Part-II

Phenylpropanoids and Flavonoids: Lignans, Tea, Ruta

Presented By;-

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Core Structural and Chemical Differences

S.NO	Feature	Phenylpropanoids	Flavonoids
1	**Relationship**	Parent class of specialized plant metabolites	Downstream sub-class of phenylpropanoids
2	**Carbon Skeleton**	C_6-C_3 skeleton (a single 6-carbon benzene ring attached to a 3-carbon propene chain)	C_6-C_3-C_6 skeleton (two 6-carbon benzene rings joined by a 3-carbon heterocyclic ring)
3	**Biosynthetic Origin**	Synthesised entirely via the Shikimate pathway from the amino acid phenylalanine	Formed at the intersection of the Shikimate pathway (C_6-C_3 part) and the Acetate pathway (C_6 part)
4	**Major Plant Functions**	Plant structural support, rigidity, and early cell wall defense	Flower and fruit pigmentation, pollinator attraction, and UV-light filtration
5	**Primary Sub-groups**	Coumarins, lignins, lignans, and hydroxycinnamic acids	Flavones, flavonols, flavanols, isoflavones, and anthocyanins
6	**Common Examples**	Caffeic acid, ferulic acid, Eugenol, and Esculin	Quercetin, Kaempferol, Catechin, and Rutin

Lignans

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Lignans

Lignans are naturally occurring phenolic compounds formed by the oxidative dimerization of two phenylpropanoid (C6–C3) units and are widely distributed in higher plants, where they exhibit diverse biological and medicinal activities.

Biosources of Lignans

Botanical Name: *Linum usitatissimum* L.

Family: Linaceae.

Plant Part Used:- seeds

Geographical Source:- Cultivated extensively across temperate and subtropical zones, notably in Canada, Russia, China, India, and the United States

Chemical Constituents

Lignans are phenylpropanoid dimers formed by the coupling of two C6–C3 units. Important lignans include:

1. Podophyllotoxin
2. α-Peltatin
3. β-Peltatin
4. Secoisolariciresinol
5. Matairesinol
6. Sesamin
7. Schisandrin
8. Arctiin
9. Arctigenin

Therapeutic Uses

1. Used as **anticancer agents** (especially podophyllotoxin derivatives).
2. Used in the treatment of **genital warts** (topical podophyllotoxin).
3. Possess **antiviral** activity.
4. Exhibit **antioxidant** properties.
5. Show **anti-inflammatory** effects.
6. Help in **cardiovascular protection**

Commercial Applications

S.No	Commercial Product	Active Constituent	Medical Use
1	Etoposide	Podophyllotoxin derivative	Testicular and lung cancers
2	Teniposide	Podophyllotoxin derivative	Acute lymphoblastic leukemia
3	Flaxseed supplements	Secoisolariciresinol	Antioxidant and heart health
4	Sesame oil	Sesamin	Nutraceutical and antioxidant
5	Schisandra preparations	Schisandrin	Liver tonic and hepatoprotective

Tea

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Tea

The **tea plant**, scientifically known as *Camellia sinensis*, is an evergreen shrub or small tree whose prepared leaves and leaf buds are used to produce true tea. It is one of the most widely consumed medicinal and beverage crops globally. Depending on how the leaves are processed, this single plant yields white, green, yellow, oolong, black, and dark (Pu-erh) teas.

Biosource of Tea

Botanical Name:- *Camellia sinensis* (L.) O. Kuntze.

Synonyms:- *Thea sinensis* L., *Camellia thea* Link.

Family:- Theaceae.

Plant Part Used:- Prepared leaves, leaf buds, and young tender stems.

Geographical Source;- The tea plant is native to **East, South, and Southeast Asia**, with its precise evolutionary center of origin situated around the intersection of southwest China, Tibet, north Myanmar, and northeast India.

Chemical Constituents

These constituents are responsible for the stimulant, antioxidant, anti-inflammatory, cardioprotective, antimicrobial, and neuroprotective activities of tea.

Major Active Constituents

1. Caffeine
2. Epigallocatechin gallate (EGCG)
3. Epigallocatechin (EGC)
4. Epicatechin gallate (ECG)
5. Epicatechin (EC)
6. L-Theanine
7. Theobromine
8. Theophylline
9. Tannins

Therapeutic Uses

1. **CNS Stimulant** – Improves alertness, concentration, and reduces fatigue due to caffeine.
2. **Antioxidant** – Protects cells from oxidative stress because of catechins (especially EGCG).
3. **Cardioprotective** – Helps lower cholesterol and supports heart health.
4. **Anti-inflammatory** – Reduces inflammation and may help prevent chronic diseases.
5. **Weight Management** – Promotes fat oxidation and supports metabolism, aiding weight control.

Commercial Applications

S.No	Commercial Product	Active Constituent	Medical Uses
1	Tea leaves (Black, Green, White Tea)	Caffeine	CNS stimulant, reduces fatigue, improves alertness and concentration, mild diuretic
2	Green Tea Extract	Epigallocatechin gallate (EGCG)	Potent antioxidant, anticancer, cardioprotective, anti-inflammatory, anti-obesity
3	Green Tea	Epigallocatechin (EGC)	Antioxidant, antimicrobial, supports immune function, protects against oxidative stress
4	Green Tea Extract	Epicatechin gallate (ECG)	Anti-inflammatory, antioxidant, cardioprotective, helps regulate blood cholesterol
5	Green Tea	Epicatechin (EC)	Improves blood circulation, antioxidant, supports vascular health, reduces oxidative damage
6	Green Tea & Dietary Supplements	L-Theanine	Reduces stress and anxiety, promotes relaxation, improves cognitive function and sleep quality

Ruta

Ruta

The **Ruta plant**, scientifically known as *Ruta graveolens*, is a strongly scented, hardy perennial evergreen herb or small shrub. Commonly referred to as **common rue**, **garden rue**, or **herb-of-grace**, it is recognized for its unique bluish-green foliage and small, pungent yellow flowers. It used in traditional medical systems like Ayurveda, Homeopathy, and Unani for its diverse therapeutic.

Biosource of Ruta

Botanical Name: *Ruta graveolens* L.

Synonyms: Garden rue, Bitter herb, Countryman's treacle.

Family: **Rutaceae**

Plant Part Used:- It consists of the **entire dried or fresh plant** or its **aerial parts**, collected primarily at the beginning of the flowering season.

Geographical Source: It is heavily grown across southern Europe, the Middle East, North Africa, and **throughout India**

Chemical Constituents

S.NO	Chemical Class	Active Constituents
1	**Flavonoids**	Rutin, Quercetin, Kaempferol
2	**Alkaloids (Quinoline & Furoquinoline)**	Graveoline, Arborinine, Skimmianine, Kokusaginine
3	**Furanocoumarins**	Psoralen, Bergapten (5-Methoxypsoralen), Xanthotoxin (8-Methoxypsoralen), Isopimpinellin
4	**Simple Coumarins**	Umbelliferone, Herniarin
5	**Essential Oil Constituents**	2-Undecanone, 2-Nonanone, Methyl nonyl ketone, Limonene, α-Pinene, β-Pinene
6	**Other Constituents**	Tannins, Resins, Organic acids, Bitter principles

Therapeutic Uses

1. **Antispasmodic** – Relieves smooth muscle spasms and abdominal cramps.
2. **Anti-inflammatory** – Reduces pain and inflammation in joints and muscles.
3. **Antimicrobial** – Effective against certain bacteria and fungi.
4. **Emmenagogue** – Traditionally used to stimulate menstrual flow (use with caution).
5. **Antioxidant** – Protects cells from oxidative damage caused by free radicals

Commercial Applications

S.NO	Commercial Product	Active Constituents	Medical Uses
1	Rutin Tablets/Capsules	Rutin (Flavonoid)	Capillary protectant, antioxidant, treatment of varicose veins, hemorrhoids, and chronic venous insufficiency
2	Methoxsalen (Psoralen) Tablets/Creams	Psoralen, Bergapten (Furanocoumarins)	PUVA therapy for psoriasis, vitiligo, and other pigmentary skin disorders
3	Rue Essential Oil	2-Undecanone, 2-Nonanone, Methyl nonyl ketone, Limonene	Antimicrobial, antifungal, insect repellent, aromatherapy, topical pain relief
4	Herbal Rue Extract	Rutin, Quercetin, Graveoline, Skimmianine	Antispasmodic, anti-inflammatory, digestive stimulant, carminative, antimicrobial
5	Antioxidant Herbal Supplements	Rutin, Quercetin	Reduces oxidative stress, supports cardiovascular health, improves blood vessel strength
6	Botanical Insect Repellent Products	2-Undecanone, Essential oil	Natural insect repellent and protection against mosquitoes and agricultural pests
7	Topical Herbal Preparations (Creams/Ointments)	Quercetin, Umbelliferone, Essential oil	Anti-inflammatory, wound healing, relief from minor skin infections and muscle pain

Thank you

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