PRATAP COLLEGE, AMALNER

S.Y. B.Sc. Botany — Ayurvedic Botany (BOT-MJ-IKS-232)

UNIT 2: PLANT_MORPHOLOGY_AND_IDENTIFICATION

Detailed Teaching Notes — syllabus-wise

Learning Objectives

- Explain external morphology used in medicinal plant identification.
- Describe anatomical features useful in crude-drug authentication.
- Explain field diagnostic characters and identification workflow.
- Describe microscopic evaluation of plant drugs.
- Explain DNA barcoding and chromatography.

2.1 Morphological Characteristics of Medicinal Plants

Plant morphology deals with external form and visible structure. It is usually the first step in identifying a medicinal plant.

Habit

- Herb, shrub, tree, climber and creeper are common habit categories.
- Habit gives a quick overall clue but should not be used alone.

Root characters

- Observe tap or fibrous root system.
- Record colour, shape, branching, surface, texture and special modifications.
- Root characters are especially important when root is the crude drug.

Stem characters

- Observe branching, nodes, internodes and orientation.
- Record herbaceous or woody nature, surface, colour, shape and exudates.
- Bark texture and lenticels may be useful in woody plants.

Leaf characters

- Arrangement: alternate, opposite or whorled.
- Simple or compound leaf.
- Shape, size, margin, apex and base.
- Venation and surface characters.
- Petiole, stipules and leaf sheath where present.

Reproductive characters

- Inflorescence type and flower structure are often highly diagnostic.
- Observe symmetry, sexuality, floral parts and colour.
- Fruit type, dehiscence and seed characters help confirm identity.

Field record

- Record habit, vegetative and reproductive characters, habitat, season and locality.
- Use photographs and authenticated references when possible.

Teacher's Note: Teach the observation sequence: whole plant → root → stem → leaf → flower → fruit → seed.

2.2 Plant Anatomy Relevant to Drug Identification

Plant anatomy studies internal structure. It is particularly valuable when medicinal material is dried, fragmented or powdered.

Important tissues

- Epidermis and its stomata/trichomes.
- Cortex and storage tissues.
- Endodermis and pericycle in roots.
- Xylem and phloem arrangement.
- Pith and supporting tissues.

Diagnostic microscopic features

- Stomatal type and distribution.
- Trichome form, wall thickness and glandular nature.
- Vessels and their thickening patterns.
- Fibres and sclereids.
- Calcium oxalate crystals such as druses, prisms and raphides.
- Secretory cells, oil glands, resin ducts and laticifers.
- Vascular-bundle arrangement.

Importance

- Anatomical features are often more stable than colour or smell.
- Powder microscopy can reveal diagnostic tissue fragments.
- Reference comparison helps detect substitution and adulteration.

Teacher's Note: The aim of microscopy is recognition of diagnostic structures, not simply observing many structures.

2.3 Diagnostic Features for Field Identification

Diagnostic features are characters that help distinguish one plant from another. Reliable field identification uses a combination of characters.

Major diagnostic characters

- Habit and branching.
- Leaf arrangement and phyllotaxy.
- Leaf shape, venation, margin, apex and surface.
- Latex, odour or glands where safely observable.
- Inflorescence and flower characters.
- Fruit and seed characters.
- Habitat and flowering/fruiting season.

Field workflow

- Observe the whole plant.
- Record vegetative characters.
- Examine flowers or fruits.
- Record habitat and season.
- Compare with a flora, taxonomic key or herbarium.
- Consult a taxonomist if identity remains uncertain.

Common errors

- Relying only on a vernacular name.
- Identifying from a photograph without diagnostic parts.
- Ignoring seasonal variation.
- Confusing related species.
- Failing to record the actual plant part used as the drug.

Teacher's Note: Ask students to support an identification using at least three independent characters.

2.4 Microscopic Evaluation Techniques

Microscopy examines cells and tissues for authentication of sections, surface preparations and powdered drugs.

Basic procedure

- Prepare a thin section or suitable powder mount.
- Clear or stain when required.
- Mount using a suitable medium.
- Observe under low power first, then high power.
- Record diagnostic structures with labelled drawings.

Leaf microscopy

- Observe epidermis, stomata, trichomes, cuticle and mesophyll.
- Examine vascular bundles and crystals where present.

Root and stem microscopy

- Observe protective tissues, cortex, endodermis where present, vascular tissue and pith.
- Record arrangement of tissues and distinctive inclusions.

Powder microscopy

- Look for vessels, fibres, starch grains, crystals, hairs, epidermal fragments and secretory structures.
- Powder microscopy is valuable when external morphology is unavailable.

Precautions

- Use clean slides and cover slips.
- Avoid air bubbles and excessive staining.
- Compare with authenticated reference material.
- Keep labelled permanent or temporary preparations as required.

Teacher's Note: Connect this topic with practical work on permanent slides and powder microscopy.

2.5 Modern Tools for Plant Authentication: DNA Barcoding and Chromatography

Molecular and chemical tools provide additional evidence when morphology and microscopy are insufficient.

DNA barcoding: principle

- Uses a short standardized DNA region as a molecular identifier.
- Plant barcode regions commonly include rbcL and matK; ITS may also be useful in appropriate groups.
- The selected region depends on taxonomic resolution and laboratory performance.

DNA barcoding: workflow

- Collect and label material.
- Extract DNA.

- Amplify selected region using PCR.
- Sequence the product.
- Compare sequence with a reliable reference database.
- Interpret together with morphological evidence.

Advantages and limitations

- Useful for sterile or processed material.
- Can help distinguish many substitutions.
- Requires laboratory facilities and suitable DNA.
- Reference databases may be incomplete or contain errors.
- A single barcode may not separate very closely related species.

Chromatography

- Chromatography separates components of mixtures.
- TLC/HPTLC is useful for chemical fingerprinting.
- HPLC provides high-resolution analysis and can quantify selected marker compounds.
- Chemical fingerprints can support identity, purity and batch consistency.

Integrated authentication

- Macroscopy + microscopy + molecular evidence + chemical profiling provides stronger authentication.
- No single method is perfect for every medicinal plant.

Teacher's Note: Easy explanation: DNA barcoding = identity from DNA; chromatography = chemical fingerprint.

Unit Summary

- Morphology is the first level of identification.
- Anatomy and microscopy are essential for dried and powdered drugs.
- Field identification should use several diagnostic characters.
- DNA barcoding gives molecular evidence and chromatography gives chemical-profile evidence.
- Integrated authentication is more reliable than a single method.

Important Terms

Term	Meaning
Morphology	Study of external form.
Anatomy	Study of internal structure.
Diagnostic character	Feature useful for distinguishing a plant/material.
DNA barcoding	Identification using selected DNA regions.
Chromatography	Separation and profiling of mixture components.

Important Examination Questions

- Describe morphological characters used in medicinal plant identification.
- Explain plant anatomy relevant to drug identification.
- What are diagnostic field features? Explain the field workflow.
- Describe microscopic evaluation techniques for medicinal drugs.
- Explain DNA barcoding with principle, steps, advantages and limitations.
- Write a note on TLC/HPTLC and HPLC in plant authentication.