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Semester 1 - Practical Notes

Introduction to Pharmacognosy

Complete Subject Manual

14 practicals and activities. Use the PDF bookmarks to move between practicals. Page numbers restart within each practical; the page counts below exclude the promotion page.

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Morphological Study of Medicinal Plants

Experiment 1 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To identify the twenty listed medicinal plants and record botanical identity, drug part and visible distinguishing characters.

Principle

Macroscopic identification uses the correct plant part and a combination of shape, surface, arrangement and texture. A vernacular name alone is insufficient because different species can share a name. Families below use modern broad groupings; older teaching texts may place some plants in different families.

Requirements

- Authenticated teaching specimens or approved plant images, hand lens and ruler.
- Plant identity labels and notebook; a medicinal garden may support comparison.

Procedure

1. Confirm identity

Read the authenticated label and record botanical name, family and examined organ. Do not infer species solely from the local name.

2. Observe the whole plant

Where available, record habit and leaf arrangement. Use leaves, flowers or fruits that are present; note what is missing.

3. Examine the drug part

Record size, shape, surface, fracture where authorised and distinguishing characters. Use a hand lens for fine features.

4. Compare

Compare similar-looking materials using multiple characters. Distinguish husk from whole seed, stem from root, and inner leaf gel from latex.

5. Record

Complete an identification entry for each listed plant and retain its authenticated label or voucher association.

Introduction to Pharmacognosy

Plant Identification Guide

Common name	Botanical name / family	Drug part and visible cue
Ashwagandha	<i>Withania somnifera</i> Solanaceae	Root; tapering, pale brown, longitudinal wrinkles
Tulsi	<i>Ocimum tenuiflorum</i> Lamiaceae	Leaf; opposite leaves, toothed margin, aromatic
Amla	<i>Phyllanthus emblica</i> Phyllanthaceae	Fruit; rounded with six longitudinal grooves
Milk thistle	<i>Silybum marianum</i> Asteraceae	Fruits, often called seeds; hard, mottled surface
Kutki	<i>Picrorhiza kurroa</i> Plantaginaceae	Rhizome and root; narrow, jointed, wrinkled pieces
Garlic	<i>Allium sativum</i> Amaryllidaceae	Bulb; multiple cloves within dry outer coverings
Arjuna	<i>Terminalia arjuna</i> Combretaceae	Stem bark; curved pieces, grey-brown outer and reddish inner surfaces
Gymnema	<i>Gymnema sylvestre</i> Apocynaceae	Leaf; opposite leaves on a climbing plant
Fenugreek	<i>Trigonella foenum-graecum</i> Fabaceae	Seed; hard, yellow-brown, angular with a groove
Turmeric	<i>Curcuma longa</i> Zingiberaceae	Rhizome; branched fingers with yellow-orange interior
Boswellia	<i>Boswellia serrata</i> Burseraceae	Oleo-gum-resin; irregular pale-yellow to brown tears
Brahmi	<i>Bacopa monnieri</i> Plantaginaceae	Whole plant; creeping herb with small opposite fleshy leaves
Giloy	<i>Tinospora cordifolia</i> Menispermaceae	Stem; nodal pieces with surface lenticels
Neem	<i>Azadirachta indica</i> Meliaceae	Leaves and other specified parts; pinnate leaves with toothed leaflets
Andrographis	<i>Andrographis paniculata</i> Acanthaceae	Aerial parts; slender stems and opposite narrow leaves
Psyllium	<i>Plantago ovata</i> Plantaginaceae	Seed husk; thin, pale flakes that swell in water
Aloe	<i>Aloe vera</i> Asphodelaceae	Leaf; fleshy toothed leaves; inner gel is distinct from latex
Chasteberry	<i>Vitex agnus-castus</i> Lamiaceae	Fruit; small rounded dark fruits; palmately compound plant leaves

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Common name	Botanical name / family	Drug part and visible cue
Shatavari	<i>Asparagus racemosus</i> Asparagaceae	Tuberous roots; clustered elongated pale roots
Vasaka	<i>Justicia adhatoda</i> Acanthaceae	Leaf; opposite lanceolate leaves with prominent venation

Names Commonly Seen in Older Texts

- Ocimum sanctum is a commonly used synonym for Ocimum tenuiflorum.
- Emblica officinalis is an older commonly used name for Phyllanthus emblica.
- Adhatoda vasica is commonly used for Justicia adhatoda; Aloe barbadensis is associated with Aloe vera.
- Gymnema was often placed in Asclepiadaceae, and Bacopa and Picrorhiza in Scrophulariaceae. Retain the institution's accepted naming convention consistently.

Observations and Record

Plant / specimen	Examined part	Observed identifying characters
_____	_____	_____
_____	_____	_____
_____	_____	_____

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Completeness check: 20 named plants are covered in the guide. If 16 are physically observed and 4 studied from approved images, record those two sources separately.
- Illustrative dimension record: three root pieces measure 4.2, 4.8 and 5.0 cm; mean length = $14.0 \div 3 = 4.67$ cm. This does not establish identity.

Result

The identification guide covers all twenty named plants. I examined ____ authenticated specimens and ____ approved images, recording part and visible characters.

Precautions

- Do not taste an unknown plant or drug.
- Do not collect protected or privately owned plants without permission.
- Use morphology with authentication; one visible feature does not guarantee purity or therapeutic quality.

Viva Questions and Answers

1. Why record the organ?

Different parts of the same species have different identity and quality characteristics.

2. Why distinguish Bacopa from Centella?

Both may be called Brahmi locally, but they are different botanical materials.

3. What does authentication add?

It links the observed specimen to a verified identity rather than an assumed local name.

Tulsi and Ashwagandha Powder Study

Experiment 2 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To compare the supplied authenticated drugs by organoleptic observation and powder microscopy.

Principle

Organoleptic observation and microscopic structures provide complementary identity evidence. Powdering destroys much gross form, but fragments of epidermis, vessels, fibres, starch and other diagnostic structures may remain. Features depend on the actual plant part, processing and preparation; confirm identity from a pattern, not a single cell.

Identity and Material

Drug	Botanical identity / family	Part examined
Tulsi	<i>Ocimum tenuiflorum</i> / Lamiaceae	Leaf; record if whole plant is supplied
Ashwagandha	<i>Withania somnifera</i> / Solanaceae	Root

Requirements

- Authenticated Tulsi leaves and Ashwagandha roots and matched teaching powders.
- Microscope, slides, coverslips and instructor-approved mounting and staining materials.
- Hand lens, labelled observation record and sketch materials.

Procedure

1. Inspect and label

Confirm the botanical labels and plant parts. Record colour, surface and texture. Assess odour only by the laboratory-approved method; do not taste material.

2. Prepare a mount

Use a small dispersed powder portion in the prescribed mount. Prepare an untreated or specifically stained mount as directed; do not combine arbitrary clearing reagents.

3. Survey

Find representative fragments at low power, then examine diagnostic features at a suitable higher power.

4. Compare

Locate more than one feature from the guide, compare with the authenticated teaching material and note absent or obscured features.

5. Record

Draw labelled structures, state magnification and write a comparison. Distinguish observed structures from expected textbook features.

Introduction to Pharmacognosy

Organoleptic and Powder Features

Drug	Macroscopic / organoleptic cues	Powder features to examine
Tulsi	Green to brown-green leaf material; characteristic aromatic odour	Epidermal fragments with stomata; covering and glandular hairs; vessel fragments
Ashwagandha	Pale brown root exterior and lighter interior; wrinkled surface	Starch-containing parenchyma, cork fragments and vessel elements

Comparison

Tulsi leaf material is recognised by a leaf-epidermal and hair pattern, whereas Ashwagandha root shows a storage-tissue and vascular pattern. A root powder should not be identified from leaf characters.

Observations and Record

Drug / mount	Observed structures	Magnification
Drug 1	_____	___ x
Drug 2	_____	___ x

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- A 10x eyepiece and 40x objective provide 400x visual magnification.
- If a feature is found in only one field, inspect additional representative fields before calling it consistently present. This is an identity observation, not a numerical purity assay.

Result

Drug 1 showed ___ and ___. Drug 2 showed ___ and ___. The observed pattern was compared with authenticated teaching material.

Precautions

- Use authenticated material and record the organ; whole-plant powder can differ from leaf-only powder.
- Do not mistake air bubbles for oil globules or a processing artefact for a diagnostic cell.
- Starch appearance can change during heating and processing.

Viva Questions and Answers

1. Why use more than one feature?

A common structure such as starch may occur in many drugs.

2. Why record processing?

Drying, boiling and powdering may alter diagnostic appearance.

3. What should the result state?

The observed features and consistency with the authenticated drug, with any limitations.

Amla and Arjuna Powder Study

Experiment 3 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To compare the supplied authenticated drugs by organoleptic observation and powder microscopy.

Principle

Organoleptic observation and microscopic structures provide complementary identity evidence. Powdering destroys much gross form, but fragments of epidermis, vessels, fibres, starch and other diagnostic structures may remain. Features depend on the actual plant part, processing and preparation; confirm identity from a pattern, not a single cell.

Identity and Material

Drug	Botanical identity / family	Part examined
Amla	<i>Phyllanthus emblica</i> / Phyllanthaceae	Dried fruit pericarp
Arjuna	<i>Terminalia arjuna</i> / Combretaceae	Stem bark

Requirements

- Authenticated Amla fruit pericarp and Arjuna stem bark and matched teaching powders.
- Microscope, slides, coverslips and instructor-approved mounting and staining materials.
- Hand lens, labelled observation record and sketch materials.

Procedure

1. Inspect and label

Confirm the botanical labels and plant parts. Record colour, surface and texture. Assess odour only by the laboratory-approved method; do not taste material.

2. Prepare a mount

Use a small dispersed powder portion in the prescribed mount. Prepare an untreated or specifically stained mount as directed; do not combine arbitrary clearing reagents.

3. Survey

Find representative fragments at low power, then examine diagnostic features at a suitable higher power.

4. Compare

Locate more than one feature from the guide, compare with the authenticated teaching material and note absent or obscured features.

5. Record

Draw labelled structures, state magnification and write a comparison. Distinguish observed structures from expected textbook features.

Introduction to Pharmacognosy

Organoleptic and Powder Features

Drug	Macroscopic / organoleptic cues	Powder features to examine
Amla	Dried grooved fruit pieces; brown fruit tissue	Parenchyma, sclereids, vessel or fibre fragments and calcium oxalate crystals
Arjuna	Curved bark pieces; grey-brown exterior and reddish inner face	Cork, stone cells or sclereids, fibres and calcium oxalate crystal groups

Comparison

Both drugs can contain supportive cells and crystals, so the bark or fruit tissue pattern and authenticated part are essential. Crystal presence alone is insufficient to distinguish them.

Observations and Record

Drug / mount	Observed structures	Magnification
Drug 1	_____	___ x
Drug 2	_____	___ x

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- A 10x eyepiece and 40x objective provide 400x visual magnification.
- If a feature is found in only one field, inspect additional representative fields before calling it consistently present. This is an identity observation, not a numerical purity assay.

Result

Drug 1 showed ___ and ___. Drug 2 showed ___ and ___. The observed pattern was compared with authenticated teaching material.

Precautions

- Use authenticated material and record the organ; whole-plant powder can differ from leaf-only powder.
- Do not mistake air bubbles for oil globules or a processing artefact for a diagnostic cell.
- Starch appearance can change during heating and processing.

Viva Questions and Answers

1. Why use more than one feature?

A common structure such as starch may occur in many drugs.

2. Why record processing?

Drying, boiling and powdering may alter diagnostic appearance.

3. What should the result state?

The observed features and consistency with the authenticated drug, with any limitations.

Turmeric and Psyllium Husk Powder Study

Experiment 4 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To compare the supplied authenticated drugs by organoleptic observation and powder microscopy.

Principle

Organoleptic observation and microscopic structures provide complementary identity evidence. Powdering destroys much gross form, but fragments of epidermis, vessels, fibres, starch and other diagnostic structures may remain. Features depend on the actual plant part, processing and preparation; confirm identity from a pattern, not a single cell.

Identity and Material

Drug	Botanical identity / family	Part examined
Turmeric	<i>Curcuma longa</i> / Zingiberaceae	Rhizome
Psyllium husk	<i>Plantago ovata</i> / Plantaginaceae	Seed husk

Requirements

- Authenticated Turmeric rhizome and Psyllium husk and matched teaching powders.
- Microscope, slides, coverslips and instructor-approved mounting and staining materials.
- Hand lens, labelled observation record and sketch materials.

Procedure

1. Inspect and label

Confirm the botanical labels and plant parts. Record colour, surface and texture. Assess odour only by the laboratory-approved method; do not taste material.

2. Prepare a mount

Use a small dispersed powder portion in the prescribed mount. Prepare an untreated or specifically stained mount as directed; do not combine arbitrary clearing reagents.

3. Survey

Find representative fragments at low power, then examine diagnostic features at a suitable higher power.

4. Compare

Locate more than one feature from the guide, compare with the authenticated teaching material and note absent or obscured features.

5. Record

Draw labelled structures, state magnification and write a comparison. Distinguish observed structures from expected textbook features.

Introduction to Pharmacognosy

Organoleptic and Powder Features

Drug	Macroscopic / organoleptic cues	Powder features to examine
Turmeric	Yellow-orange rhizome interior; characteristic aromatic material	Yellow parenchyma, starch or gelatinised starch masses, cork and vessel fragments
Psyllium husk	Pale, lightweight, thin husk flakes; visible swelling in water	Fragments of mucilage-bearing outer seed-coat cells; compare dry and hydrated mounts

Comparison

Turmeric powder is a rhizome preparation with pigment and storage tissue. Psyllium husk is the separated seed coat; a whole-seed microscopic pattern should not be assumed to describe pure husk. Cooking or curing can gelatinise turmeric starch.

Observations and Record

Drug / mount	Observed structures	Magnification
Drug 1	_____	___ x
Drug 2	_____	___ x

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- A 10x eyepiece and 40x objective provide 400x visual magnification.
- If a feature is found in only one field, inspect additional representative fields before calling it consistently present. This is an identity observation, not a numerical purity assay.

Result

Drug 1 showed ___ and ___. Drug 2 showed ___ and ___. The observed pattern was compared with authenticated teaching material.

Precautions

- Use authenticated material and record the organ; whole-plant powder can differ from leaf-only powder.
- Do not mistake air bubbles for oil globules or a processing artefact for a diagnostic cell.
- Starch appearance can change during heating and processing.

Viva Questions and Answers

1. Why use more than one feature?

A common structure such as starch may occur in many drugs.

2. Why record processing?

Drying, boiling and powdering may alter diagnostic appearance.

3. What should the result state?

The observed features and consistency with the authenticated drug, with any limitations.

Brahmi and Fenugreek Powder Study

Experiment 5 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To compare the supplied authenticated drugs by organoleptic observation and powder microscopy.

Principle

Organoleptic observation and microscopic structures provide complementary identity evidence. Powdering destroys much gross form, but fragments of epidermis, vessels, fibres, starch and other diagnostic structures may remain. Features depend on the actual plant part, processing and preparation; confirm identity from a pattern, not a single cell.

Identity and Material

Drug	Botanical identity / family	Part examined
Brahmi	<i>Bacopa monnieri</i> / Plantaginaceae	Whole plant; note stem and leaf proportions
Fenugreek	<i>Trigonella foenum-graecum</i> / Fabaceae	Seed

Requirements

- Authenticated Brahmi whole plant and Fenugreek seeds and matched teaching powders.
- Microscope, slides, coverslips and instructor-approved mounting and staining materials.
- Hand lens, labelled observation record and sketch materials.

Procedure

1. Inspect and label

Confirm the botanical labels and plant parts. Record colour, surface and texture. Assess odour only by the laboratory-approved method; do not taste material.

2. Prepare a mount

Use a small dispersed powder portion in the prescribed mount. Prepare an untreated or specifically stained mount as directed; do not combine arbitrary clearing reagents.

3. Survey

Find representative fragments at low power, then examine diagnostic features at a suitable higher power.

4. Compare

Locate more than one feature from the guide, compare with the authenticated teaching material and note absent or obscured features.

5. Record

Draw labelled structures, state magnification and write a comparison. Distinguish observed structures from expected textbook features.

Introduction to Pharmacognosy

Organoleptic and Powder Features

Drug	Macroscopic / organoleptic cues	Powder features to examine
Brahmi	Small opposite fleshy leaves on a creeping herb	Leaf epidermis with stomata; stem vessels and fibres; parenchyma and possible starch
Fenugreek	Hard angular yellow-brown seeds with a distinct groove	Palisade seed-coat cells, underlying supporting cells, endosperm and cotyledon fragments

Comparison

Brahmi whole-plant powder combines leaf and stem features, while Fenugreek shows a seed-coat and storage-tissue pattern. For this practical Brahmi means *Bacopa monnieri*, not *Centella asiatica*.

Observations and Record

Drug / mount	Observed structures	Magnification
Drug 1	_____	___ x
Drug 2	_____	___ x

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- A 10x eyepiece and 40x objective provide 400x visual magnification.
- If a feature is found in only one field, inspect additional representative fields before calling it consistently present. This is an identity observation, not a numerical purity assay.

Result

Drug 1 showed ___ and ___. Drug 2 showed ___ and ___. The observed pattern was compared with authenticated teaching material.

Precautions

- Use authenticated material and record the organ; whole-plant powder can differ from leaf-only powder.
- Do not mistake air bubbles for oil globules or a processing artefact for a diagnostic cell.
- Starch appearance can change during heating and processing.

Viva Questions and Answers

1. Why use more than one feature?

A common structure such as starch may occur in many drugs.

2. Why record processing?

Drying, boiling and powdering may alter diagnostic appearance.

3. What should the result state?

The observed features and consistency with the authenticated drug, with any limitations.

Moisture Content of Crude Drugs

Experiment 6 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To determine loss on drying of a crude drug and distinguish mass loss from a water-specific measurement.

Principle

Loss on drying measures the decrease in mass under defined conditions. It may include volatile constituents as well as water. A water-specific method such as an appropriate distillation or validated titration is different; the method must suit the drug and its monograph.

Requirements

- Representative drug portion at prescribed particle size.
- Balance, tared drying dish, prescribed oven or drying system and desiccator.

Procedure

1. Prepare the dish

Dry and weigh the dish as prescribed; record tare mass m_0 .

2. Weigh the portion

Add the assigned representative portion and record dish plus material before drying, m_1 . Spread appropriately for the specified method.

3. Dry

Use the temperature and time from the drug's prescribed method. A common classroom oven example is 105°C, but it is not suitable for every volatile or heat-sensitive drug.

4. Cool and reweigh

Cool in a desiccator and weigh, m_2 . Repeat the prescribed drying and weighing sequence until the stated constant-mass criterion is met.

5. Calculate

Use $100 \times (m_1 - m_2) \div (m_1 - m_0)$. Record conditions, replicates and the basis of the reported result.

Introduction to Pharmacognosy

Observations and Record

Measurement	Symbol	Mass
Empty dish	m0	___ g
Dish + material before drying	m1	___ g
Dish + material after drying	m2	___ g

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Illustrative masses: $m_0 = 28.000$ g; $m_1 = 30.000$ g; $m_2 = 29.840$ g. Test portion = 2.000 g; loss = 0.160 g.
- Loss on drying = $0.160 \div 2.000 \times 100 = 8.0\%$.
- Report "8.0% loss on drying under the stated conditions", not automatically "8.0% water", when other volatile material may be lost.

Result

Loss on drying = ___% using ___ conditions. Replicate values and the prescribed specification are recorded.

Precautions

- Weigh only after cooling under the prescribed conditions.
- Avoid scorching or decomposition; mass loss then no longer represents the intended test.
- Use the stated constant-mass criterion rather than an invented universal tolerance.

Viva Questions and Answers

1. Why use a desiccator?

It helps limit moisture uptake during cooling.

2. Is loss on drying always water content?

No; volatile compounds may also be lost.

3. Why record particle size?

It can influence drying rate and the reproducibility of the method.

Swelling Index and Foaming Index

Experiment 7 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To determine the swelling behaviour and foaming index of suitable crude drugs by the prescribed physical tests.

Principle

Swelling index describes the volume occupied by a stated mass of herbal material and its associated mucilage after a defined hydration procedure. Foaming index describes the dilution at which an aqueous preparation gives a defined persistent foam height. Neither result alone proves clinical efficacy or full chemical identity.

Requirements

- Suitable authenticated crude drug, balance and water or specified vehicle.
- Stoppered graduated cylinders, boiling vessel, filters, test tubes, rack and timer.

Procedure

1. Set swelling conditions

Weigh the prescribed mass and use the stated particle size, cylinder and vehicle. Record all conditions because they affect the result.

2. Hydrate

For the common teaching cylinder method, use the prescribed 25 mL vehicle, agitate at 10-minute intervals over the first hour and allow the specified three-hour standing period. Read material plus mucilage volume.

3. Repeat swelling

Obtain the prescribed replicates and express mean occupied volume per gram. Do not substitute a percentage expansion calculation for a mL/g result.

4. Prepare the foam series

Use the prescribed aqueous decoction. In the standard teaching series, place 1-10 mL portions in separate tubes and bring each to 10 mL with water.

5. Assess foam

Shake and stand under the method's fixed conditions, commonly 15 seconds shaking and 15 minutes standing. Identify a, the original decoction volume producing 1 cm foam; index = $1000/a$. If no tube reaches or all exceed the criterion, apply the method's extension.

Introduction to Pharmacognosy

Observations and Record

Test	Recorded data	Calculated result
Swelling	Mass ____ g; volumes ____ / ____ / ____ mL	____ mL/g
Foam series	a = ____ mL for 1 cm foam	Index ____
Conditions	Particle size, vehicle and timing	_____

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Swelling example: three 1.0 g portions occupy 11, 12 and 13 mL. Mean = 12 mL; index = 12 mL/g.
- Foam example: a = 5 mL. Foaming index = $1000 \div 5 = 200$.
- For the standard 1-10 mL series: all foam below 1 cm implies an index below 100; all above 1 cm implies above 1000 and needs the specified extended dilution.

Result

Swelling index = ____ mL/g. Foaming index = _____. Both results include the specified test conditions.

Precautions

- Use consistent particle size and the same reading convention for material plus mucilage.
- Clean tubes must not contain detergent residues that could produce foam.
- Do not change shaking time or standing time between tubes.

Viva Questions and Answers

1. What are swelling-index units?

Commonly mL per gram under the stated method.

2. What does a mean in $1000/a$?

The mL of original decoction producing the specified 1 cm foam height.

3. Why are test conditions important?

Hydration, agitation and time affect both swelling and foam behaviour.

Stomatal Number and Stomatal Index

Experiment 8 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To measure stomatal density and calculate stomatal index for a specified leaf surface.

Principle

Stomatal number is the number of stomata per defined area, commonly per mm^2 . Stomatal index is the percentage of stomata among stomata plus ordinary epidermal cells in the counted field. A pair of guard cells enclosing one pore is counted as one stoma, not as two stomata.

Requirements

- Authenticated leaf and instructor-prepared epidermal peel or cleared preparation.
- Microscope, calibrated field-area method and counting sheet.

Procedure

1. Identify the surface

Record the species, leaf maturity and upper or lower surface. Use representative regions selected by the prescribed method.

2. Calibrate area

Determine the viewed area with the stage micrometer or the validated field-area method; magnification alone does not provide area.

3. Count stomata

Apply a consistent boundary rule and count S stomata in each selected field.

4. Count epidermal cells

In the same fields count E ordinary epidermal cells, excluding the guard cells from E.

5. Calculate and repeat

Stomatal number = $S \div \text{area}$. Index = $100S \div (S + E)$. Calculate each field and report the prescribed summary with the surface stated.

Observations and Record

Field / surface	S and E	Area / calculated values
1 / ____	S ____; E ____	____ mm^2 ; ____ / ____
2 / ____	S ____; E ____	____ mm^2 ; ____ / ____
3 / ____	S ____; E ____	____ mm^2 ; ____ / ____

Introduction to Pharmacognosy

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Field example: $S = 20$, $E = 80$, area = 0.25 mm^2 . Stomatal number = $20 \div 0.25 = 80 \text{ stomata/mm}^2$.
- Stomatal index = $20 \div (20 + 80) \times 100 = 20\%$.
- The index is dimensionless; the density has an area unit. These two measurements should not be reported interchangeably.

Result

On the ____ leaf surface, stomatal number = ____/ mm^2 and stomatal index = ____%, using ____ fields.

Precautions

- Count on the same leaf surface and use representative comparable regions.
- Avoid damaged or obscured fields and document the selection method.
- Do not count two guard cells as two separate stomata.

Viva Questions and Answers

1. Why is field calibration necessary?

Density requires a known area, not just a cell count.

2. Which cells are included in E?

Ordinary epidermal cells in the same field, excluding guard cells.

3. Can upper and lower surface counts be mixed?

Not without an explicitly defined method; their distributions can differ.

Vein Islet and Vein Termination Numbers

Experiment 9 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To count vein islets and free vein endings in a calibrated area of a suitable leaf preparation.

Principle

A vein islet is a small area enclosed by the ultimate vein network. A vein termination is a free vein ending within the network. Quantitative leaf characters are measured in a known area and specified region; a whole-leaf count is a different measurement.

Requirements

- Authenticated leaf and instructor-cleared, stained teaching preparation.
- Microscope, stage micrometer or calibrated area grid and drawing sheet.

Procedure

1. Choose the region

Record the leaf identity, maturity and selected lamina region. Avoid the main midrib unless the prescribed method includes it.

2. Calibrate

Define the counted area, usually expressed in mm^2 . Draw or record the field boundary.

3. Count islets

Identify enclosed areas and apply the prescribed boundary convention. Do not count an open area as a complete islet.

4. Count terminations

Count the visible free endings in the defined area. Distinguish a genuine ending from a cut or poorly cleared vein.

5. Repeat and calculate

Use representative fields and express islets and terminations per mm^2 , with the number of fields and counting convention stated.

Introduction to Pharmacognosy

Observations and Record

Field	Area / islets	Terminations
1	___ mm ² / ___	___
2	___ mm ² / ___	___
3	___ mm ² / ___	___

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- In a 0.5 mm² field, 12 counted islets correspond to $12 \div 0.5 = 24$ islets/mm².
- If 8 free endings occur in the same field, vein termination number = $8 \div 0.5 = 16$ /mm².
- Replicate field values should be summarised by the prescribed method rather than selecting the field that best matches an expected value.

Result

Vein islet number = ___/mm² and vein termination number = ___/mm² in the specified region.

Precautions

- Use a sufficiently cleared preparation; hidden veins can change counts.
- Use one stated boundary convention for all fields.
- Do not confuse processing breaks with natural vein endings.

Viva Questions and Answers

1. What is a vein islet?

An area enclosed by the small vein network.

2. What is a vein termination?

A free vein ending within the lamina network.

3. Why state the leaf region?

Vein patterns and counts may differ across the leaf.

Ash Values and Extractive Values

Experiment 10 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To calculate total ash, selected ash fractions and water- or alcohol-soluble extractive values for a prescribed crude drug.

Principle

Ash tests assess the residue remaining after controlled incineration. Total ash includes physiological mineral residue and extraneous inorganic matter; acid-insoluble ash can indicate siliceous contamination. Extractive value measures residue recovered under a defined solvent and extraction method, not the amount of one specific active constituent.

Requirements

- Representative powdered drug; prescribed water, alcohol and acid reagents.
- Tared crucibles, furnace, desiccator and balance.
- Extraction flask, volumetric glassware, filter and tared evaporating dish.

Procedure

1. Determine total ash

Weigh the prescribed drug portion in a tared crucible. Incinerate gradually at the method's temperature to the required endpoint, cool in a desiccator and weigh.

2. Determine ash fractions

Treat the total ash with the specified acid for acid-insoluble residue, or water for the water-soluble ash determination. Collect and incinerate the relevant residue as directed.

3. Extract

Weigh the drug portion and use the prescribed solvent strength, solvent volume, time and agitation. Prepare a separate water and alcohol test where required.

4. Measure an aliquot

Filter as prescribed and transfer a known aliquot to a tared dish. Evaporate and dry the residue under the stated conditions.

5. Calculate

Express ash as $\text{residue mass} \div \text{drug mass} \times 100$. For extractive value, account for total extract volume and the aliquot volume; state the solvent and basis.

Introduction to Pharmacognosy

Observations and Record

Test	Starting portion / residue	Calculated value
Total / acid-insoluble ash	___ g / ___ g	___% / ___%
Water-soluble ash	Total ash minus insoluble residue	___%
Extractive	Drug ___ g; residue ___ g; volumes ___	___%

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Total ash example: 0.10 g ash from 2.00 g drug gives 5.0%. Acid-insoluble residue 0.02 g gives 1.0% on the original drug basis.
- If water-insoluble residue is 0.03 g from 0.10 g total ash, water-soluble ash is $0.07 \div 2.00 \times 100 = 3.5\%$.
- Extractive (%) = $100 \times \text{residue mass} \times \text{total extract volume} \div (\text{aliquot volume} \times \text{drug mass})$.
- Example: 4.0 g drug, 100 mL extract, 25 mL aliquot, 0.080 g dry residue: $100 \times 0.080 \times 100 \div (25 \times 4.0) = 8.0\%$.

Result

Total ash ___%; acid-insoluble ash ___%; water-soluble ash ___%; ___-soluble extractive ___%. Conditions and basis are recorded.

Precautions

- Avoid flaming, loss of ash and weighing a hot crucible.
- Use the stated solvent strength and extraction conditions; changing them changes the extractive value.
- Apply the drug-specific specification rather than an invented universal limit.

Viva Questions and Answers

1. What can acid-insoluble ash suggest?

The presence of siliceous material such as sand, interpreted with the method and specification.

2. Is extractive value an assay of one active ingredient?

No; it measures total extracted residue under defined conditions.

3. Why correct for the aliquot?

Only part of the extract was evaporated, so its residue must be scaled to the total volume.

Foreign Organic Matter in Crude Drugs

Experiment 11 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To separate and weigh foreign matter in a representative crude-drug portion and report the defined category.

Principle

Foreign matter can include unwanted plant parts, material from another species and extraneous contaminants. The drug's prescribed definition determines what is counted. Sand or stones are inorganic foreign matter, so a result labelled foreign organic matter should not silently combine both categories.

Requirements

- Representative intact or cut crude drug and the prescribed definition.
- Balance, clean tray, forceps, hand lens and separate tared containers.

Procedure

1. Inspect the lot

Note the drug identity, form and visible distribution of unwanted material. Obtain the representative test portion by the prescribed selection method.

2. Weigh

Record the original test-portion mass before separating matter.

3. Sort

Spread the material on a clean tray and separate unwanted organic matter using the defined criteria. Keep inorganic material in a separate category when applicable.

4. Check borderline pieces

Use the hand lens and instructor authentication for uncertain fragments. Do not discard legitimate drug parts solely because they are a different size.

5. Calculate

Weigh each category and divide by the original test-portion mass. State exactly which categories the reported percentage includes.

Introduction to Pharmacognosy

Observations and Record

Category	Mass	Percentage
Original portion	___ g	100%
Foreign organic matter	___ g	___%
Other defined foreign matter	___ g	___%

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Illustrative 50.0 g portion contains 1.2 g unwanted organic material and 0.3 g sand.
- Foreign organic matter = $1.2 \div 50.0 \times 100 = 2.4\%$.
- If the prescribed total-foreign-matter definition includes both categories: total = $1.5 \div 50.0 \times 100 = 3.0\%$. Do not label that 3.0% as organic matter alone.

Result

Foreign organic matter = ___%. Other defined matter = ___%. The categories and drug-specific criterion are stated.

Precautions

- Choose a representative portion; selecting only clean pieces biases the result.
- Do not confuse unwanted matter with legitimate parts covered by the drug definition.
- Use the specified portion mass and limit; no one cutoff applies to all crude drugs.

Viva Questions and Answers

1. What is the denominator?

The original test-portion mass before sorting.

2. Is sand organic foreign matter?

No; report it under the appropriate inorganic or total category.

3. Why define the drug part?

A stem may be acceptable in whole-plant material but unwanted in a leaf-only drug.

Eyepiece Micrometry of Crystals and Fibres

Experiment 12 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To calibrate an eyepiece scale and measure calcium oxalate crystals and phloem fibres in a prepared drug mount.

Principle

An eyepiece micrometer has an arbitrary scale. Calibration against a stage micrometer converts its divisions to actual length for a particular optical configuration. Changing the objective or another magnification factor changes the conversion.

Requirements

- Microscope with eyepiece scale and stage micrometer with known markings.
- Instructor-provided crystal and phloem-fibre mounts.
- Measurement sheet and drawing materials.

Procedure

1. Read the stage scale

Confirm the marked total length and number of divisions. If 1 mm has 100 divisions, one stage division is $0.01 \text{ mm} = 10 \text{ }\mu\text{m}$.

2. Align scales

Focus the stage micrometer with the objective to be used. Align zero points and identify a second coinciding mark over a suitable span.

3. Calculate calibration

$\mu\text{m per eyepiece division} = \text{stage span in }\mu\text{m} \div \text{corresponding eyepiece divisions}$. Record objective and eyepiece.

4. Measure crystals

Replace the stage scale with the prepared drug mount. Measure the stated crystal axis, distinguishing crystal dimensions from surrounding cell dimensions.

5. Measure fibres

Measure the specified fibre length and width for an intact fibre lying suitably in the field. For a length extending beyond the field, use the prescribed validated measurement method rather than guessing.

6. Summarise

Measure the assigned number of structures and report mean and range separately for crystals and fibres.

Introduction to Pharmacognosy

Observations and Record

Object / configuration	Eyepiece divisions	Calculated dimension
Calibration	Stage ____ μm = ____ divisions	____ $\mu\text{m}/\text{division}$
Crystal axis	____ divisions	____ μm
Fibre width / length	____ / ____ divisions	____ / ____ μm

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Calibration example: 20 stage divisions $\times$ 10 μm = 200 μm correspond to 50 eyepiece divisions. Factor = $200 \div 50 = 4 \mu\text{m}/\text{division}$.
- A crystal spans 8 divisions: dimension = $8 \times 4 = 32 \mu\text{m}$. A fibre width spans 5 divisions: width = 20 μm .
- If a lower-power calibrated factor is 10 $\mu\text{m}/\text{division}$ and an intact fibre spans 80 divisions, length = 800 μm . Use the factor for that objective, not 4 $\mu\text{m}/\text{division}$.

Result

Calibration at ____ objective: ____ $\mu\text{m}/\text{division}$. Crystal ____ dimension: mean ____ μm , range ____ . Fibre length / width: ____ / ____ μm .

Precautions

- Calibrate separately for each optical configuration used.
- Do not measure a broken fibre as if it were its full original length.
- Avoid selecting only unusually large structures; record representative measurements.

Viva Questions and Answers

1. Why is the eyepiece scale arbitrary?

Its divisions have no fixed specimen length until calibrated.

2. Does the factor remain unchanged at another objective?

No; recalibration is required.

3. Why state the measured axis?

Irregular or anisotropic objects can have different lengths and widths.

Powder Purity by Lycopodium Spore Method

Experiment 13 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To calculate an estimated powder purity from diagnostic-element counts and a known lycopodium-spore standard.

Principle

A weighed spore standard provides a particle-number comparison. In a uniformly mixed suspension, the ratio of diagnostic drug elements to spores estimates the number of drug elements per gram. Percentage purity additionally requires the established diagnostic-element count per gram of genuine drug; it cannot be obtained from spores alone.

Requirements

- Drug powder with a validated countable diagnostic element.
- Lycopodium standard with a stated spore count per gram, balance and approved mounting vehicle.
- Microscope, counting sheet and validated genuine-drug element count.

Procedure

1. Define constants

Record M, test powder mass in g; W, lycopodium mass in g; L, spores/g of the standard; and P, diagnostic elements/g of genuine drug.

2. Prepare a uniform mixture

Mix weighed powder and standard by the prescribed method. Disperse in the specified vehicle without selective settling or clumping.

3. Count representative fields

Count N diagnostic elements and S spores over the prescribed number of fields using consistent boundaries. Count both in the same representative preparation.

4. Estimate element concentration

Elements/g test powder = $(N/S) \times (W \times L/M)$. Check all mass units before calculation.

5. Calculate purity

Purity (%) = $N \times W \times L \times 100 \div (S \times M \times P)$. Repeat and report uncertainty or poor agreement as directed.

Introduction to Pharmacognosy

Observations and Record

Quantity	Meaning / unit	Value
M / W	Drug mass / spore-standard mass, g	___ / ___
L / P	Spores/g standard / elements/g genuine drug	___ / ___
N / S	Total diagnostic elements / total spores	___ / ___

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Illustrative constants only: M = 0.25 g; W = 0.05 g; L = 94,000 spores/g; P = 11,750 elements/g. Counts: N = 100, S = 200.
- $\text{Elements/g} = (100/200) \times (0.05 \times 94,000 / 0.25) = 9400$.
- $\text{Purity} = 9400 \div 11,750 \times 100 = 80\%$. The value 94,000 must not be assumed for every spore-standard lot.
- Without a validated P value for the genuine material, report the estimated element concentration rather than a claimed percentage purity.

Result

Diagnostic elements/g = ___. Estimated purity = ___% only where validated P was available. Constants, counts and replicate agreement are recorded.

Precautions

- Use matching units: spores/g is different from spores/mg.
- Uneven mixing, settling and misidentified elements can bias the ratio.
- A microscopic purity estimate does not rule out chemical contamination or every form of adulteration.

Viva Questions and Answers

1. Why add a spore standard?

Its known particle count provides a quantitative comparison.

2. What else is required for percentage purity?

A validated diagnostic-element count per gram of genuine drug.

3. Why count both particles in the same fields?

The ratio should describe the same representative preparation.

Medicinal Plant Collection and Voucher Specimens

Experiment 14 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To document an authorised medicinal-garden visit, identify plant material and prepare a traceable voucher record.

Principle

A voucher preserves material and collection information so that an identification can be checked later. Field observations supplement laboratory study, but ethical collection, correct authentication and traceable labels are necessary. A photograph alone may not show every character needed for botanical identification.

Requirements

- Authorised garden visit, notebook, camera where permitted and plant-identification support.
- Labels, paper and press materials approved for the specimen type.
- Collect only material permitted by the site and educator.

Procedure

1. Plan the visit

Confirm access, collection permission and any protected-species restrictions. Define which plants and organs will be studied.

2. Record in the field

Assign a unique collection identifier. Record date, location, habitat, plant habit and visible flowers, fruits and leaf arrangement.

3. Collect appropriately

Use an authorised representative portion; do not damage a plant unnecessarily. If collection is not allowed, record an image-based observation and its limitation.

4. Prepare the specimen

Arrange permitted material to preserve diagnostic parts and dry using the institution's method. Succulent or bulky material may need a specialised preparation rather than ordinary pressing.

5. Authenticate and label

Have the identity checked by the designated botanist or educator. Label botanical name, family, collector, identifier, date, locality and examined part.

6. Archive

Link the voucher or authorised photograph to the practical record. Retain the identification date and any later correction.

Introduction to Pharmacognosy

Observations and Record

Field	Record	Verification
Collection identifier / date	_____	_____
Locality / habit / part	_____	_____
Botanical name / authenticator	_____	_____

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Illustrative label: FirstHope-Tulsi-01; collection date ____; authorised garden locality ____; botanical identity *Ocimum tenuiflorum*; family Lamiaceae; collector ____; identified by ____.
- If 12 plants are observed but only 3 authorised vouchers collected, report both numbers accurately. Do not present photographs as pressed specimens.

Result

The visit documented ____ plants. ____ authorised vouchers and ____ image records were linked to authenticated identities and field notes.

Precautions

- Do not collect protected, rare or restricted plants without the required permission.
- Do not taste field material or assume a local name establishes identity.
- Preserve enough collection information for future checking and avoid mixing material from different plants.

Viva Questions and Answers

1. Why prepare a voucher?

It preserves evidence that supports later verification of the botanical identity.

2. Why record flowers or fruits?

Reproductive structures often help distinguish similar species.

3. What should be done when collection is prohibited?

Document authorised observation or photography and state that no specimen was collected.

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