata* reveals various shapes and sizes of cystoliths; presence of lithocyst containing minute crystals; presence of acicular fibers and numerous small crystals (2) *Adhatoda vesica* possess various cystoliths; diacytic stoma on both surfaces; occurrence of uniseriate 2- 4 celled hairs (3) *Aloe barbadensis* composed of double row of vascular bundles, large mucilage cells, bundles of raphider. (4) *Alysicarpus vaginalis* composed of papillose on lower surface; rubiaceous stomata on both surfaces; veins with sclerenchymatous sheath; uniseriate hairs with short basal cell and elongated terminal cell. (5) *Boerhaavia diffusa* consists anomocytic stimatas and uniseriate hairs with blunt terminal end. (6) *Cinnamomum camphora* possess paracytic type of stomata which confined to the lower side only; numerous fibers, long, slender, tips pointed, distinctly thick-walled, length 360-1600 μm breadth about 20 μm ; fiber tracheids of various shape and size. (7) *Croton oblongifolius* reveals numerous collateral bundle arranged in a continuous cylinder, paracytic stomata on both surfaces; abundant druses and minute crystals, rare occurrence of stellate hairs; long fibers and fiber tracheads of various length and shape (8) *Datura stramoniumvar tatule* can be distinguished by its wavy epidermal cells; presence of numerous druses especially as row of druses underlying the palisade cells; frequent occurrence of crystals in the form of rods, squares, rectangular, crystal sands; uniseriate 2-3 celled clothing hairs with warty wall (9) *Jatropha multifida* polygonal cells paracytic stoma confined only to lower surface; strongly curved are vascular bundle; druses large; secretory cells with oily contents appearing as bright dots and absence of fibers and hairs (10) *Leonotis hepitifolia* reveals sinuous epidermal cells; diacytic stoma; short needle like crystals; short stalk glandular hairs; uniseriate 2-3 celled hairs with warty walls; (11) *Orthosiphon stamineus* strongly sinuous epidermal hairs; diacytic stoma; uniseriate 2-4 celled hairs large glandular hairs minute bright dots (12) *Phyllanthus rheedii* can be distinguished by numerous druses; sinuous walls; vascular bundles accompanied by sclerenchymatous cap; papillose projections occurred on upper epidermal side; small rounded idioblast appearing as bright dots.

4. Summary and Conclusion

This paper is the second part of a microscopical survey of the genuine parts of the medicinal plants used in Myanmar indigenous medicine. The first part dealt with some roots, rhizomes, barks and wood; this present paper is concerned with the leaves from the 12 species, which are recommended by the practitioners to possess high medicinal values. From this study it was noted that microscopy proves very helpful for individual identifications. The unique characters of the 12 genuine parts of the twelve species were recorded, for use as an authentic proof in identification, substitution, adulteration and fraud.

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