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 - ✓ Unit 3
 - ✓ Unit 4
 - ✓ Unit 5
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 - ✓ Unit 2
 - ✓ Unit 3
 - ✓ Unit 4
 - ✓ Unit 5
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- ✓ Unit 1
 - ✓ Unit 2
 - ✓ Unit 3
 - ✓ Unit 4
 - ✓ Unit 5
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- ✓ Unit 1
 - ✓ Unit 2
 - ✓ Unit 3
 - ✓ Unit 4
 - ✓ Unit 5
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NOTES

- ✓ Unit 1
 - ✓ Unit 2
 - ✓ Unit 3
 - ✓ Unit 4
 - ✓ Unit 5
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PHARMACOGNOSY AND PHYTOCHEMISTRY - II

UNIT 2

TOPIC :

- **Glycosides** : Senna, Aloes, Bitter Almond



Glycosides

- Glycosides are organic compounds in which a sugar (carbohydrate part) is linked to a non-sugar component (aglycone or genin) through a special type of bond known as a glycosidic linkage.
- “Glycosides are compounds in which a sugar molecule is combined with a non-sugar part (aglycone) through an oxygen, nitrogen, or sulfur linkage.”

General Characteristics

- Glycosides are natural plant products (secondary metabolites).
- Bitter in taste and soluble in water or alcohol.
- Insoluble in non-polar solvents like chloroform or ether.
- When hydrolyzed, they yield a sugar part (glycone) and a non-sugar part (aglycone or genin).
- The pharmacological activity depends on the aglycone part, while the glycone part helps in solubility and transport.

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Senna

- Common Name: Senna, Indian Senna, Tinnevely Senna
- Botanical Name: *Cassia angustifolia* Vahl
- Family: Fabaceae (Leguminosae)
- Part Used: Dried leaflets and pods (fruits)
- Description:
 - Senna is a small shrub cultivated mainly for its laxative properties.
 - Leaves are greenish-yellow, thin, and have a characteristic odor and bitter taste.
 - It is one of the most important natural purgatives used in medicine.
- Significance:
 - Used in both modern and traditional systems of medicine for treating constipation and cleansing the bowel before surgery.



Composition

- **Major Active Constituents:**
 - Anthraquinone glycosides (Sennosides A–B–C–D) – responsible for laxative action.
- **Other Constituents:**
 - Aloe-emodin, rhein, chrysophanol, flavonoids, resins, and mucilage.
- **Important Chemical Compounds:**
 - Sennosides A & B – main active glycosides.
 - Aloin and rhein anthrone – intermediate metabolites formed in the intestine.
 - Calcium oxalate crystals – present in leaf tissues.

Chemistry & Chemical Classes

- **Chemical Class:**
 - Anthraquinone glycosides (anthracene derivatives).

- **Chemical Nature:**

- Sennosides are dianthrone glycosides, meaning they contain two anthrone nuclei linked together.
- Upon hydrolysis in the intestine, they release active anthrones that stimulate bowel movement.

- **Properties:**

- Color: Greenish-yellow (leaves), brownish (pods).
- Taste: Slightly bitter.
- Solubility: Soluble in alcohol, partly in water.

Biosources

- **Biological Source:**

- Dried leaflets and pods of *Cassia angustifolia* Vahl and *Cassia acutifolia* Delile.

- **Cultivation and Distribution:**

- Cultivated mainly in India (Tamil Nadu, Rajasthan, Gujarat) and Egypt, Sudan.
- Grows best in dry, warm climates with sandy soil.

- **Collection:**

- Leaves and pods are collected when mature, dried in shade, and stored in airtight containers to prevent loss of potency.

Therapeutic Uses

- **Laxative (Purgative):**

- Stimulates peristaltic movement of the colon and helps in relieving constipation.

- **Bowel Cleansing:**

- Used before abdominal surgery or diagnostic procedures (like colonoscopy).

- **Anthelmintic:**

- Helps in the expulsion of intestinal worms (mild effect).

- **Antibacterial:**

- Exhibits mild antibacterial and anti-inflammatory properties in the intestine.

- **Traditional Uses:**
 - Used in Ayurveda and Unani for treating constipation, indigestion, and skin diseases.
- **Mechanism of Action:**
 - Sennosides are prodrugs that are converted by intestinal bacteria to rhein anthrone, which stimulates peristalsis and reduces water absorption → resulting in soft stool evacuation.

Commercial Applications

- **Pharmaceutical Uses:**
 - Used in the preparation of laxative tablets, granules, powders, and syrups (e.g., *Senokot*).
 - Often combined with isapgol or docusate sodium to enhance bowel movement.
- **Traditional and Herbal Formulations:**
 - Used in Ayurvedic formulations like *Triphala Churna* and *Swadisht Virechan Churna*.
- **Industrial Uses:**
 - Used in herbal teas and dietary supplements as a natural laxative.
- **Other Applications:**
 - Sometimes used in small doses to detoxify the digestive system

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Aloes

- Common Name: Aloes, Indian Aloes
- Botanical Source: Dried latex (juice) obtained from the leaves of various species of *Aloe*, mainly —
 - *Aloe barbadensis* Mill. (Curacao or Barbados Aloes)
 - *Aloe perryi* Baker (Socotrine Aloes)
 - *Aloe ferox* Mill. (Cape Aloes)
- Family: Liliaceae (Aloaceae)
- Part Used: Dried juice (latex) obtained from leaves.
- Description:
 - Aloes is a succulent perennial herb with thick, fleshy leaves arranged in a rosette form.
 - The yellowish-brown bitter juice obtained from the cut leaves is dried to form Aloes.
 - It is a well-known natural purgative used since ancient times.



Composition

- **Active Constituents:**
 - Anthraquinone glycosides, mainly barbaloin (aloin) and isobarbaloin.
- **Other Constituents:**
 - Resins, polysaccharides, enzymes, chromones, and small amounts of volatile oil.
- **Important Chemical Compounds:**
 - Aloin (Barbaloin) – major constituent responsible for laxative action.
 - Aloe-emodin, rhein, and aloesin – secondary anthraquinones.
 - Enzymes: Oxidases and catalases.

Chemistry & Chemical Classes

- **Chemical Class:**
 - Anthraquinone glycosides (anthracene derivatives).

- **Chemical Nature:**

- Aloin is a C-glycoside of aloe-emodin anthrone.
- Upon hydrolysis, it releases aloe-emodin, which exerts purgative activity.

- **Properties:**

- Color: Dark brown to black solid.
- Taste: Bitter.
- Odor: Characteristic.
- Solubility: Soluble in water and alcohol.

- **Tests for Identification:**

- Borntrager's Test: Pink to red coloration indicates the presence of anthraquinone glycosides.

Biosources and Varieties

There are three main varieties of Aloes based on their origin:

Type of Aloes	Botanical Source	Geographical Source	Characteristics
Curacao (Barbados) Aloes	<i>Aloe barbadensis</i>	West Indies	Brown, translucent, less bitter
Socotrine Aloes	<i>Aloe perryi</i>	Socotra Island (Yemen)	Reddish-brown, aromatic, best quality
Cape Aloes	<i>Aloe ferox</i>	South Africa	Very dark, very bitter, strong purgative
Indian Aloes	<i>Aloe vera</i>	India (Rajasthan, Gujarat, Tamil Nadu)	Locally used, mild purgative

Therapeutic Uses

- **Laxative (Purgative):**

- Aloin stimulates peristaltic movement of the large intestine, promoting defecation.

- **Digestive Tonic:**
 - In small doses, used as a bitter tonic to stimulate gastric juice and improve appetite.
- **Wound Healing:**
 - The gel from the leaves (not latex) has soothing, healing, and moisturizing effects for burns, wounds, and ulcers.
- **Anti-inflammatory:**
 - Exhibits mild anti-inflammatory and antimicrobial properties.
- **Other Uses:**
 - Used in dyspepsia, liver congestion, and skin care formulations.
- **Mechanism of Action:**
 - Aloin is hydrolyzed in the colon to aloe-emodin anthrone, which increases intestinal motility and reduces water absorption, resulting in a laxative effect.

Commercial and Pharmaceutical Applications

- **Pharmaceutical Preparations:**
 - Used in the manufacture of compound pills, tablets, and tinctures as a purgative.
 - Examples: *Compound Aloes Pill*, *Aloes Compound Powder*.
- **Cosmetic and Herbal Uses:**
 - Aloe gel is widely used in cosmetic creams, lotions, and shampoos for its soothing and moisturizing properties.
- **Industrial Uses:**
 - Used in herbal soaps, aloe drinks, and skincare products.
- **Adulterants:**
 - Often adulterated with other plant extracts or starch, so chemical tests like Borntrager's are used to check purity.

Bitters (Bitter Drugs)

Bitters are plant-derived substances that have a characteristic bitter taste and are mainly used to stimulate appetite and digestion.

- **Nature:**
They are non-toxic bitter-tasting compounds found in various medicinal plants.
- **Action:**
When tasted, bitters stimulate taste buds, which reflexly increase secretion of saliva, gastric juice, and bile, improving digestion.
- **Common Names:** Bitter tonics or stomachics.
- **Examples of Bitter Drugs:**
 - Gentian (*Gentiana lutea*)
 - Chirata (*Swertia chirata*)
 - Quassia (*Picrasma excelsa*)
 - Andrographis (*Andrographis paniculata*)
 - Picrorhiza (*Picrorhiza kurroa*)

Composition

- **Active Constituents:**
Bitters contain one or more of the following:
 - Bitter glycosides (e.g. amarogentin in Gentian, chiratin in Chirata)
 - Bitter principles (non-glycosidic compounds)
 - Alkaloids (in some cases)
 - Volatile oils and resins (in aromatic bitters)

Chemistry & Chemical Classes

Bitters are chemically classified into the following types:

Type	Example	Active Constituent / Chemical Nature
Simple Bitters	Gentian, Chirata	Bitter glycosides (amarogentin, chiratin)
Aromatic Bitters	Orange peel, Lemon peel	Volatile oils (limonene, citral)
Alkaloidal Bitters	Quinine, Berberine	Alkaloids (quinine, berberine)
Resinous Bitters	Quassia, Calumba	Bitter resin and lactones
Irritant Bitters	Aloe, Nux vomica	Anthraquinones or alkaloids with strong action

- **General Chemical Nature:**

- Mostly glycosides or lactones.
- Some contain terpenoids or alkaloids.
- Usually water-soluble and have a strong bitter taste even in low concentrations.

Biosources

- Bitters are obtained from various medicinal plants belonging to different families such as:
 - Gentianaceae (*Gentiana lutea*, *Swertia chirata*)
 - Simaroubaceae (*Picrasma excelsa*, *Quassia amara*)
 - Acanthaceae (*Andrographis paniculata*)
 - Scrophulariaceae (*Picrorhiza kurroa*)
- Plant Parts Used:
 - Roots, stems, bark, or whole plant depending on the species.

Therapeutic Uses

- **Appetizer and Digestive Tonic:**
 - Bitters stimulate taste buds → reflexly increase saliva, gastric juice, and bile → improve appetite and digestion.
- **Liver Stimulant (Hepatoprotective):**
 - Some bitters (e.g., Andrographis, Picrorhiza) protect and stimulate the liver.
- **Fever and Weakness:**
 - Bitters act as mild tonics to restore body strength.
- **Anti-inflammatory and Antimicrobial:**
 - Some bitters have antibacterial and antipyretic properties.
- **Examples of Uses:**

Drug	Use
Gentian	Stomachic, appetite stimulant
Chirata	Antipyretic, bitter tonic
Andrographis	Liver tonic, hepatoprotective
Picrorhiza	Antibilious, liver tonic
Quassia	Anthelmintic, insecticidal

Commercial and Pharmaceutical Applications

- **Pharmaceutical Preparations:**
 - Used in tinctures, tonics, and elixirs as bitter stomachics.
 - Examples:
 - *Tincture of Gentian Compound*
 - *Elixir of Calumba*
- **Cosmetic Use:**
 - In small amounts, bitters are added to herbal formulations for skin toning.
- **Veterinary Use:**
 - Used as appetizers for livestock.
- **Trade Importance:**
 - Many bitter drugs like Gentian and Quassia are imported and used in pharmaceutical and traditional medicine industries.

Almond

- Common Name: Almond, Sweet Almond, Bitter Almond
- Botanical Name: *Prunus amygdalus* Batsch (syn. *Prunus dulcis*)
- Family: Rosaceae
- Part Used: Dried ripe seeds (kernels)
- Description:
 - Almond is a small deciduous tree cultivated for its edible seeds (nuts).
 - The fruit is a drupe, with a hard shell enclosing the seed (kernel).
 - Almonds are of two main types – Sweet almond and Bitter almond.
- Distribution:
 - Grown widely in India (Kashmir, Himachal Pradesh), Iran, Spain, Italy, and California.



Types of Almond

Type	Botanical Variety	Characteristic	Use
Sweet Almond	<i>Prunus amygdalus</i> var. <i>dulcis</i>	Edible, non-poisonous	Used as food and for almond oil
Bitter Almond	<i>Prunus amygdalus</i> var. <i>amara</i>	Contains toxic compound (amygdalin)	Used for extraction of essential oil

Composition

- **Sweet Almond:**
 - Fixed oil (40–60%) – mainly oleic acid and linoleic acid.
 - Proteins (20%) and carbohydrates (10%).
 - Vitamins: Vitamin E, B-complex.
 - Minerals: Calcium, magnesium, phosphorus.
- **Bitter Almond:**
 - Contains glycoside – amygdalin (2–4%), which on hydrolysis produces:
 - Benzaldehyde (responsible for aroma)
 - Hydrogen cyanide (HCN) (toxic)

Chemistry & Chemical Classes

- **Chemical Classes:**

- Fixed oils and fats: Glycerides of oleic and linoleic acids.
- Cyanogenic glycosides: Amygdalin (in bitter almond).

- **Chemical Nature:**

- Sweet almond oil – non-drying oil, colorless to pale yellow.
- Bitter almond – produces volatile oil of bitter almond (contains benzaldehyde and traces of HCN).

Biosources

- Biological Source: Dried ripe seeds of *Prunus amygdalus* (Rosaceae).
- Cultivation and Distribution:
 - Cultivated in temperate regions.
 - India (Kashmir, Himachal), USA (California), Iran, Afghanistan, and Mediterranean countries.
- Collection:
 - Fruits collected when ripe → shells removed → seeds dried and stored.

Therapeutic Uses

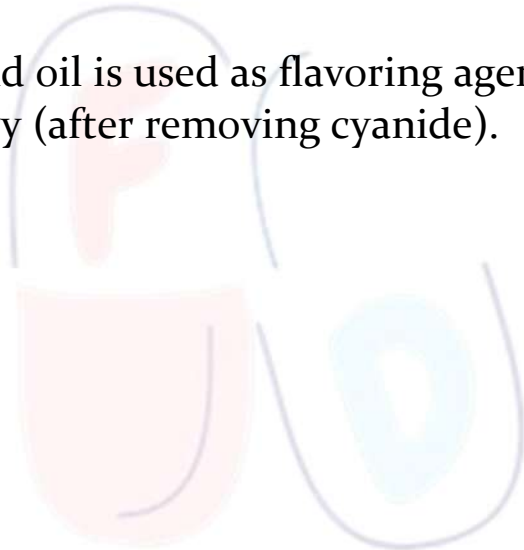
Type	Main Uses
Sweet Almond	- Nutritive, demulcent, emollient - Used in skin care (softens skin) - Used in cosmetics and baby oil - Almond oil acts as mild laxative
Bitter Almond	- Used externally as flavoring and fragrance source - Used for making aromatic almond oil (after removing HCN) - Not used internally due to toxicity of HCN

- **Pharmacological Actions:**

- Almond oil: Demulcent, emollient, nutrient, mild laxative.
- Amygdalin (from bitter almond): Antitussive (in small safe doses, after detoxification).

Commercial and Pharmaceutical Applications

- **Pharmaceutical Uses:**
 - Sweet almond oil is used in ointments, creams, and massage oils.
 - Used as a solvent for injections and in cosmetic preparations.
- **Nutritional Use:**
 - Used as food supplement, snack, or ingredient in sweets and bakery products.
- **Cosmetic Use:**
 - Almond oil is used in lotions, shampoos, and skin care products.
- **Industrial Use:**
 - Bitter almond oil is used as flavoring agent in perfumery and confectionery (after removing cyanide).



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