Pharmacognosy

Second Edition

Practical Notebook

Change is the natural phenomenon of universe and likewise the role of the pharmacist has undergone continuous evolution from a "dispenser of medicines" to a "medicine expert" in the health care team. The syllabus framed under ER-2020 program prescribed by PCI provides hands-on experience with respect to identification of crude drugs, anatomical study of the herbal drugs and evaluation of the crude drugs. The increasing demand of the crude drugs in the national and international markets suggests a methodical approach for evolution of the crude drugs in their organised and unoganised forms.

This Practical Notebook includes 37 experiments for first year DPharm students as specified under course code ER20-13P. Facing every experiment, the left-sided page is kept blank for making the student to draw diagrams of crude drugs.

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for First Year Diploma in Pharmacy

According to the latest syllabus prescribed by Pharmacy Council of India under Regulation 7 of the Education Regulations, 2020, for Diploma in Pharmacy course, implemented with strict compliance from 2021–2022 academic session.

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Leaf

Identification of Leaf Drugs by Morphological Characters

Leaves are flat, green and broad part of the shoot which possess neither nodes nor internodes and branches arise in their axils. For morphological study of various crude drugs the following types of characters are studied.

1. Arrangement of Leaves (phyllotaxy)

a. Alternate

Only one leaf arises from each node. Every next leaf arises from the successive node in opposite direction, e.g. peepal.

b. Opposite

Two leaves are attached at each node opposite to each other, e.g. jasmine.

c. Whorled

More than two leaves are attached at each node arranged in a whorl, e.g. oleander.

2. Shape

Shape of lamina may be acicular, linear, lanceolate, oblong, subulate, ovate, cordate, sagittate, hastate, reniform, lunate, obovate, obcordate, spathulate, cuneate, elliptical and rotund.

3. Margin

Entire, repend, serrate, biserrate, retroserrate, dentate, bidentate, crenate, bicrenate, spiny and lobed.

4. Apex

Acute, acuminate, obtuse, mucronate, cuspidate, tendrillar, cirrhose, truncate, retuse, emargenate, etc.

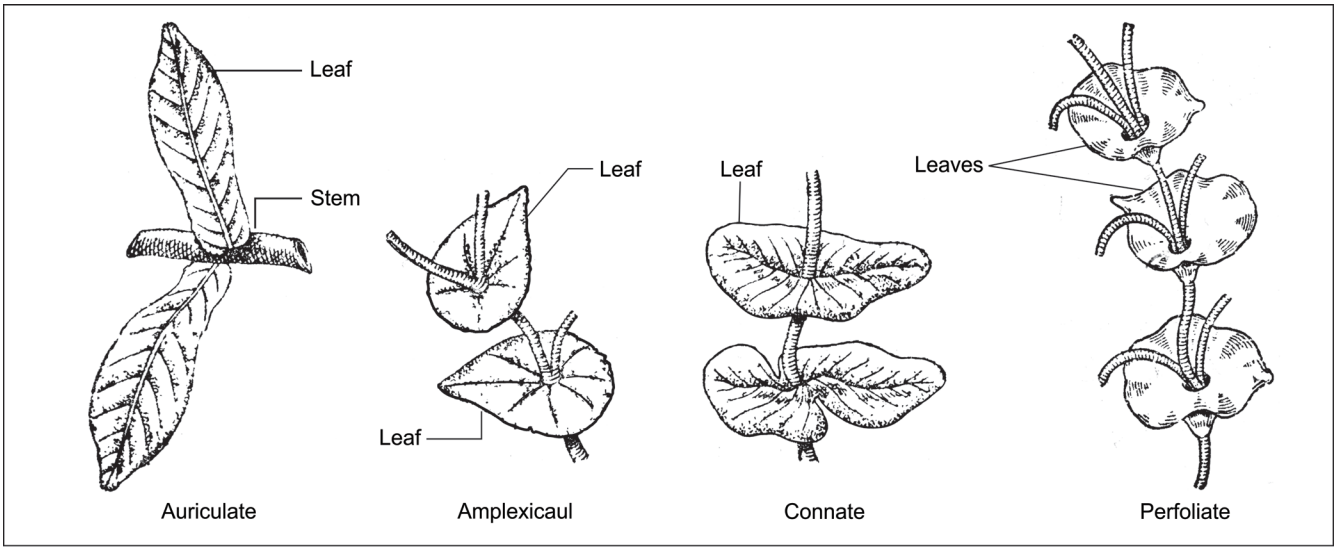
5. Petiole

It is leaf stalk which cylindrical or sub-cylindrical structures.

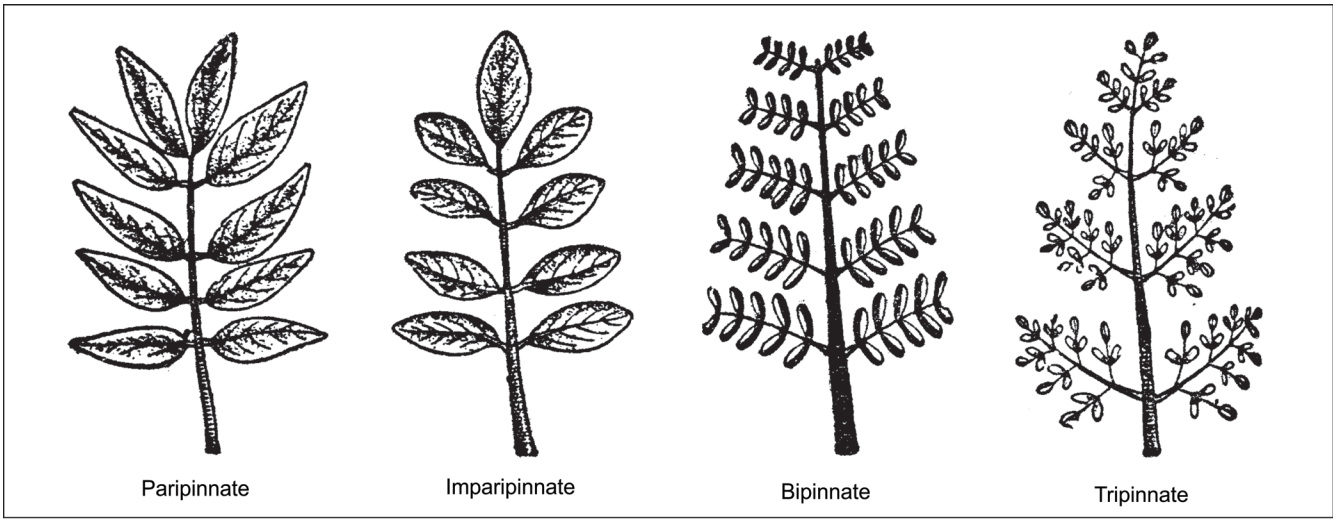
a. Petiolate: A leaf with petiole.
b. Sessile: A leaf without petiole.

6. Surface

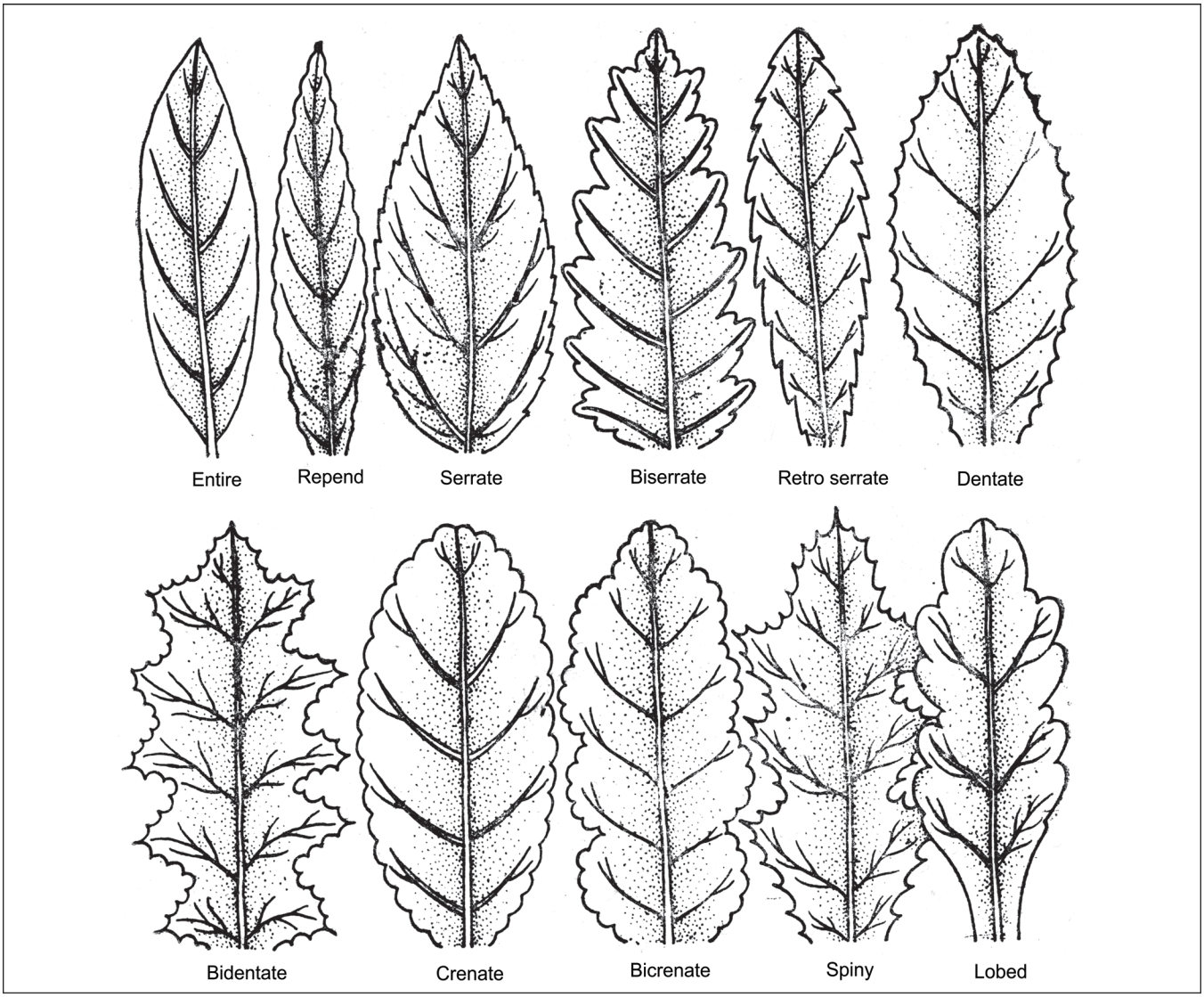
a. Glabrous: Smooth surface.
b. Pubescent: Hairy surface.
c. Glaucous: Covered by whitest substances.
d. Gland dotted: Possessing non-sticky glands.
e. Spiny: Covered by spine.



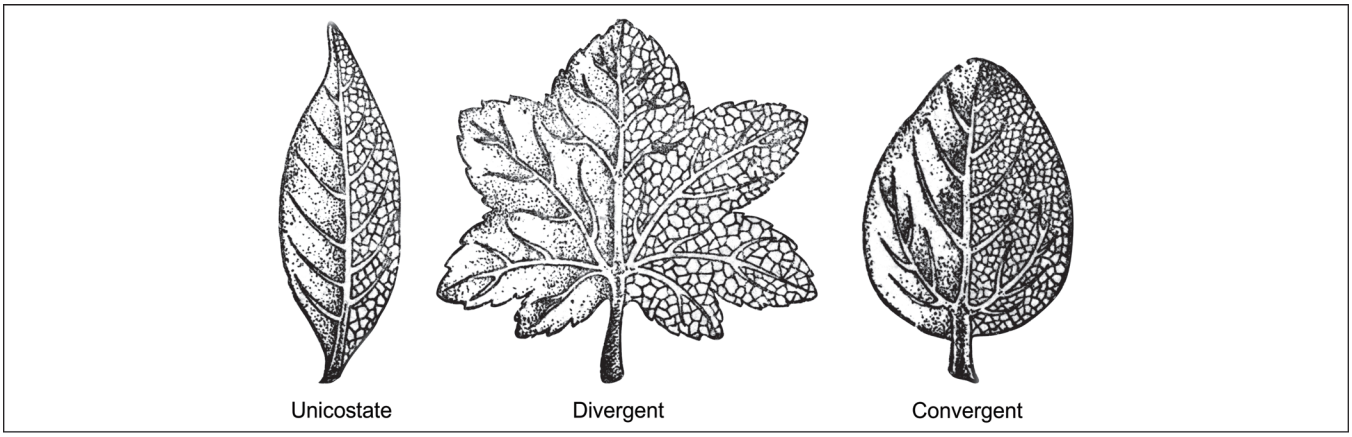
Leaf base



Pinnate compound leaf



LeaF—Margin



Reticulate venation

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Bark

Identification of Bark Drugs

All tissues lying out side the secondary phloem, i.e. pericycle, cortex, periderm (cork cambium, cork and secondary cortex) and all dead cells external to periderm. So bark consists of the external tissue of stems or roots removed by making longitudinal and transverse incisions.

Rhytidoma

The external covering of a bark which consists of layers of dead phloem alternating with bands of cork is termed as rhytidoma.

Methods of Collection

1. Felling

The fully grown tree was cut down near the ground level and barks are removed from stem and branches, e.g. cinchona.

2. Uprooting

It is the most common method of collection. The root is dug up and the barks are removed from the truck, branches and root of the 10–15 years old tree.

3. Copping

In this case the tree is allowed to grow. The stem is then cut down to within short distance from the ground and the bark is removed. The stools are allowed to grow again and the bark is stripped from them.

Shape of Pieces

Depending on the type of incisions made to the bark, the nature and extent of the shrinkage which occurs during drying the bark, are characterized by the following features.

a. Flats

When finished bark consists of flat pieces, e.g. cinchona.

b. Curved

When only slightly concave on the inside.

c. Re-curved

When concavity is on the out side.

d. Channelled

When the curvature on the inside is so great to form channel.

e. Quill

When the curvature is so deep that the one edge overlaps the other.

f. Double quill

When each edge is rolled independently into a quill.

g. Compound quill

When quills are packed one inside the other, e.g. cinnamon.

CHARACTERS OF THE OUTER SURFACE

a. Smooth

When the cork is evenly developed.

b. Scaly

When rhytidoma is present.

c. Exfoliates

The corky layer frequently flakes off.

d. Cracks and fissures

It happens owing to the lack of elasticity in the dead tissue.

e. Wrinkles

The wrinkles appears due to shrinkage of the softer tissue.

f. Furrows

When the troughs between the wrinkles are very wide.

Characters of Inner Surface

a. Striations: Due to formation of parallel longitudinal ridges.

b. Corrugations: The longitudinal shrinkage produces parallel transverse wrinkles.

Fracture

The nature of exposed surfaces of a transversely broken bark is called fracture.

a. **Short:** The surfaces are smooth.

b. **Granular:** The surfaces exhibit small rounded structures.

c. **Splintery:** When jagged projecting points are formed.

d. **Fibrous:** When the surface consists of fine fibrous threads.

e. **Laminated:** When fractured region breaks into tangentially arranged layers.

Experiment 2: Cinchona

OBJECT

Identification of bark drug **Cinchona** by study of morphological characters.

Morphological Characters

Size	Up to 30 cm long, diameter 15–20 mm and thickness 2–8 mm.
Shape	Compound quill.
Outer surface	Rough due to presence of cracks, wrinkles and often bears epiphytes such as lichens.
Inner surface	Longitudinal striations.
Fractures	Short and fibrous.
Root bark	Channelled, twisted, outer surface-scaly, inner surface-striated.

Organoleptic Characters

Colour outer surface	Greyish green
Colour inner surface	Reddish brown
Odour	Odourless
Taste	Bitter or more less astringent

Chemical Constituents

It contains alkaloids like quinine, quinidine, cinchonine and cinchonidine. Other constituents are quinovin, oxidase, calcium oxalate and starch.

Use

Antimalarial and antipyretic. It is used to treat cardiac arrhythmias.

Biological Source

The given sample of crude drug consists of root or stem bark of *Cinchona calisaya* and other species, belonging to the family Rubiaceae.

Experiment 3: Cinnamon

OBJECT

Identification of bark drug **Cinnamon** by study of morphological characters.

Morphological Characters

Size	Up to 100 cm long, diameter 6–10 mm thickness 0.5 mm.
Shape	Single or double compound quill.
Outer surface	Longitudinal wavy lines and occasional scars and holes.
Inner surface	Longitudinal striations.
Fractures	Short, splintery.

Organoleptic Characters

Colour outer surface	Yellowish brown
Colour inner surface	Dark green
Odour	Aromatic
Taste	Warm sweet

Chemical Constituents

Volatile oil consists of eugenol, pinene, phellandrene, caryophyllene and cinnamyl acetate. It also contains mucilage, calcium oxalate, sugar starch and phlobatannin.

Use

Carminative, stomachic.

Biological Source

The given sample of crude drug consists of dried bark of *Cinnamomum zeylanicum* belonging to the family Lauraceae.

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Flower

Identification of Flower Drugs

A flower is modified condensed shoot specialized to carry out sexual reproduction in higher plants.

Bract

A small leaf like structure which arises at the axil. It is situated at the base of the pedicel.
(a) *Bracteate:* Bract present. (b) *Ebracteate:* Bract absent.

Bracteole

A small leaf like structures are present in the middle of pedicel.
(a) *Bracteolate:* Bracteole present. (b) *Ebracteolate:* Bracteole absent.

Pedicellate

Pedicel present.

Sessile

Pedicel absent.

Type of Flower

Flower may be hermaphrodite or unisexual.

Whorls of Flower

A flower consists of four whorls, i.e. calyx, corolla, androecium and gynoecium. Out of which calyx and corolla are non-essential or helping whorls. Androecium and gynoecium are fertile or essential whorls.

Calyx

It is the outermost whorl. The individual unit is called sepal. In bud condition it encloses the inner part of the flower.

Corolla

The individual unit is called petal. Petals are the large coloured attractive part of the flower.

Androecium

It is the male part of the flower. The individual unit is called stamen. Each stamen consists of the anther and filament.

Gynoecium (Pistil)

It is a female part of the flower and individual unit is called carpel. Each carpel consists of ovary, stigma and style. The oval structures are found in the ovary is called ovules which forms seeds after fertilization.

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Seed

Identification of Seed Drugs

Seed is fertilized mature ovule which contains an embryo.

Seed coat

It is an outer covering of the seed which develop from the integuments from the ovules.

Testa and Tegmen

The outer coat is called testa and the inner layer is called tegmen. The testa is hard where as tegmen is thin and membranous.

Hilum

It is the mark of attachment with the stalk on outer surface of the seed.

Mycropyle

A small hole in the ovule is being left through which the pollen tube may pass on it way to the embryosac.

Nucellus

A mass of parenchymatous tissue of the ovule is called nucellus.

Perisperm

In some seed like cardamom and pepper, the nucellus develops to form a storage tissue called perisperm.

Funicle

The part of ovule which joins with placenta. The ovule without funicle is called sessile ovule.

Raphe

It is short ridge like structures which serves as path from funicle to chalaza. Chalaza is the base of the ovule.

Integuments

It is one or two layers around the nucellus. The number of integuments is the characteristics of a particular family.

Embryo

The embryo is differentiated into radicle, plumule and cotyledons. The radicle gives rise to primary root where as plumule gives rise to aerial shoot.

Albuminous and exalbuminous seeds

Albuminous

The seeds which store food materials in endosperm, e.g. castor, wheat.

Exalbuminous

The seeds which store food materials in their cotyledons, e.g. almond, ground nut, etc.

Forms of ovules

1. Orthotropous

Funicle, chalaza and micropyle of a ovule are situated in a straight line, e.g. polygonaceae, piperaceae.

2. Anatropous

The ovule is completely inverted. The nucellus is parallel to funicle. The micropyle comes near to hilum. The degree of curvature 180°.

3. Hemitropous ovule

It is intermediate between orthotropus and antropous, i.e. at right angle to funicle. The micropyle–chalaza line is horizontal and placed at 90° to the line of funicle.

4. Campylotropous

The body of ovule becomes curved so that the micropyle and chalaza come to line on either side of the funicle. The raphe is not formed.

5. Amphitropous

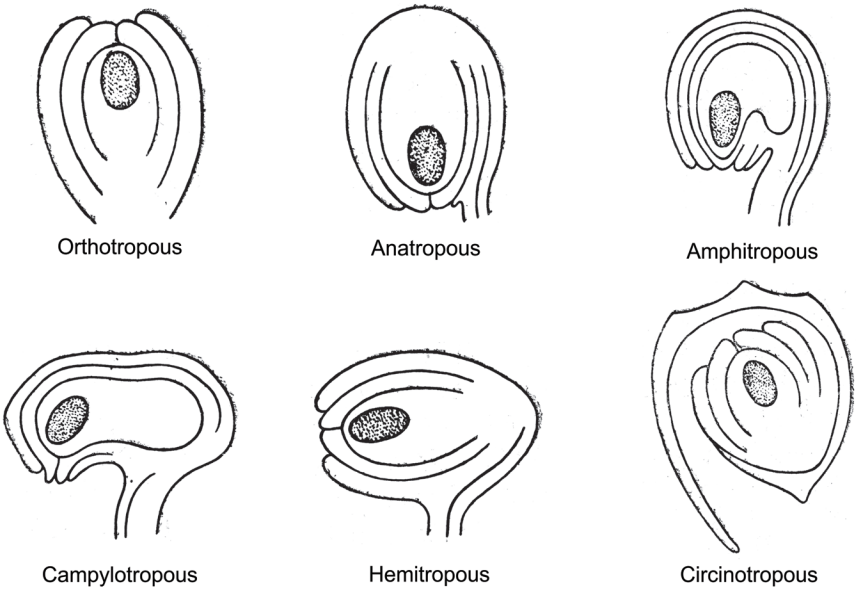
The ovule curved to form horseshoe shaped.

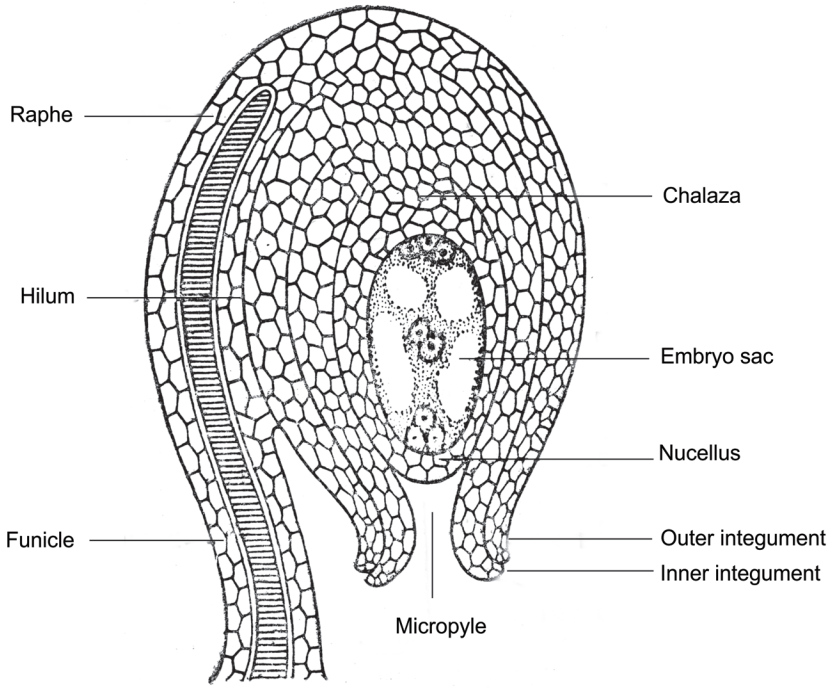
6. Circinotropous

The ovule is straight with micropyle facing upwards. The funicle is elongated and coiled. It completely encircles the ovule.

Morphology of seeds consists of the following characters

1. Physical character: Shape, dimension, hardness, etc.
2. Seed coat: Number, marking, hilum, raphe, aril, etc.
3. Perisperm: Present or absent, nature of reserves.
4. Endosperm: Present or absent nature of reserve.
5. Embryo
    a. Position, shape, dimensions.
    b. Cotyledons—colour, outline and venation.
    c. Radicle.
    d. Odour and taste.
    e. Others.


Orthotropous
Anatropous
Amphitropous
Campylotropous
Hemitropous
Circinotropous


Raphe
Chalaza
Hilum
Embryo sac
Nucellus
Funicle
Outer integument
Inner integument
Micropyle

LS of ovule

2. It helps in reduction of surface evaporation of water due to presence of cuticle.
3. The epidermis forms phellogen by introduction of meristematic activity. It gives rise to cork layers and also helps in healing of wounds.
4. All gaseous exchange occurs through stomata and lenticels present in the epidermis.

Ground tissue system

It forms the bulk of body and consists of mainly parenchymatous, collenchymatous, sclerenchymatous, glandular and laticiferous tissue. This tissue system originates from ground meristem.

1. Cortex

It is the region between the epidermis and endodermis. This region consists of primary cells, specially parenchymatous, collenchymatous and sclerenchymatous. The main functions of cortex are storage of water, reserve food, to provide turgidity to the plant body, lateral transport of minerals, organic solutes and water, to provide mechanical support and gaseous exchange.

2. Endodermis

It is a single layer of compactly arranged parenchymatous cells present between the cortex and pericycle.

3. Pericycle

It is single layered or multi-layered cylinder of thin-walled or thick-walled cells present between the epidermis and vascular tissues. In dicot. roots the cork cambium originates in the pericycle which results in the formation periderm.

4. Medullary rays

The primary medullary rays are present in between the adjacent vascular bundle in primary structure of dicot. stem. These are made up of parenchymatous cells and extend from pith towards the periphery.

5. Pith

It is centrally located tissues, is made up of parenchymatous cells with intracellular spaces. It stores water and food.

6. Ground tissue of leaves

Ground tissue of petiole is made up of uniform parenchymatous cells with distinct intercellular spaces, in leaf lamina the bulk of ground tissue is called mesophyll which is usually differentiated into palisade and spongy parenchyma. The main function of mesophyll is photosynthesis.

Vascular tissue system

This tissue system includes vascular tissues, i.e. xylem and phloem. The xylem and phloem strands are usually found in bundles called vascular bundles.

Radial

The xylem and phloem are found in different radious, e.g. roots.

Conjoint

A vascular bundle having both xylem and phloem together is called conjoint, e.g. stem.

Collateral

A vascular bundle in which the phloem lies towards outside and xylem toward inner side.

Bicollateral

A vascular bundle having the phloem strands are both outer and inner sides of xylem.

Concentric

One tissue is completely surrounded by the other.

a. *Amphivasal:* The phloem lies in the centre and is surrounded by xylem.
b. *Amphicribal:* The xylem lies in the centre and is surrounded by phloem.

Open vascular bundle

The cambium is present.

Closed vascular bundle

The cambium is absent.

Exarch

The protoxylem lies towards periphery and metaxylem towards centre.

Endarch

The protoxylem lies towards centre and metaxylem towards periphery.

Mesarch

The protoxylem remains surrounded on all sides by metaxylem.

Section cutting

The nature and arrangement of tissue system can be studied conveniently by cutting thin sections of plant parts transversely and longitudinally. Hold the material being examined between the first finger and thumb of the left hand. The position of the thumb should be just below the surface of the material to avoid injury to the finger. Take the razor in the right hand and cut the number of sections. Put all sections in watch glass containing water. The section cutting of the lamina of the leaf is carried out by sandwiching the material between the two pieces of pith or potato. Take a clean slide and place a drop of glycerine water in the centre of the slide. Select the thin section of material and put it on the slide. Place cover slip on the material being examined without any air bubbles trapped inside. Focus the slides containing material under the microscope and adjust the require illumination with the help of condenser and diaphragm.

Extract

This is prepared by evaporation of aqueous decoctions of certain parts of plants/animal.

Juices

Drugs in liquid form obtained by compression of certain parts of plants, e.g. dried juice obtained from cut leaves of aloe and dried latex obtained from capsule of poppy.

Gums

These are exudates obtained by producing incisions in bark, these are amorphous, translucent solid substance, these are soluble in water and produce viscous, adhesive solution with water or swollen in water to form jelly like mass. These are in soluble in alcohol and many organic solvents. These are abnormal pathological products of plants produced due to pathological condition brought about by injury, etc.

Resins

These are heterogeneous mixture of chemical substances, which include acids, esters, glycosides and resenes. These are heavier than water, usually amorphous, hard and a brittle solid, on heating softens and fuse, insoluble in water, more or less soluble in alcohol, organic solvents and fixed and volatile oil, these are classified as:

- Acid resins – e.g. colophony, guaiacum
- Ester resins – e.g. benzoin
- Mixed resins – e.g. shellac

Oleo-gum-resins: As the name indicate the substances chiefly consists of resins with gum (gum-resins), e.g. myrrh or resins with volatile oils or oily liquid (olio- resins), e.g. balsams.

Waxes

Normally solid, physically similar to fats and oils, but chemically differ, consisting of mixture of esters or of esters and acids, but never contains ester of glycerol.

Fixed oils and fats

These are substances obtained from vegetable or animals, liquids are known as oils and solids are known as "fat", lighter than water, greasy, insoluble in water. Freely soluble in ether, chloroform but usually soluble in alcohol, do not volatile in air, chemically these are esters of glycerol which is combined with organic acid of high molecular weight.

Saccharin substances

These substances are normally solid or liquid, translucent, and soluble in water. Sweet in taste either a result of exudation of plant (e.g. Manna) or made by animal (e.g. honey).

Experiment 28: Catechu

OBJECT

Identification of unorganized drug **Catechu** by physical and chemical characters.

Synonym

Kattha.

Physical Characters

Physical form	Solid mass.
Colour and fluorescence	Externally dull dark reddish brown, internally pale yellow.
Hardness and fracture	Hard, friable, break easily in porous fractures.
Solubility	Slightly soluble in alcohol and water.
Odour and taste	Odourless, very bitter astringent after sweetish taste.

Chemical Tests

1. Catechu tannic acid present produces green, blue or black colour with solution of ferric chloride.
2. Prepare alcoholic solution of catechu, make it alkaline with caustic soda, shake with light petroleum, a brilliant green fluorescence is produced.
3. Dip the match stick in decoction of catechu, dry it and again dip in conc. HCl. Dry again and burn in flame. It gives pink or red or violet coloured flame due to formation of phloroglucinol.
4. Prepare the vanillin–HCl–Alcohol reagent in ratio of 1:10:10. Catechu gives pink or red colour with above reagent in warm condition.

The black catechu gives all the test except test number 2 (fluorescence test) which distinguishes it from pale catechu.

Use

Used as astringent in diarrhoea and as local astringent in lozenges.

Biological Source

The given sample of crude drug (pale catechu) consists of dried extract from leaves of *Uncaria gambir* family Rubiaceae. Where as black catechu is dried extract from the heart wood of *Acacia catechu* family Leguminosae.

Experiment 30: Acacia

OBJECT

Identification of unorganized drug **Acacia** by study physical and chemical characters.

Synonym

Babool ki Gond.

Physical Characters

Physical form	Rounded or ovoid tears.
Colour and fluorescence	Opaque white with yellowish tint.
Hardness and fracture	Hard and brittle.
Solubility	Insoluble in alcohol but soluble in water and produce translucent viscous liquid.

Chemical Tests

1. Aqueous solution (2% W/V) + a few drops of lead sub-acetate = white precipitate.
2. On boiling with dilute HCl for 10 minutes, hydrolysis takes place which gives positive test with Fehling's solution.
3. Take 5% solution, add few drops of H_2O_2 solution and few drops of 1% benzidine in alcohol. A deep blue colour is obtained on shaking which is unstable.
4. It gives positive test with Molisch's reagent.
5. It gives negative test with N/50 iodine solution (distinction from agar and tragacanth).

Use

Demulcent, suspending and emulsifying agent.

Biological Source

The given sample of crude drug consists of dried exudation of *Acacia senagal* of family Leguminosae.

Experiment 31: Tragacanth

OBJECT

Identification of unorganized drug **Tragacanth** by study physical and chemical characters.

Synonym

Anjira.

Physical Characters

Physical form	Thin, flattened, curved, flakes.
Colour and fluorescence	Translucent
Hardness and fracture	Hard and fractures are short.
Solubility	Slightly soluble in water and form tenacious gelatinous mass.

Chemical Tests

1. The powder is heated with 5% aqueous caustic potash to give yellow colour.
2. Treat 0.1 gm. of powder with N/50 iodine solution to give olive green colour mixture.
3. To 0.5% W/V solution of the sample, add 20% W/V solution of lead acetate. A flocculent precipitate is obtained.
4. 0.5% W/V solution is heated with conc. HCl (0.5 ml) on water bath for 30 minutes. Make the solution alkaline with NaOH (1.5 ml) then add Fehling's solution and warm on water bath to give red precipitate.

Use

Pharmaceutical aid, thickening and suspending agent.

Biological Source

The given sample of crude drug consists of dried gummy exudation of *Astragalus gummifer* belonging to family Leguminosae.

Experiment 32: Colophony

OBJECT

Identification of unorganized drug **Colophony** by study physical and chemical characters.

Synonyms

Amber resin, resin.

Physical Characters

Physical form	Solid, irregularly shaped pieces of different size.
Colour and fluorescence	Transparent or translucent, pale yellow or brownish yellow.
Hardness and fracture	Hard, brittle and glassy mass.
Solubility	Insoluble in water and soluble in alcohol other organic solvents.
Effect of heat	Softens on heating and fuse.
Odour and taste	Odour is slightly turpentine like, taste is slightly bitter.

Chemical Tests

1. Alcoholic solution of colophony gives acidic reaction (blue litmus to red).
2. Prepare solution of colophony in a petroleum ether, add to it twice the volume of dilute solution of copper acetate. The petroleum ether layer takes green colour.
3. On adding of water to alcoholic solution of colophony gives milky white precipitate.
4. Prepare the solution colophony in acetic acid. Gently heat the solution, cool and add one drop of conc. H_2SO_4. A purple red colour changes to violet.

Use

Stimulant and diuretic, ingredient of ointments and plasters.

Biological Source

The given sample of crude drug oleo-gum-resin consists of residue of oil of turpentine from various species of *Pinus* of family Pinaceae.

Experiment 37: Benzoin

OBJECT

Identification of unorganized drug **Benzoin** by physical and chemical characters.

Synonyms

Loban, Sambrani (in ayurveda)

PHYCIAL CHARACTER

Physical form: Opaque, creamy tears/lumps
Hardness and fracture: Hard, brittle fractured surface dull and uneven.

ORGANOLEPTIC PROPERTIES

Colour

Grayish brown or reddish brown

Odour

Balsamic and agreeable

Taste

Sweetish and acrid taste

CHEMICAL TEST

1. To alcoholic solution of benzoin, add water, a milky white colour produced.
2. Benzoin + ether + few drops of H_2SO_4–dark brown/purple colour obtained.
3. On warming with $KMnO_4$ a smell of benzaldehyde produced (Sumatra banzoin)
4. Heat small quantity of benzoin in test tube, after melting white fumes produced.

Use

It is oleoresin. Internally used as expectorant, diuretic and carminative. Externally it work as antiseptic and stimulant.

Biological Source

It is a pathological product, formed by inducing injury to the tree, from Styrex benzoin (Sumatra benzoin), styrex tonkinensis (siam benzoin), family Styracaceae.