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PHARMACOGNOSY AND PHYTOCHEMISTRY - II

UNIT 2

TOPIC :

- **Tannins : Catechu, Pterocarpus**



Tannins

- Tannins are complex, high-molecular-weight polyphenolic compounds that are widely distributed in plants. They have the ability to precipitate proteins, alkaloids, and heavy metals, and are responsible for the astringent taste of many plant materials.
- “Tannins are water-soluble phenolic compounds of plant origin that form insoluble complexes with proteins and alkaloids.”

General Characteristics

- Polyphenolic compounds (contain multiple –OH groups).
- Soluble in water and alcohol; insoluble in nonpolar solvents like benzene and chloroform.
- Astringent taste – causes tightening of mucous membranes and skin.
- Precipitate proteins and alkaloids from solution.
- Form dark blue, green, or black color with ferric chloride (FeCl_3).
- Non-volatile and amorphous solids.
- Decomposed by microbial and enzymatic oxidation on long storage.

Classification of Tannins

Tannins are classified based on their chemical structure and hydrolytic behavior.

A. Hydrolysable Tannins

- Composed of a central core of glucose or polyhydric alcohol esterified with gallic acid or ellagic acid.
- Easily hydrolyzed by acids or enzymes (tannase) to yield gallic acid or ellagic acid.

Types:

1. Gallotannins → yield gallic acid on hydrolysis.
Example: Tannic acid from *Tara*, *Chinese gall*.
2. Ellagitannins → yield ellagic acid on hydrolysis.
Example: *Pomegranate rind*, *Eucalyptus leaves*.

Examples & Sources:

- Tannic acid → *Quercus infectoria* (Nutmalls)
- Gallotannin → *Tara, Sumach*
- Ellagitannin → *Pomegranate rind*

Chemical Test:

- FeCl_3 test: Blue-black color (for gallotannins).
- Hydrolysis test: Yields gallic or ellagic acid.

B. Condensed Tannins (Non-hydrolysable Tannins)

- Do not undergo hydrolysis easily.
- On heating with acids, they produce phlobaphenes (red insoluble compounds).
- Chemically flavonoid polymers (e.g., catechin, leucoanthocyanidins).

Examples:

- *Catechu* (*Acacia catechu*) – contains catechin.
- *Cinnamon bark* – contains condensed tannins.
- *Cocoa and Tea* – contain condensed tannins.

Chemical Test:

- FeCl_3 test: Greenish-black color.
- Vanillin-HCl test: Red color (specific for catechins).

C. Pseudo-tannins

- Simple low molecular weight phenolics that do not precipitate gelatin.
- Convert into true tannins upon polymerization.

Examples:

- Catechol, Chlorogenic acid, Gallic acid.
- Found in *Tea* and *Coffee*.

D. Complex Tannins

- Contain both hydrolysable and condensed tannin components.
- On hydrolysis, yield gallic acid, ellagic acid, and catechin.

Example:

- *Hamamelis virginiana* (Witch Hazel).

Catechu

- Common Name: Catechu, Black Catechu, Cutch
- Botanical Name: *Acacia catechu* Willd.
- Family: Fabaceae (Leguminosae)
- Part Used: Heartwood and wood extract
- Description:
 - *Acacia catechu* is a medium-sized deciduous tree found in India and Southeast Asia.
 - The tree has dark brown bark and yellow flowers.
 - The heartwood yields a brownish extract known as catechu.
- Significance:
 - Catechu is an important astringent, antiseptic, and tanning agent used in medicine and industry.



Composition

- Major Active Constituents:
 - Tannins (20–55%) – mainly catechutannic acid.
 - Catechin ($C_{15}H_{14}O_6$) – main flavonoid responsible for astringency.
 - Epicatechin – isomer of catechin.
 - Quercetin, flavonoids, resins, and gum – present in small amounts.

Chemistry & Chemical Classes

- Chemical Class:
 - Mainly Tannins and Flavonoids.
- Important Chemical Compounds:
 - Catechin – a flavanol that gives antioxidant and astringent properties.
 - Catechutannic acid – hydrolyzable tannin responsible for medicinal action.
 - Epicatechin and Quercetin – support antioxidant activity.
- Properties:
 - Catechu is a brown to black, brittle, resin-like mass.
 - Soluble in water and alcohol; tastes strongly astringent.

Biosources

- Biological Source:
 - Extract obtained from the heartwood of *Acacia catechu* Willd.
- Cultivation and Collection:
 - The tree grows in dry forests of India (especially Madhya Pradesh, Bihar, and Uttar Pradesh).
 - Wood is boiled in water, and the extract is concentrated and dried to form solid catechu (also called “kattha”).

Therapeutic Uses

- Astringent:
 - Used to treat diarrhea, dysentery, and sore throat.
- Antiseptic:
 - Used in mouthwashes and gargles for oral infections.
- Antioxidant:
 - Protects cells from oxidative damage.
- Anti-inflammatory:
 - Reduces swelling and irritation in mouth and gums.
- Hemostatic:
 - Helps stop minor bleeding.
- Digestive Aid:
 - Traditionally used with betel leaves for improving digestion.

Commercial Applications

- Pharmaceutical Uses:
 - Used in tooth powders, mouthwashes, gargles, and astringent lotions.
 - Included in Ayurvedic and Unani formulations for diarrhea and sore throat.
- Industrial Uses:
 - Used in tanning leather and dyeing fabrics due to its high tannin content.
- Food Uses:
 - Used as a component of betel quid (paan) for its flavor and astringency.
- Other Uses:
 - Catechu extract used in inks, wood stains, and adhesives.

Pterocarpus

- Common Name: Indian Kino, Vijaysar, Malabar Kino
- Botanical Name: *Pterocarpus marsupium* Roxb.
- Family: Fabaceae (Leguminosae)
- Part Used: Heartwood and gum (kino)
- Description:
 - *Pterocarpus marsupium* is a large deciduous tree found in India, Sri Lanka, and Nepal.
 - It has thick bark, yellow flowers, and winged fruits.
 - When the bark or wood is cut, a reddish juice exudes and hardens into a dark resinous material known as kino.
- Significance:
 - Widely used in traditional Indian medicine (Ayurveda) for its antidiabetic, astringent, and anti-inflammatory properties.



Composition

- Major Active Constituents:
 - Tannins (about 50–80%)
 - Flavonoids:
 - Marsupsin, Pterosupin, Epicatechin
 - Kinotannic acid – main astringent principle
 - Gum and coloring matter (kino red)

Chemistry & Chemical Classes

- Chemical Class:
 - Mainly Tannins and Flavonoids.
- Important Chemical Compounds:
 - Kinotannic acid – hydrolyzable tannin responsible for astringency.
 - Epicatechin (C₁₅H₁₄O₆) – a flavonoid with antioxidant and antidiabetic activity.
 - Marsupsin and Pterosupin – unique flavonoids with blood sugar-lowering properties.
- Properties:
 - Solid extract (kino) is dark reddish-brown, brittle, and astringent.
 - Soluble in water and alcohol.

Biosources

- Biological Source:
 - Dried juice (kino) obtained from the heartwood of *Pterocarpus marsupium* Roxb.
- Cultivation and Distribution:
 - Found in the forests of Central and Southern India — mainly in Madhya Pradesh, Gujarat, and Kerala.
- Collection:
 - The bark is incised, and the exuded juice is collected, dried, and stored as kino.
 - The heartwood is also cut into pieces and used medicinally.

Therapeutic Uses

- Antidiabetic:
 - Reduces blood glucose levels; wood extracts are used in diabetes treatment.
- Astringent:
 - Used to treat diarrhea, dysentery, and bleeding disorders.
- Anti-inflammatory:
 - Reduces inflammation in wounds and ulcers.
- Antioxidant:
 - Protects tissues from oxidative stress.
- Wound Healing:
 - Promotes repair of damaged tissues.

Commercial Applications

- Pharmaceutical Uses:
 - Used in antidiabetic formulations, astringent tonics, and wound-healing preparations.
 - Extracts used in Ayurvedic medicines like *Vijaysar powder* and *kino tablets*.
- Other Uses:
 - The heartwood is used to make wooden cups — water kept in these cups is believed to lower blood sugar naturally.
 - Kino resin used in tanning leather and dyeing fabrics.
- Food Uses:
 - Sometimes used in traditional beverages for medicinal benefits.