Module Title	**Phyto-therapeutic Agents**
Subject /Course	Introduction to Pharmacognosy
Subject/Course ID	BP105T
Semester	I
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Learning Outcome of Module 05

LO	Learning Outcome	Course Outcome
LO1	Classify phyto-therapeutic agents based on their therapeutic applications such as adaptogens, hepatoprotectives, cardiovascular drugs, antidiabetics, CNS drugs, antimicrobial agents, gastrointestinal drugs, dermatological agents, women's health drugs, and respiratory drugs.	BP105. 5
LO2	Identify the biological sources and major phytochemical constituents of the prescribed phyto-therapeutic agents.	BP105. 4
LO3	Explain the therapeutic uses and pharmacological significance of various classes of phyto-therapeutic agents.	BP105. 5
LO4	Correlate major phytoconstituents with the therapeutic activities of medicinal plants used in healthcare.	BP105. 4
LO5	Evaluate the role of phyto-therapeutic agents in traditional and contemporary healthcare systems for the management of various disease conditions.	BP105. 5

Content Table

Biological source, major constituents and uses of the following classes of drugs: • Adaptogens and Immunomodulators: Ashwagandha, Tulsi, Amla • Hepatoprotectives: Milk thistle, Kutki • Cardiovascular drugs: Garlic, Arjuna • Antidiabetics: Gymnema, Fenugreek • Anti-inflammatory and analgesics: Turmeric, Boswellia • CNS drugs: Brahmi • Antimicrobial and antivirals: Giloy, Neem, Andrographis • Gastrointestinal drugs: Psyllium • Dermatological agents: Aloe • Drugs used in women's health: Chasteberry, Shatavari • Respiratory drugs: Vasaka

INTRODUCTION

Concept of Phytotherapy

Phytotherapy, also known as herbal medicine, refers to the use of medicinal plants and plant-derived products for the prevention, management, and treatment of diseases. The term is derived from the Greek words *phyton* meaning "plant" and *therapeia* meaning "treatment." Unlike traditional folk remedies based solely on empirical knowledge, modern phytotherapy emphasizes the scientific evaluation of medicinal plants with respect to their safety, efficacy, quality, and mechanisms of action. Plant-based medicines contain a variety of biologically active compounds known as phytochemicals that exert therapeutic effects on the human body. Phytotherapy has been practiced for thousands of years in various traditional systems of medicine such as Ayurveda, Traditional Chinese Medicine, Unani, Siddha, and Native American medicine. Today, it serves as an important component of complementary and integrative healthcare worldwide.

Importance of Medicinal Plants in Healthcare

Medicinal plants constitute one of the oldest and most valuable resources for healthcare. According to estimates by the World Health Organization (WHO), a significant proportion of the global population relies on herbal medicines for primary healthcare needs. Medicinal plants provide a rich source of bioactive compounds that can be used directly as therapeutic agents or serve as lead molecules for the development of modern drugs. Several important pharmaceuticals, such as morphine, quinine, digoxin, atropine, and paclitaxel, have originated from plants.

Herbal medicines are widely used for promoting general health, boosting immunity, managing metabolic disorders, supporting cardiovascular health, treating infections, and improving quality of life. Furthermore, medicinal plants play a crucial role in drug discovery, biodiversity conservation, and the economic development of communities involved in their cultivation and processing.

Table 1: Advantages and limitations of Phytochemicals

Advantages	Limitations
Natural and plant-derived	Variation in phytochemical content
Generally safe with fewer side effects	Lack of standardization
Synergistic therapeutic effects	Inconsistent quality and potency
Cost-effective and accessible	Potential herb–drug interactions
Suitable for chronic disease management	Risk of toxicity if misused
Broad-spectrum activity	Limited clinical evidence for some products
Culturally accepted	Contamination and adulteration risks
Source of new drug molecules	Regulatory and quality control challenges

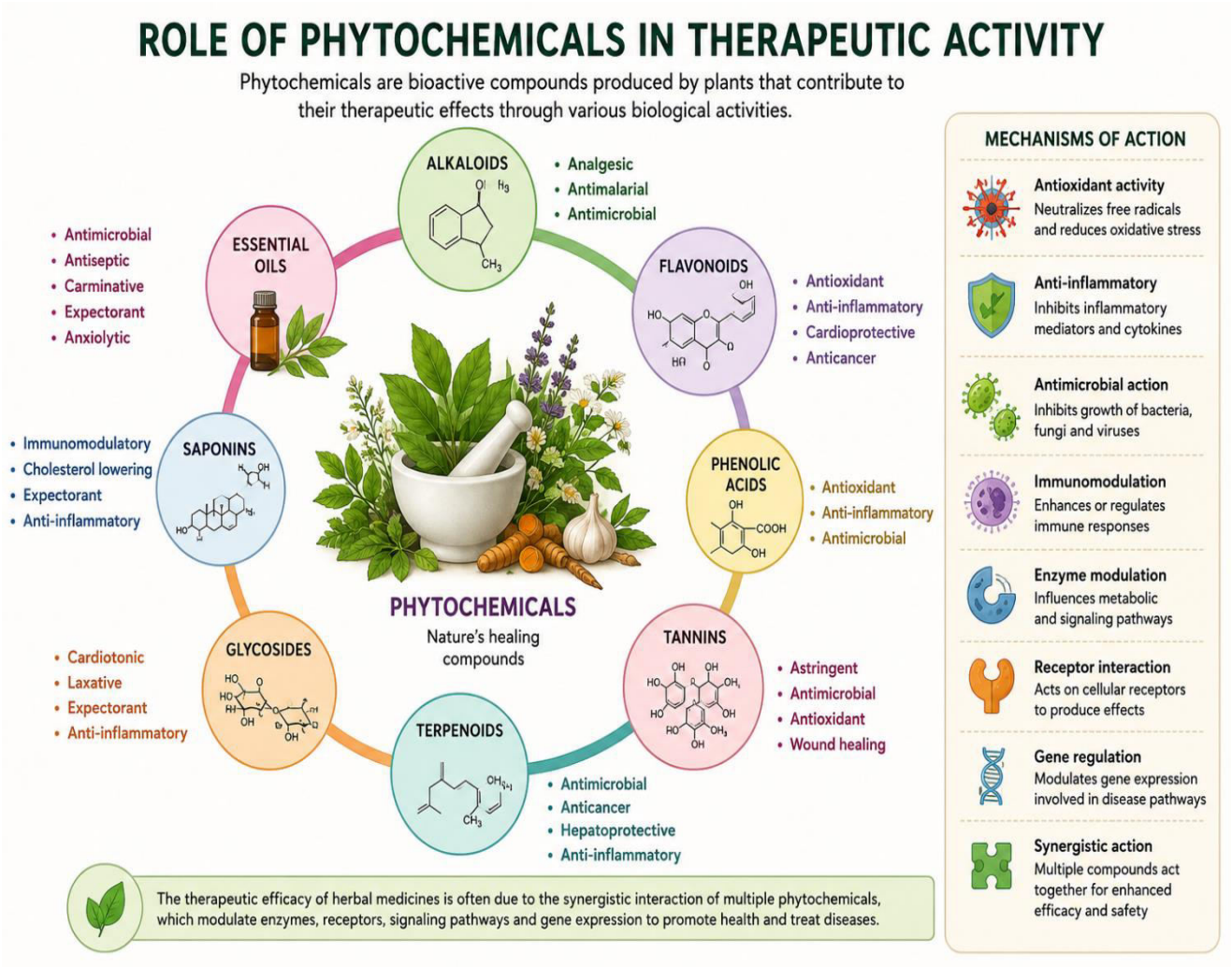

Figure 1: Classification of Phyto-Therapeutic Agents Based on Therapeutic Uses

Phyto-therapeutic agents can be classified according to their primary therapeutic applications. This classification facilitates the study of medicinal plants based on their pharmacological activities and clinical uses.

1. Adaptogens and Immunomodulators: These agents enhance the body's resistance to physical, chemical, and biological stress while regulating immune function. Examples include Ashwagandha (*Withania somnifera*), Tulsi (*Ocimum tenuiflorum*), and Amla (*Phyllanthus emblica*).

2. Hepatoprotective Agents: These plants protect liver cells from damage caused by toxins, infections, and metabolic disorders. Examples include Milk Thistle (*Silybum marianum*) and Kutki (*Picrorhiza kurroa*).

3. Cardiovascular Agents: These drugs support heart health, regulate blood pressure, improve circulation, and reduce cardiovascular risk factors. Examples include Garlic (*Allium sativum*) and Arjuna (*Terminalia arjuna*).

4. Antidiabetic Agents: These medicinal plants help regulate blood glucose levels and improve insulin sensitivity. Examples include Gymnema (*Gymnema sylvestre*) and Fenugreek (*Trigonella foenum-graecum*).

5. Anti-inflammatory and Analgesic Agents: These plants reduce inflammation and relieve pain through various biochemical mechanisms. Examples include Turmeric (*Curcuma longa*) and Boswellia (*Boswellia serrata*).

6. Central Nervous System Agents: These drugs influence cognitive functions, memory, and neurological health. Brahmi (*Bacopa monnieri*) is a well-known example.

7. Antimicrobial and Antiviral Agents: These plants inhibit the growth of microorganisms and help combat infections. Examples include Giloy (*Tinospora cordifolia*), Neem (*Azadirachta indica*), and Andrographis (*Andrographis paniculata*).

8. Gastrointestinal Agents: These agents promote digestive health and manage gastrointestinal disorders. Psyllium (*Plantago ovata*) is commonly used as a bulk-forming laxative.

9. Dermatological Agents: These plants are used for skin protection, wound healing, and the treatment of various skin disorders. Aloe (*Aloe vera*) is a prominent example.

10. Drugs Used in Women's Health: These medicinal plants support reproductive health and hormonal balance. Examples include Chasteberry (*Vitex agnus-castus*) and Shatavari (*Asparagus racemosus*).

11. Respiratory Agents: These plants help manage respiratory disorders such as cough, bronchitis, and asthma. Vasaka (*Justicia adhatoda*) is widely used for this purpose.

Table 2: Classification of Phyto-Therapeutic Agents Based on Therapeutic Uses

Class of Phytochemical	General Characteristics	Major Therapeutic Activities	Examples
Alkaloids	Nitrogen-containing organic compounds with pronounced physiological effects	Analgesic, antimalarial, antimicrobial, antihypertensive, anticancer	Morphine, Quinine, Atropine, Berberine
Flavonoids	Polyphenolic compounds widely distributed in plants	Antioxidant, anti-inflammatory, cardioprotective, hepatoprotective, anticancer	Quercetin, Kaempferol, Rutin, Catechin

Phenolic Acids	Phenolic compounds containing aromatic rings and hydroxyl groups	Antioxidant, anti-inflammatory, antimicrobial, neuroprotective	Gallic acid, Caffeic acid, Ferulic acid
Tannins	High-molecular-weight polyphenolic compounds capable of precipitating proteins	Astringent, antimicrobial, antioxidant, wound healing, antidiarrheal	Tannic acid, Ellagitannins
Terpenoids	Compounds derived from isoprene units; major constituents of essential oils	Antimicrobial, anticancer, hepatoprotective, anti-inflammatory, antimalarial	Curcumin, Artemisinin, Limonene
Glycosides	Compounds consisting of a sugar moiety linked to a non-sugar (aglycone) component	Cardiotonic, laxative, expectorant, anti-inflammatory	Digoxin, Sennosides, Salicin
Saponins	Glycosides producing stable foam in aqueous solutions	Immunomodulatory, cholesterol-lowering, expectorant, anti-inflammatory	Ginsenosides, Glycyrrhizin, Shatavarins
Lignans	Phenolic dimers formed by the coupling of phenylpropanoid units	Antioxidant, anticancer, antiviral, estrogenic activity	Podophyllotoxin, Secoisolariciresinol
Essential Oils	Volatile aromatic compounds obtained from various plant parts	Antimicrobial, antiseptic, carminative, expectorant, anxiolytic	Eugenol, Menthol, Thymol, Citral
Polysaccharides	Complex carbohydrate polymers present in many medicinal plants	Immunostimulatory, wound healing, gastroprotective, prebiotic effects	Acemannan, β-glucans, Mucilage
Coumarins	Benzopyrone derivatives commonly found in medicinal plants	Anticoagulant, anti-inflammatory, antimicrobial, vasodilatory	Coumarin, Umbelliferone
Steroids and Phytosterols	Plant-derived steroidal compounds structurally similar to cholesterol	Anti-inflammatory, hormone-modulating, cholesterol-lowering	β-Sitosterol, Diosgenin

PHARMACOGNOSTIC PROFILE OF ADAPTOGENS AND IMMUNOMODULATORS

Adaptogens and immunomodulators are an important class of phyto-therapeutic agents that help the body maintain physiological balance and enhance its ability to cope with physical, chemical, and biological stress. These medicinal plants have been extensively used in traditional systems of medicine, particularly Ayurveda, for promoting health, improving vitality, and strengthening the body's defense mechanisms. With increasing stress-related

disorders and the growing prevalence of infectious and chronic diseases, adaptogenic and immunomodulatory herbs have gained considerable attention in modern healthcare.

Adaptogens

Adaptogens are natural substances that increase the body's resistance to various stressors and help restore normal physiological functions. The term "adaptogen" was first introduced by the Russian scientist Nikolai Lazarev in 1947 to describe substances that enhance the body's non-specific resistance to stress without disturbing normal biological processes. Adaptogens act primarily by regulating the hypothalamic-pituitary-adrenal (HPA) axis and modulating stress hormones such as cortisol. They improve physical endurance, mental performance, energy levels, and resilience to environmental stress.

An ideal adaptogen should be non-toxic, produce a normalizing effect on physiological functions, and increase resistance to a wide range of stressors. Adaptogenic plants are widely used to combat fatigue, anxiety, depression, cognitive decline, and stress-induced disorders.

Major Actions of Adaptogens

- Enhance resistance to physical, mental, and environmental stress.
- Improve physical stamina and endurance.
- Reduce fatigue and weakness.
- Promote mental alertness and cognitive performance.
- Regulate hormonal and metabolic functions.
- Improve overall vitality and well-being.

Examples of Adaptogens

- Ashwagandha (*Withania somnifera*)
- Tulsi (*Ocimum tenuiflorum*)
- Amla (*Phyllanthus emblica*)

Immunomodulators

Immunomodulators are substances that modify the activity of the immune system by either stimulating or suppressing immune responses depending on the body's requirements. Herbal immunomodulators primarily enhance immune function and increase the body's ability to defend against infections, diseases, and environmental challenges. They influence various components of the immune system, including macrophages, lymphocytes, natural killer cells, cytokines, and antibodies.

Plant-derived immunomodulators are increasingly used to improve immunity, reduce susceptibility to infections, support recovery from illness, and maintain overall health. Many

medicinal plants contain polysaccharides, flavonoids, alkaloids, terpenoids, and other phytochemicals that contribute to their immunomodulatory effects.

Major Actions of Immunomodulators

- Stimulate innate and adaptive immune responses.
- Enhance macrophage and lymphocyte activity.
- Increase antibody production.
- Improve resistance against microbial infections.
- Regulate inflammatory responses.
- Support immune balance and homeostasis.

Examples of Immunomodulators

- Ashwagandha (*Withania somnifera*)
- Tulsi (*Ocimum tenuiflorum*)
- Amla (*Phyllanthus emblica*)
- Giloy (*Tinospora cordifolia*)

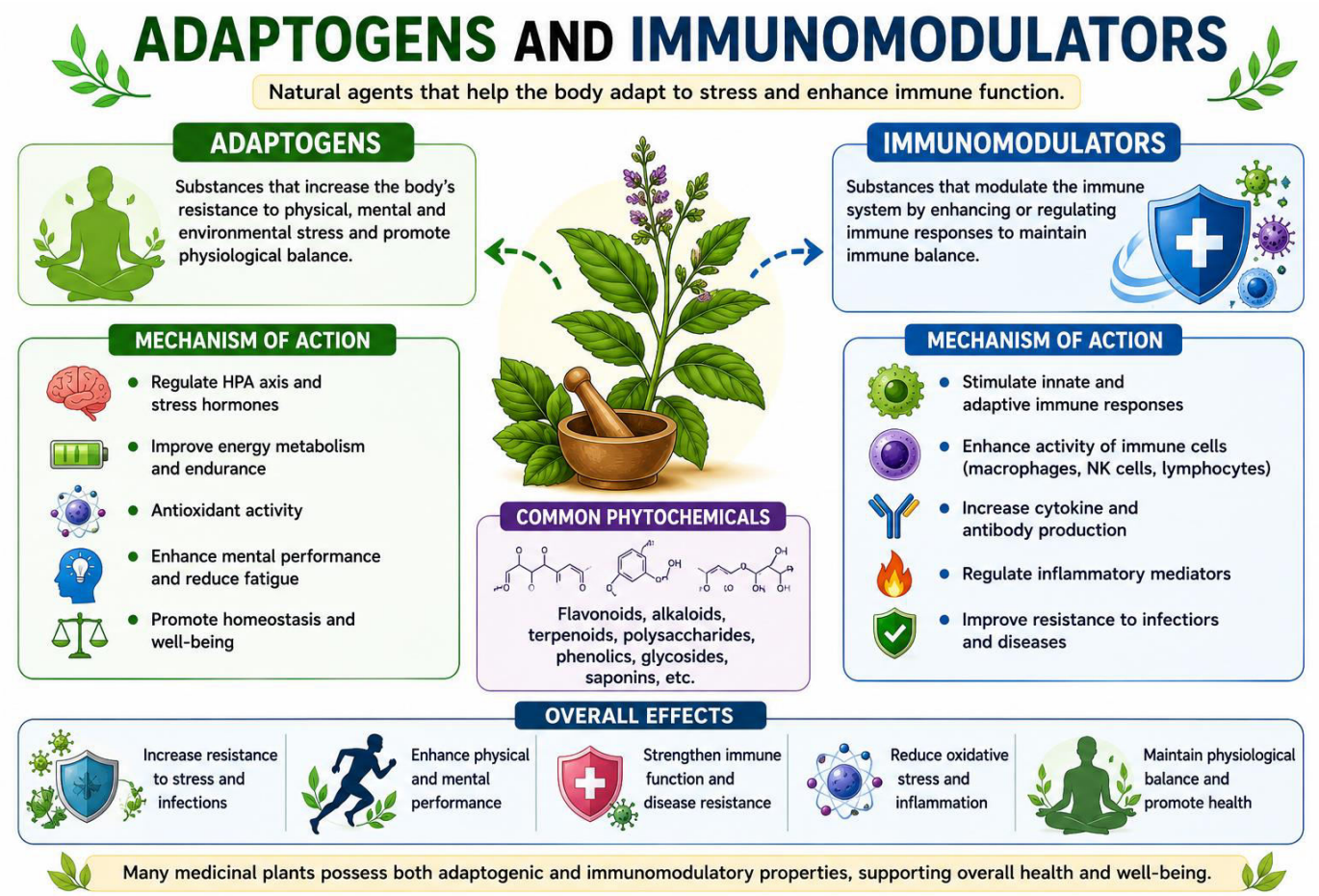

Figure 2: Adaptogens and immunomodulators

Table 3:Difference Between Adaptogens and Immunomodulators

Feature	Adaptogens	Immunomodulators
Primary Function	Increase resistance to stress	Regulate immune responses
Target System	Neuroendocrine and stress-response systems	Immune system
Main Effect	Improves adaptation and resilience	Enhances or suppresses immunity as required
Therapeutic Uses	Stress, fatigue, anxiety, weakness	Infections, immune deficiency, inflammation
Examples	Ashwagandha, Tulsi, Amla	Ashwagandha, Tulsi, Amla, Giloy

ASHWAGANDHA (WITHANIA SOMNIFERA)

Biological Source

Ashwagandha consists of the dried roots and occasionally the leaves of *Withania somnifera* (L.) Dunal, a medicinal plant belonging to the family Solanaceae. It is one of the most important Rasayana drugs described in Ayurveda and is widely recognized for its adaptogenic and immunomodulatory properties.

Geographical Source

The plant is extensively cultivated throughout India, particularly in Rajasthan, Madhya Pradesh, Gujarat, Punjab, and Uttar Pradesh. It is also grown in several tropical and subtropical regions of the world.

Macroscopic Characters

The roots are cylindrical, straight, and unbranched or slightly branched. They are buff to grayish-yellow externally and possess a short, smooth fracture. The root has a characteristic odor resembling that of a horse, from which the name Ashwagandha is derived ("Ashwa" meaning horse and "Gandha" meaning smell). The taste is slightly bitter and acrid.

Microscopic Characters

A transverse section of the root shows a multilayered cork composed of rectangular cells. Beneath the cork lies the cortex containing numerous starch grains. The secondary phloem forms a narrow zone, while the secondary xylem occupies a major portion of the root and consists of vessels, fibers, tracheids, and parenchyma. Medullary rays are distinct and run radially through the xylem region.

Chemical Constituents

The principal active constituents of Ashwagandha are steroidal lactones collectively known as withanolides. Important compounds include withaferin A, withanolide D, sitoindosides, somniferine, anaferine, and various alkaloids and flavonoids. These compounds are responsible for the plant's therapeutic activities.

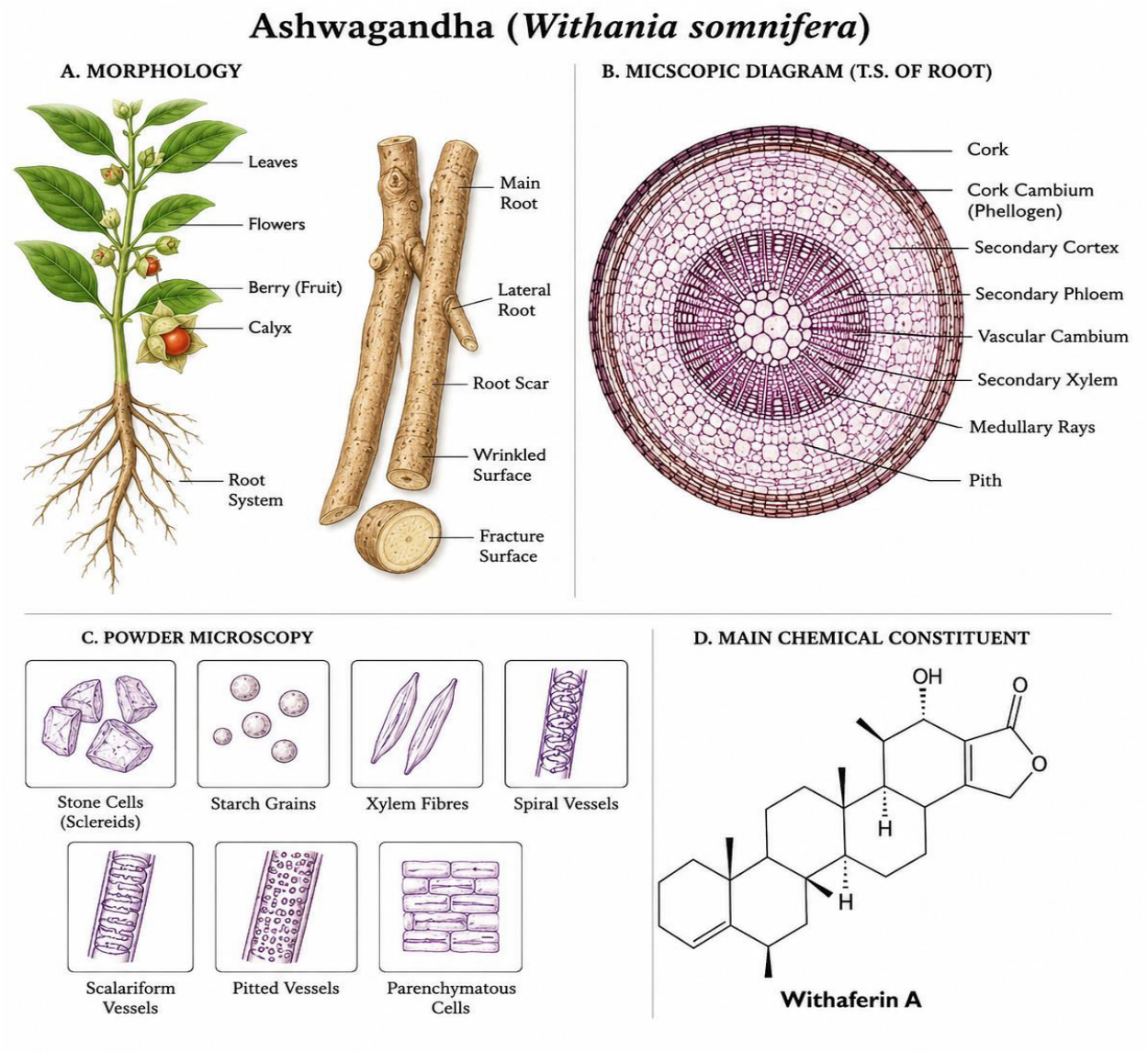

Figure 3: Morphology, Microscopy and Main active constituent of Ashwagandha

Pharmacological Activities

Ashwagandha is widely known for its adaptogenic action, helping the body cope with physical and mental stress. It also exhibits immunomodulatory, antioxidant, anti-inflammatory, neuroprotective, anti-anxiety, and rejuvenating activities. The herb enhances vitality, improves resistance to disease, and promotes overall well-being.

Uses

Ashwagandha is used in the management of stress, anxiety, insomnia, chronic fatigue, weakness, nervous disorders, reduced immunity, and age-related debility. It is also employed as a general health tonic and rejuvenator.

TULSI (*OCIMUM SANCTUM / OCIMUM TENUIFLORUM*)

Biological Source

Tulsi consists of the fresh or dried leaves and flowering tops of *Ocimum sanctum* Linn. (syn. *Ocimum tenuiflorum*), belonging to the family Lamiaceae. It is regarded as a sacred plant in India and has been used extensively in traditional medicine for centuries.

Geographical Source

Tulsi is cultivated throughout India and grows abundantly in tropical and subtropical regions. It is commonly found in household gardens, temples, and medicinal plant farms.

Macroscopic Characters

The leaves are simple, opposite, petiolate, ovate, and possess serrated margins. Depending on the variety, the leaves may be green or purplish in color. They have a strong aromatic odor due to the presence of essential oils and a pungent, slightly bitter taste.

Microscopic Characters

The leaf is dorsiventral in structure with a distinct upper and lower epidermis. The epidermal layers contain diacytic stomata and numerous multicellular covering trichomes. Glandular trichomes are abundant and serve as storage sites for volatile oils. A single layer of palisade cells is present beneath the upper epidermis, followed by spongy parenchyma.

Chemical Constituents

Tulsi contains essential oils rich in eugenol, methyl eugenol, linalool, and caryophyllene. Other important constituents include ursolic acid, rosmarinic acid, flavonoids, tannins, and phenolic compounds. Eugenol is considered the major bioactive constituent responsible for many of its medicinal properties.

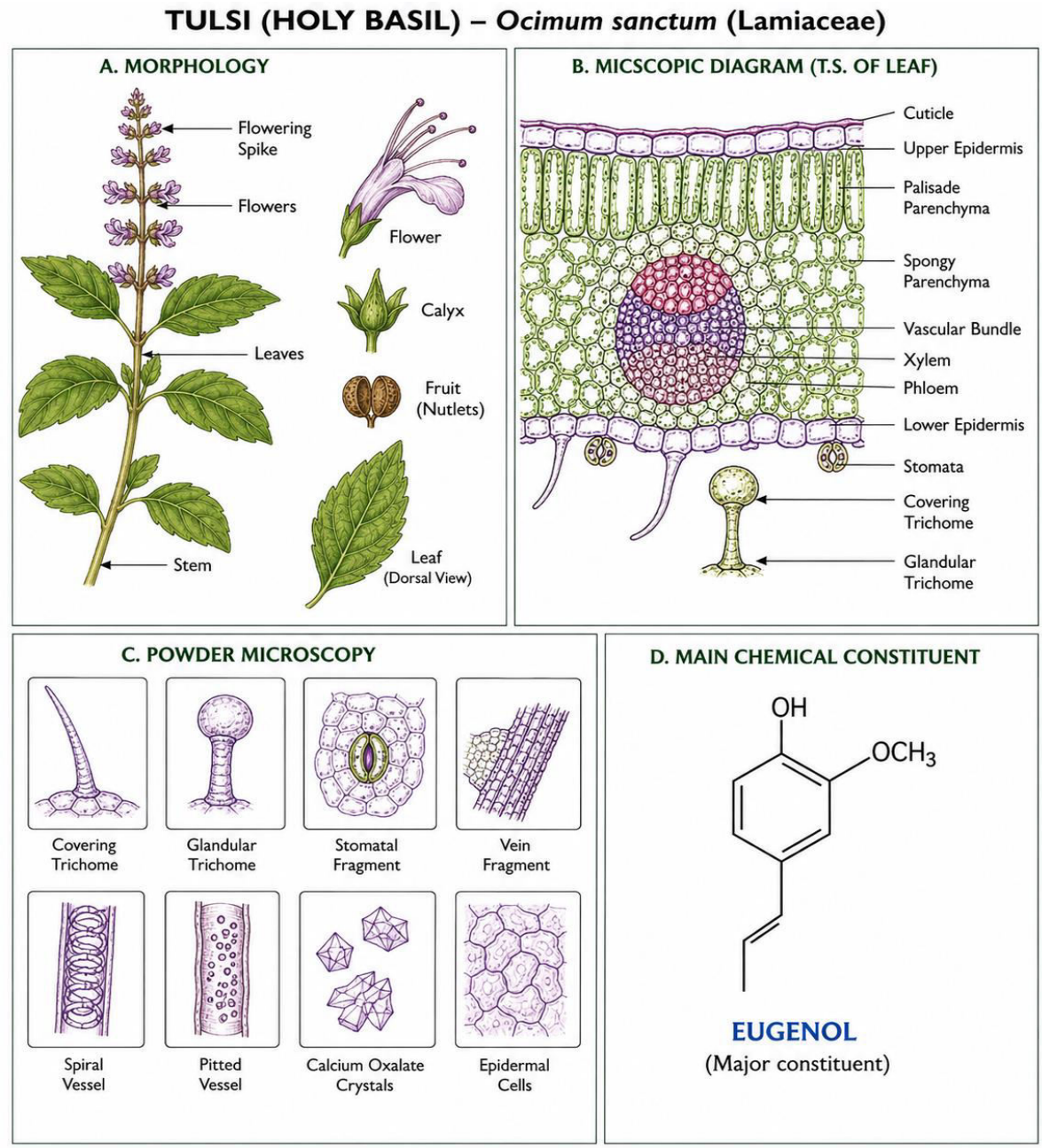

Figure 4: Morphology, Microscopy and Main active constituent of Tulsi

Pharmacological Activities

Tulsi possesses adaptogenic, immunomodulatory, antimicrobial, antioxidant, anti-inflammatory, antipyretic, and hepatoprotective activities. It improves the body's resistance to stress and enhances immune function. The herb is particularly effective in protecting against respiratory infections and environmental stressors.

Uses

Tulsi is commonly used in the treatment of cough, cold, bronchitis, asthma, fever, and microbial infections. It is also consumed as an herbal tea or tonic for stress relief, immunity enhancement, and maintenance of general health.

AMLA (PHYLLANTHUS EMBLICA / EMBLICA OFFICINALIS)

Biological Source

Amla consists of the fresh or dried fruits of *Phyllanthus emblica* Linn. (syn. *Emblica officinalis*), belonging to the family Phyllanthaceae. It is one of the most valued medicinal fruits in Ayurveda and is considered a potent Rasayana drug.

Geographical Source

The plant is distributed throughout tropical and subtropical India and is cultivated extensively in Uttar Pradesh, Madhya Pradesh, Rajasthan, Tamil Nadu, and other regions.

Macroscopic Characters

The fruit is nearly spherical, smooth, and light greenish-yellow in color. It possesses six prominent vertical furrows running from the apex to the base. The fruit pulp is firm and fibrous, with a characteristic sour and astringent taste.

Microscopic Characters

The fruit shows an outer epidermal layer covered with a cuticle. The mesocarp consists of parenchymatous cells containing tannins and other metabolites. Numerous stone cells (sclereids) and calcium oxalate crystals are scattered throughout the tissue. Vascular bundles are embedded within the mesocarp.

Chemical Constituents

Amla is exceptionally rich in vitamin C and contains powerful antioxidant compounds such as emblicanin A and emblicanin B. Other constituents include gallic acid, ellagic acid, tannins, flavonoids, polyphenols, amino acids, and pectin. These compounds contribute significantly to its therapeutic effectiveness.

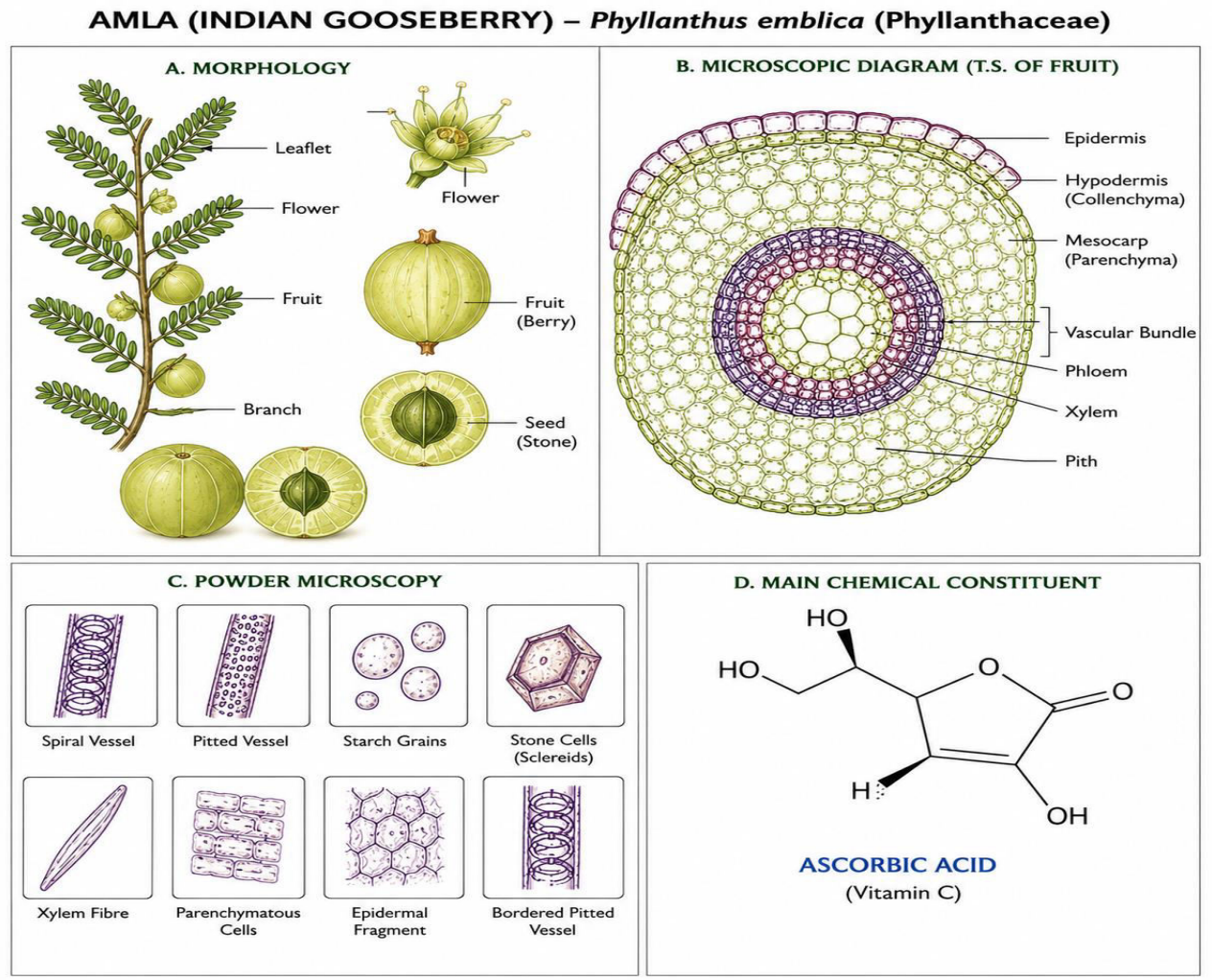

Figure 5: Morphology, Microscopy and Main active constituent of Amla

Pharmacological Activities

Amla exhibits potent antioxidant, immunomodulatory, adaptogenic, anti-inflammatory, hepatoprotective, gastroprotective, and anti-aging activities. It strengthens the immune system, protects tissues from oxidative stress, and promotes overall health and longevity.

Uses

Amla is widely used as an immune booster, rejuvenative tonic, digestive aid, liver protective agent, and nutritional supplement. It forms a major ingredient of several Ayurvedic formulations such as Triphala and Chyawanprash and is commonly recommended for enhancing vitality and disease resistance.

PHARMACOGNOSTIC PROFILE OF HEPATOPROTECTIVE DRUGS

Hepatoprotective drugs are substances that protect the liver from damage caused by toxins, drugs, alcohol, infections, metabolic disorders, and environmental pollutants. The liver is one of the most important organs in the human body, responsible for metabolism, detoxification, synthesis of proteins, storage of nutrients, and regulation of various biochemical processes. Continuous exposure to harmful agents can lead to liver disorders such as hepatitis, fatty liver disease, cirrhosis, and liver failure. Hepatoprotective agents help prevent or minimize liver injury, promote regeneration of liver cells, and maintain normal liver function.

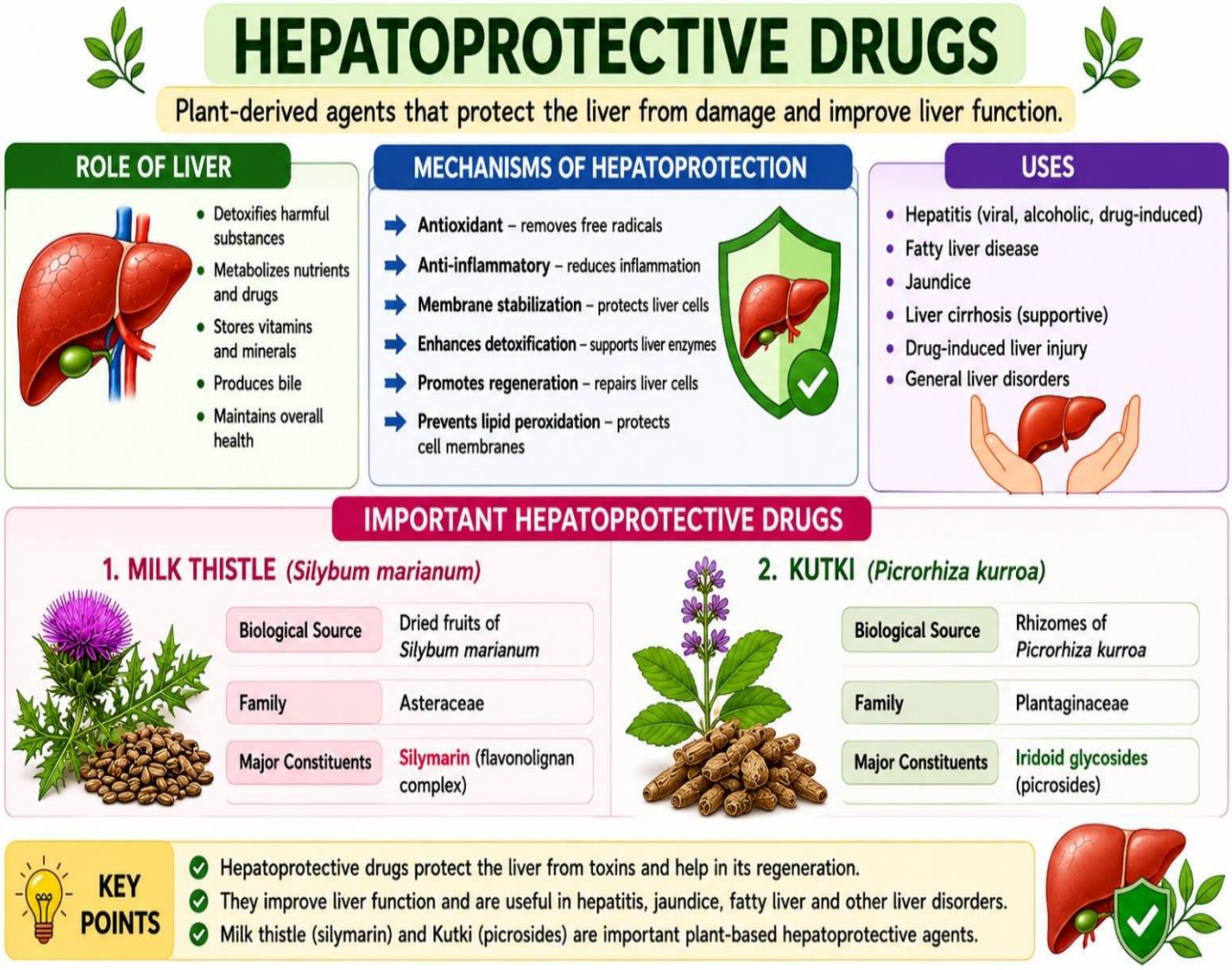

Figure 6: Hepatoprotective drugs

Medicinal plants have been used for centuries to treat liver disorders and improve hepatic health. Many plant-derived hepatoprotective agents contain bioactive compounds such as

flavonoids, phenolic compounds, lignans, terpenoids, iridoid glycosides, and antioxidants that protect hepatocytes from oxidative stress, inflammation, and toxin-induced damage. These phytochemicals enhance liver function by stabilizing cell membranes, scavenging free radicals, stimulating protein synthesis, and promoting regeneration of damaged liver tissue.

Mechanisms of Hepatoprotective Action

Hepatoprotective plants exert their beneficial effects through several mechanisms:

- **Antioxidant activity:** Neutralize free radicals and reduce oxidative stress.
- **Anti-inflammatory action:** Inhibit inflammatory mediators and cytokines.
- **Membrane stabilization:** Protect hepatocyte membranes from toxic damage.
- **Detoxification enhancement:** Support liver enzymes involved in detoxification.
- **Promotion of liver regeneration:** Stimulate repair and regeneration of damaged liver cells.
- **Prevention of lipid peroxidation:** Protect cellular membranes from oxidative degradation.
- **Immunomodulatory effects:** Regulate immune responses associated with liver injury.

Milk Thistle (*Silybum marianum*)

Biological Source

Milk thistle consists of the dried ripe fruits (achenes) of *Silybum marianum* (L.) Gaertn., a medicinal plant belonging to the family Asteraceae. The plant has been used for centuries in European traditional medicine and is considered one of the most effective natural remedies for liver protection.

Geographical Source

Milk thistle is native to the Mediterranean region and is widely cultivated in Europe, North America, South America, Australia, and several Asian countries. It thrives in dry and sunny climates and is commonly grown as a medicinal crop.

Macroscopic Characters

The fruits are small, oblong to oval, smooth, and shiny. They are black or dark brown in color with characteristic grayish streaks on the surface. A tuft of silky hairs known as pappus is present at one end of the fruit. The fruits are odorless or possess a faint odor and have a slightly bitter taste.

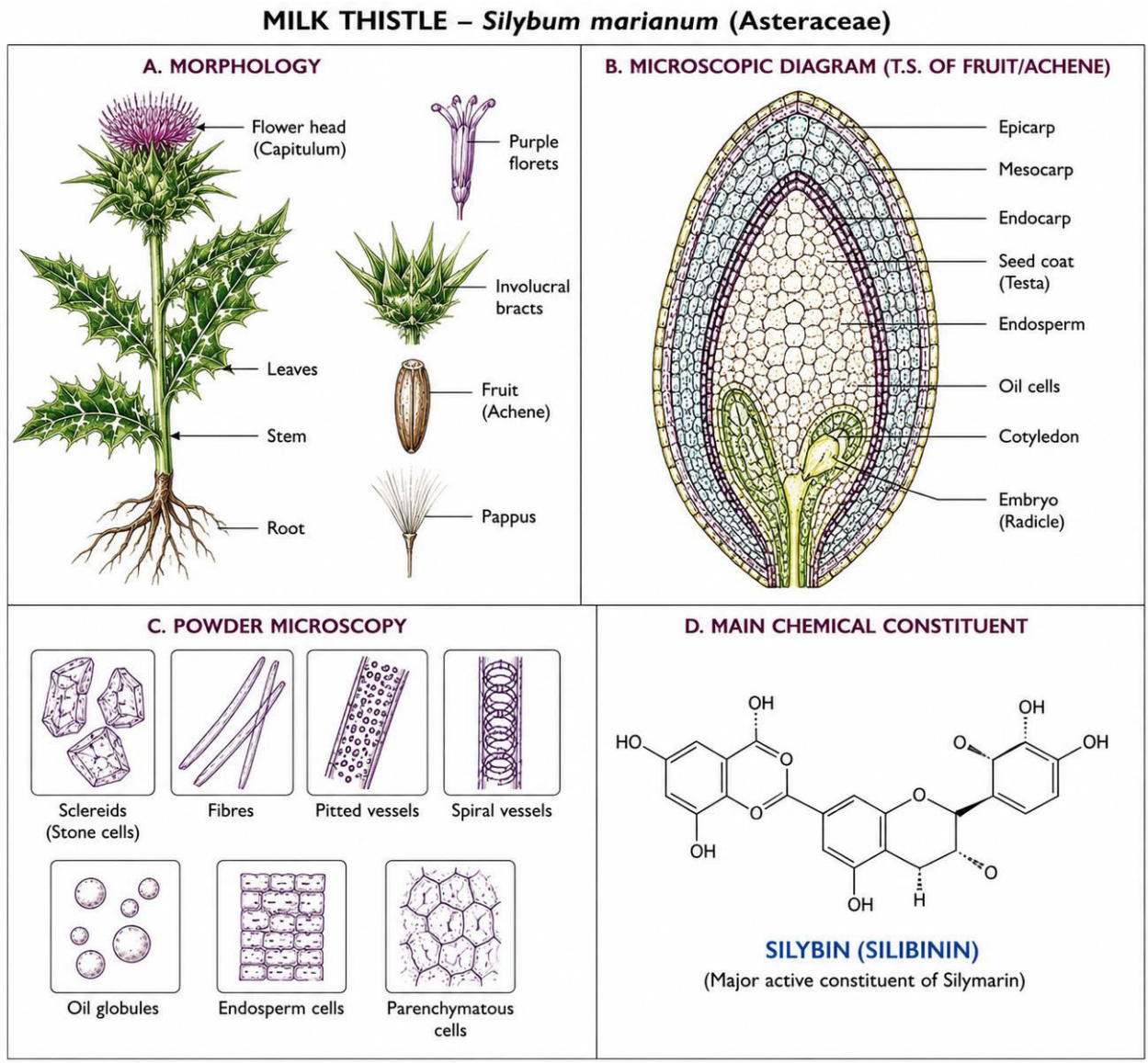

Figure 7: Morphology, Microscopy and Main active constituent of Milk thistle

Microscopic Characters

A transverse section of the fruit reveals an outer epidermal layer covered by a cuticle. The pericarp consists of sclerenchymatous tissues that provide mechanical strength. The endosperm contains fixed oil and protein-rich cells. The embryo occupies a major portion of the seed cavity and contains abundant storage materials.

Chemical Constituents

The major active constituents of Milk thistle are collectively known as silymarin, a mixture of flavonolignans including silybin (silibinin), silychristin, and silydianin. Other constituents

include flavonoids, fixed oils, proteins, sterols, tocopherols, and mucilage. Silybin is considered the principal bioactive component responsible for hepatoprotective activity.

Pharmacological Activities

Milk thistle exhibits potent hepatoprotective, antioxidant, anti-inflammatory, antifibrotic, and membrane-stabilizing properties. Silymarin protects hepatocytes from toxic substances by preventing lipid peroxidation and enhancing protein synthesis, thereby promoting regeneration of damaged liver cells. It also scavenges free radicals and improves liver detoxification mechanisms.

Uses

Milk thistle is extensively used in the treatment of hepatitis, cirrhosis, fatty liver disease, alcoholic liver damage, drug-induced hepatotoxicity, and liver dysfunction associated with environmental toxins. It is also used as a supportive therapy for maintaining overall liver health.

Kutki (*Picrorhiza kurroa*)

Biological Source

Kutki consists of the dried rhizomes and roots of *Picrorhiza kurroa* Royle ex Benth., belonging to the family Plantaginaceae. It is an important Ayurvedic medicinal plant known for its bitter taste and remarkable hepatoprotective properties.

Geographical Source

Kutki is native to the alpine Himalayan regions of India, Nepal, Bhutan, and Tibet. It grows at altitudes ranging from approximately 3,000 to 5,000 meters above sea level in cool and moist environments.

Macroscopic Characters

The rhizomes are cylindrical, straight or slightly curved, and grayish-brown externally. They possess distinct transverse wrinkles and leaf scars. The fracture is short and brittle, and the taste is intensely bitter. The roots are thin, elongated, and attached to the rhizome.

Microscopic Characters

A transverse section of the rhizome shows a multilayered cork followed by a cortex composed of parenchymatous cells containing starch grains. The vascular bundles are arranged in a ring and consist of xylem and phloem tissues. Medullary rays and storage parenchyma are prominent features. Calcium oxalate crystals may also be present.

Chemical Constituents

The principal active constituents of Kutki are iridoid glycosides, including picroside I, picroside II, and kutkoside. Other constituents include apocynin, cucurbitacins, phenolic

compounds, and various glycosides. Picrosides are considered the major hepatoprotective compounds.

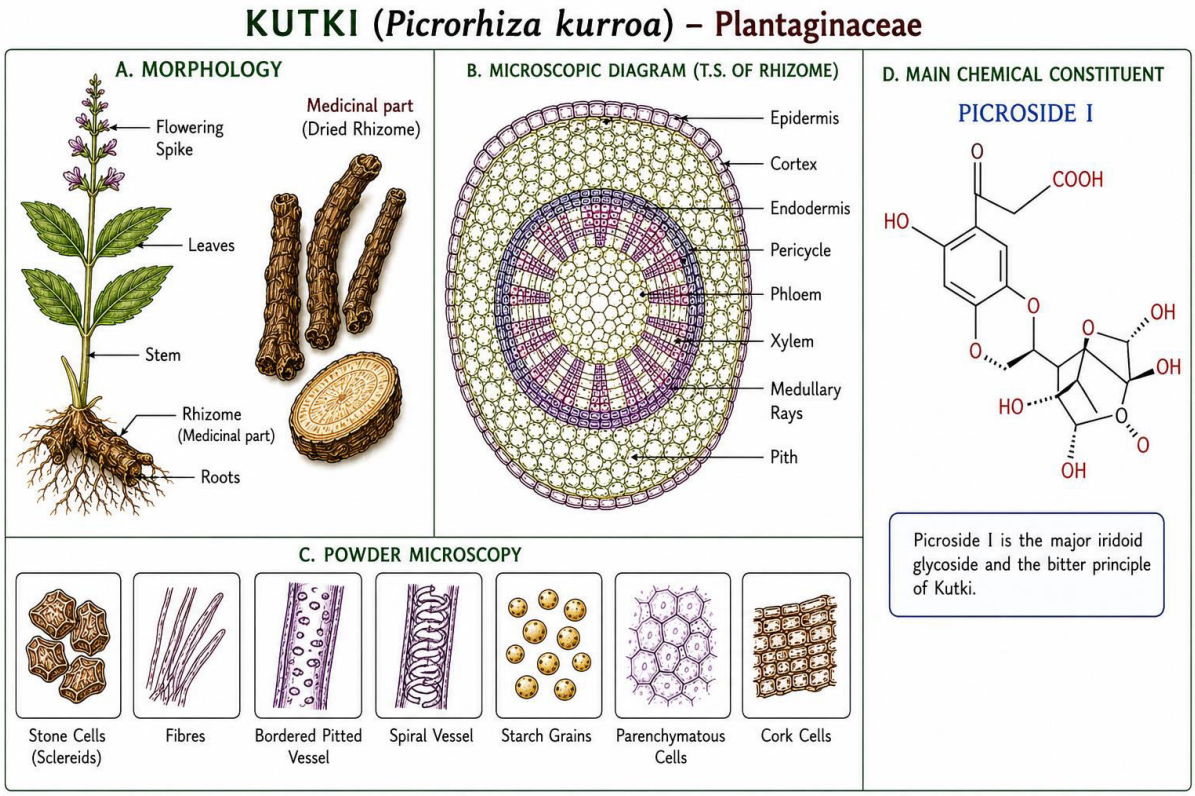

Figure 8: *Morphology, Microscopy and Main active constituent of of Kutki*

Pharmacological Activities

Kutki exhibits hepatoprotective, antioxidant, anti-inflammatory, immunomodulatory, antipyretic, and cholagogue activities. It protects liver tissues from toxic injury, enhances bile secretion, and promotes regeneration of damaged hepatocytes. Its antioxidant action helps reduce oxidative stress associated with liver diseases.

Uses

Kutki is widely used in Ayurveda for the treatment of jaundice, hepatitis, fatty liver, liver enlargement, indigestion, chronic fever, and disorders associated with impaired liver function. It is also employed as a bitter tonic and digestive stimulant.

PHARMACOGNOSTIC PROFILE OF CARDIOVASCULAR DRUGS

Cardiovascular drugs are therapeutic agents used for the prevention and management of disorders affecting the heart and blood vessels. Cardiovascular diseases (CVDs), including hypertension, coronary artery disease, atherosclerosis, heart failure, and stroke, are among the leading causes of morbidity and mortality worldwide. Maintaining cardiovascular health is essential for ensuring adequate blood circulation, oxygen delivery, and nutrient transport throughout the body.

Medicinal plants have been used traditionally to support cardiovascular function and reduce the risk of heart-related disorders. Many plant-derived cardiovascular drugs contain bioactive constituents such as flavonoids, polyphenols, sulfur-containing compounds, tannins, triterpenoids, and antioxidants that contribute to cardioprotective effects. These phytochemicals help improve blood circulation, regulate blood pressure, reduce cholesterol levels, prevent oxidative damage, and enhance the overall functioning of the cardiovascular system.

The increasing prevalence of lifestyle-related disorders such as obesity, diabetes, stress, and hypertension has led to growing interest in herbal cardiovascular agents as complementary and preventive healthcare options. These natural remedies are often valued for their multi-targeted actions and long-term safety profiles.

Role of the Cardiovascular System

The cardiovascular system performs several vital functions:

- Pumps blood throughout the body.
- Supplies oxygen and nutrients to tissues.
- Removes carbon dioxide and metabolic wastes.
- Maintains blood pressure and circulation.
- Supports thermoregulation and homeostasis.
- Transports hormones and immune cells.

Mechanisms of Cardioprotective Action

Herbal cardiovascular drugs exert beneficial effects through various mechanisms:

- **Antioxidant activity:** Protects cardiac tissues from oxidative stress.
- **Hypolipidemic action:** Reduces cholesterol and triglyceride levels.
- **Antihypertensive effect:** Helps regulate blood pressure.
- **Anti-atherosclerotic activity:** Prevents plaque formation in blood vessels.
- **Vasodilatory action:** Improves blood flow by relaxing blood vessels.

- **Antiplatelet activity:** Reduces abnormal blood clot formation.
- **Cardiotonic effect:** Improves the strength and efficiency of heart contractions.
- **Anti-inflammatory action:** Reduces inflammation associated with cardiovascular diseases.

Major Therapeutic Uses

Cardiovascular herbal drugs are commonly used for:

- Hypertension (high blood pressure)
- Hyperlipidemia (high cholesterol levels)
- Coronary artery disease
- Atherosclerosis
- Angina pectoris
- Heart failure (supportive therapy)
- Prevention of cardiovascular complications
- Improvement of circulation and cardiac function

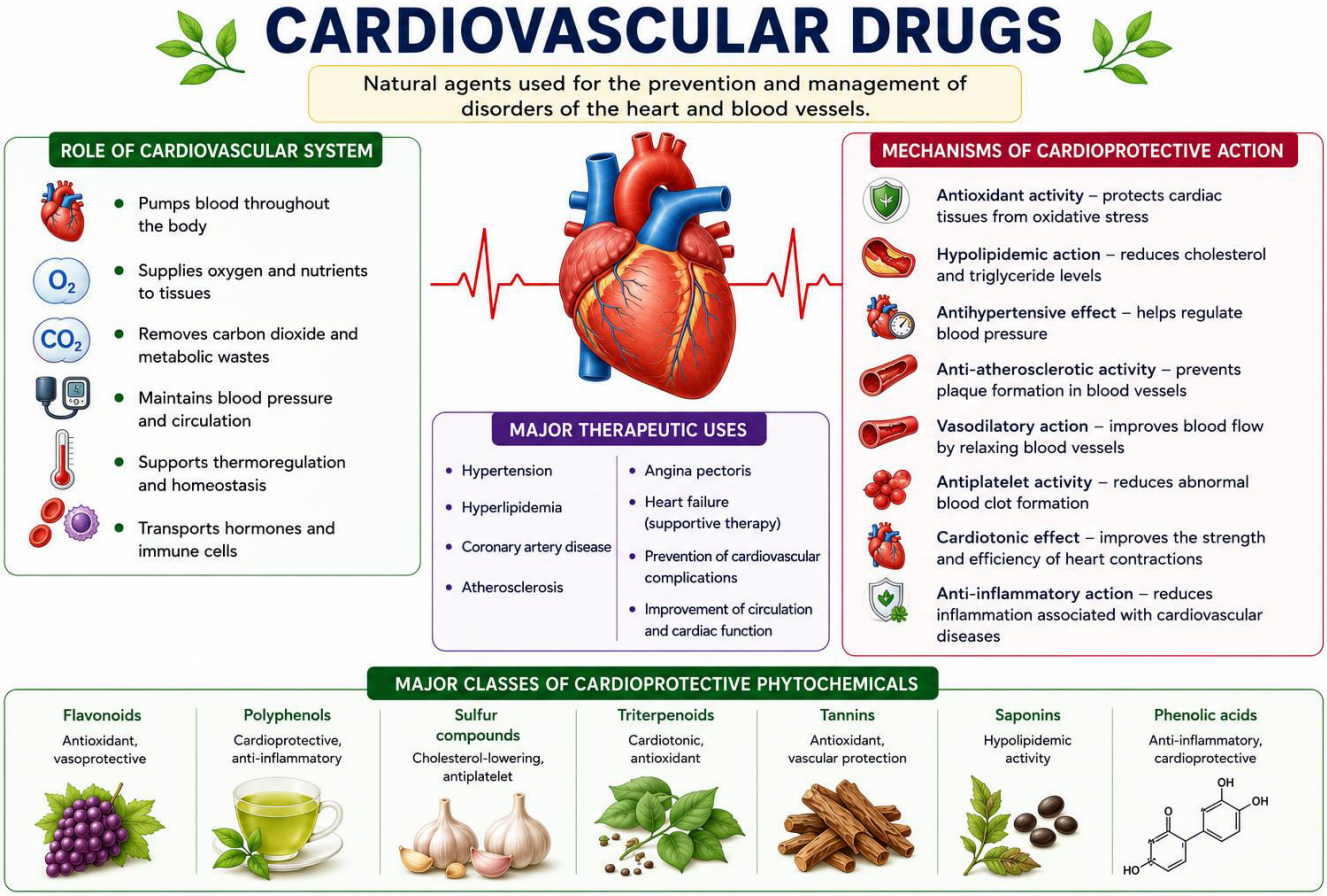

Figure 9: Cardiovascular Drugs

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Major Classes of Cardioprotective Phytochemicals

Phytochemical Class	Cardiovascular Activity
Flavonoids	Antioxidant, vasoprotective
Polyphenols	Cardioprotective, anti-inflammatory
Sulfur compounds	Cholesterol-lowering, antiplatelet
Triterpenoids	Cardiotonic, antioxidant
Tannins	Antioxidant, vascular protection
Saponins	Hypolipidemic activity
Phenolic acids	Anti-inflammatory, cardioprotective

Garlic (*Allium sativum*)

Biological Source

Garlic consists of the fresh or dried bulbs of *Allium sativum* L., belonging to the family Amaryllidaceae. It is one of the oldest cultivated medicinal plants and has been used for centuries as a food, spice, and therapeutic agent.

Geographical Source

Garlic is cultivated throughout the world, particularly in India, China, Egypt, Europe, and the Mediterranean region. China is currently the largest producer of garlic. In India, it is widely grown in Madhya Pradesh, Rajasthan, Gujarat, Punjab, and Uttar Pradesh.

Macroscopic Characters

The bulb is composed of several cloves enclosed within a thin, white or pinkish papery sheath. Each clove is covered by a membranous scale leaf and possesses a characteristic pungent odor. The cloves are irregularly ovoid and have a strong, acrid taste.

Microscopic Characters

A transverse section of the garlic clove shows an epidermal layer covered by a thin cuticle. The tissue consists mainly of large parenchymatous cells containing reserve food materials. Numerous oil droplets and sulfur-containing compounds are present within the cells. Vascular bundles are scattered throughout the storage tissue.

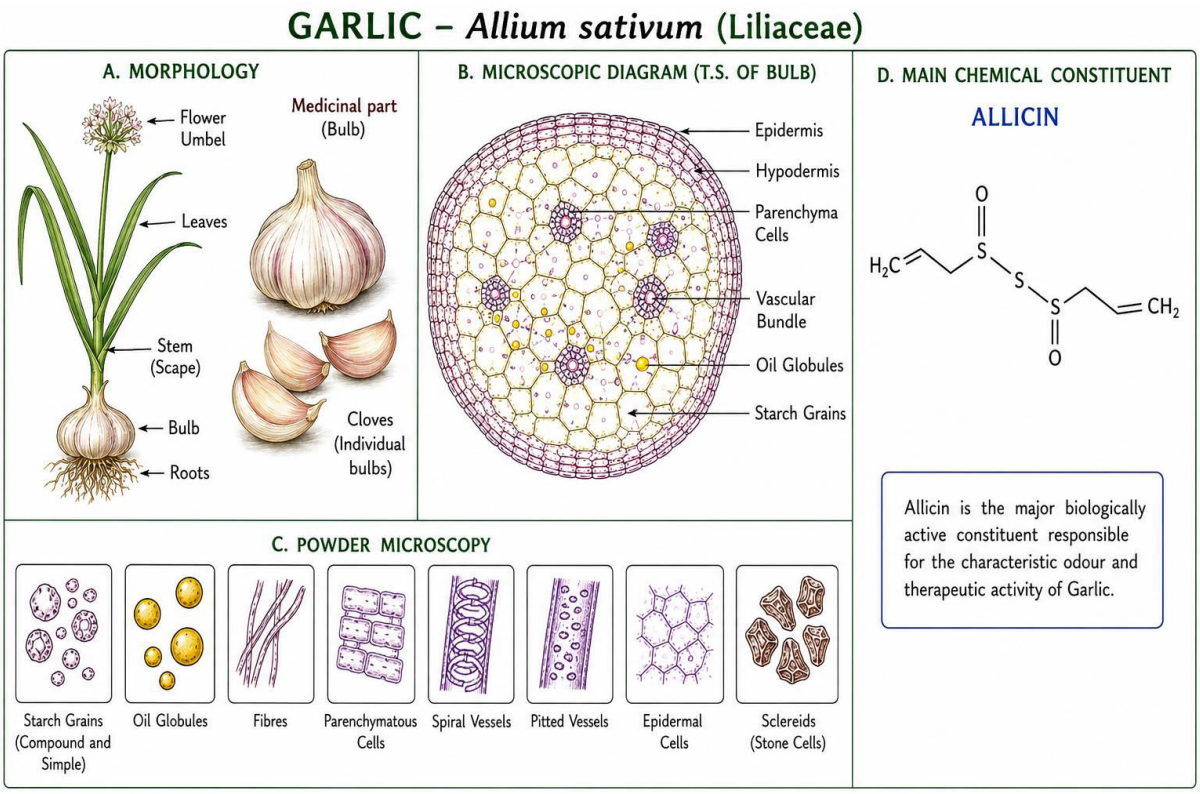

Figure 10: *Morphology, Microscopy and Main active constituent of Garlic*

Chemical Constituents

Garlic contains sulfur-containing compounds that are responsible for its medicinal properties. The major constituents include alliin, allicin, ajoene, diallyl disulfide, diallyl trisulfide, and other organosulfur compounds. It also contains flavonoids, enzymes, vitamins, amino acids, selenium, and volatile oils.

Pharmacological Activities

Garlic exhibits cardioprotective, antihypertensive, hypolipidemic, antiplatelet, antioxidant, antimicrobial, and anti-inflammatory activities. It helps reduce serum cholesterol and triglyceride levels, lowers blood pressure, prevents platelet aggregation, and improves blood circulation. Its antioxidant action protects blood vessels from oxidative damage and atherosclerosis.

Uses

Garlic is widely used in the management of hypertension, hyperlipidemia, atherosclerosis, coronary artery disease, and other cardiovascular disorders. It is also employed as a preventive agent for maintaining heart health and reducing cardiovascular risk factors.

Arjuna (*Terminalia arjuna*)

Biological Source

Arjuna consists of the dried stem bark of *Terminalia arjuna* (Roxb.) Wight & Arn., belonging to the family Combretaceae. It is one of the most important cardiotonic drugs described in Ayurveda and has been used traditionally for strengthening the heart.

Geographical Source

The plant is distributed throughout India, Sri Lanka, Bangladesh, and Myanmar. It commonly grows along riverbanks, streams, and moist forests. In India, it is found extensively in Uttar Pradesh, Madhya Pradesh, Bihar, Maharashtra, and South Indian states.

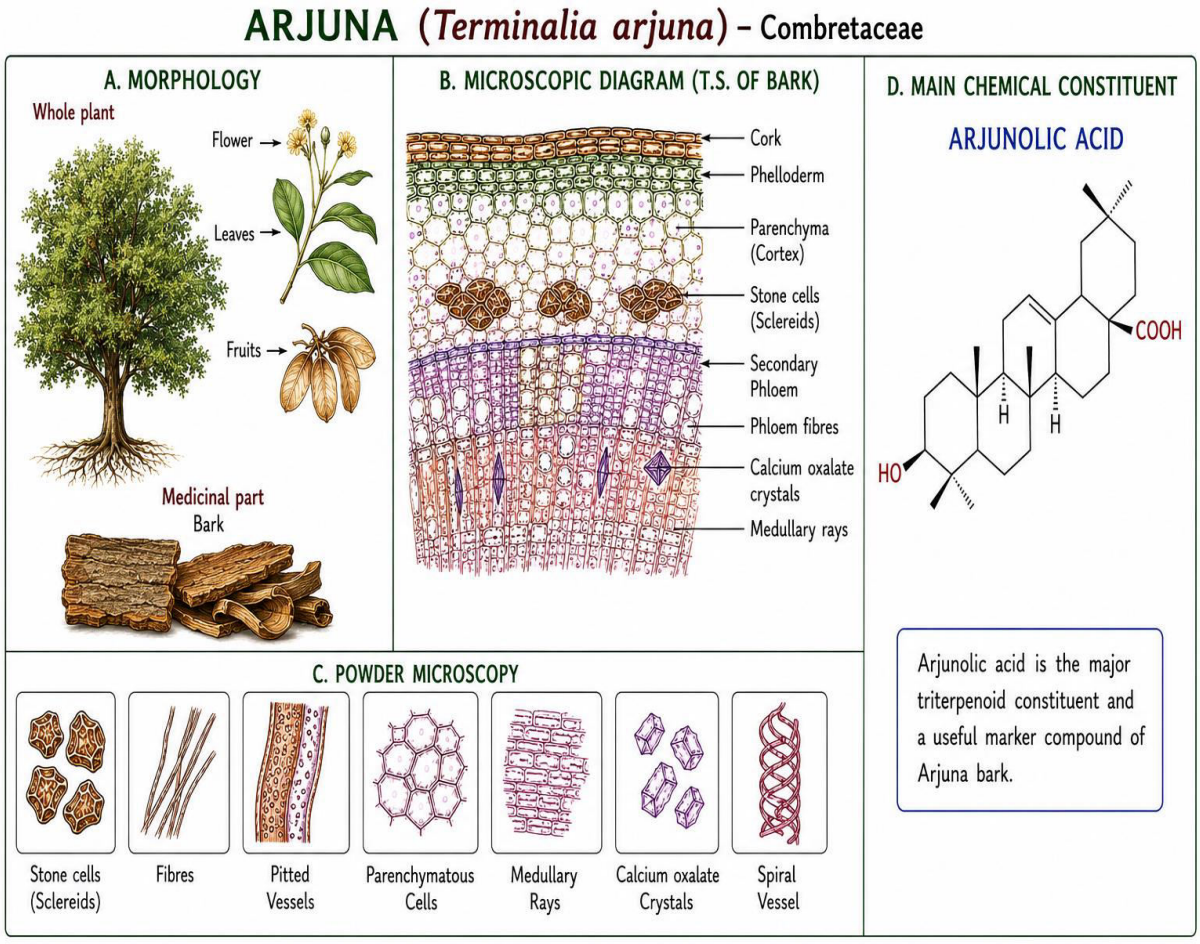

Figure 11: Morphology, Microscopy and Main active constituent of Arjuna

Macroscopic Characters

The bark occurs in flat or curved pieces and is smooth externally with a gray to pinkish-gray surface. The inner surface is reddish-brown and fibrous. The bark is hard and tough, with a slightly astringent taste and faint odor.

Microscopic Characters

A transverse section of the bark shows a well-developed cork layer followed by cortex and secondary phloem. Numerous stone cells, sclerenchymatous fibers, and calcium oxalate crystals are present. Medullary rays are distinct and vascular tissues are prominently developed.

Chemical Constituents

Arjuna contains triterpenoid saponins such as arjunic acid, arjunolic acid, arjungenin, and arjunetin. Other important constituents include flavonoids, tannins, phytosterols, glycosides, ellagic acid, gallic acid, and minerals such as calcium and magnesium.

Pharmacological Activities

Arjuna exhibits cardiotonic, cardioprotective, antioxidant, antihyperlipidemic, antihypertensive, anti-ischemic, and anti-inflammatory activities. It improves myocardial function, enhances coronary circulation, strengthens cardiac muscles, and protects the heart from oxidative stress and ischemic injury.

Uses

Arjuna is widely used in the treatment of angina pectoris, congestive heart failure, hypertension, ischemic heart disease, hyperlipidemia, and cardiac weakness. It is also used as a heart tonic to maintain cardiovascular health and improve cardiac performance.

PHARMACOGNOSTIC PROFILE OF ANTIDIABETIC DRUGS

Introduction

Antidiabetic drugs are therapeutic agents used to prevent, manage, and control diabetes mellitus, a chronic metabolic disorder characterized by elevated blood glucose levels resulting from insufficient insulin production, impaired insulin action, or both. Diabetes is one of the most prevalent non-communicable diseases worldwide and is associated with serious complications affecting the cardiovascular system, kidneys, eyes, nerves, and other organs.

Medicinal plants have been used traditionally for the management of diabetes and are gaining increasing attention due to their efficacy, safety, and affordability. Plant-derived antidiabetic drugs contain various bioactive constituents such as alkaloids, flavonoids, saponins, terpenoids, glycosides, polysaccharides, and dietary fibers that help regulate blood glucose levels through multiple mechanisms. Unlike many synthetic drugs that act through a single pathway, herbal antidiabetic agents often exhibit multi-targeted actions, making them valuable in the long-term management of diabetes.

Diabetes Mellitus

Diabetes mellitus is a metabolic disorder characterized by persistent hyperglycemia due to defects in insulin secretion, insulin action, or both.

Major Types of Diabetes

1. Type 1 Diabetes Mellitus

- Caused by autoimmune destruction of pancreatic β-cells.
- Results in little or no insulin production.
- Usually develops during childhood or adolescence.

2. Type 2 Diabetes Mellitus

- Characterized by insulin resistance and impaired insulin secretion.
- Most common form of diabetes.
- Associated with obesity, sedentary lifestyle, and genetic factors.

3. Gestational Diabetes

- Occurs during pregnancy.
- Usually resolves after childbirth but increases future diabetes risk.

Mechanisms of Antidiabetic Action

Herbal antidiabetic drugs help control blood glucose through various mechanisms:

- Stimulate insulin secretion from pancreatic β-cells.
- Improve insulin sensitivity in peripheral tissues.
- Enhance glucose uptake by cells.
- Inhibit carbohydrate-digesting enzymes.
- Reduce intestinal glucose absorption.
- Promote regeneration of pancreatic β-cells.
- Delay gastric emptying and glucose release.
- Provide antioxidant protection against diabetic complications.

Therapeutic Uses

Antidiabetic herbal drugs are used for:

- Management of Type 2 diabetes mellitus.
- Control of postprandial hyperglycemia.
- Improvement of insulin sensitivity.
- Prevention of diabetic complications.
- Management of metabolic syndrome.
- Supportive therapy in obesity-associated diabetes.

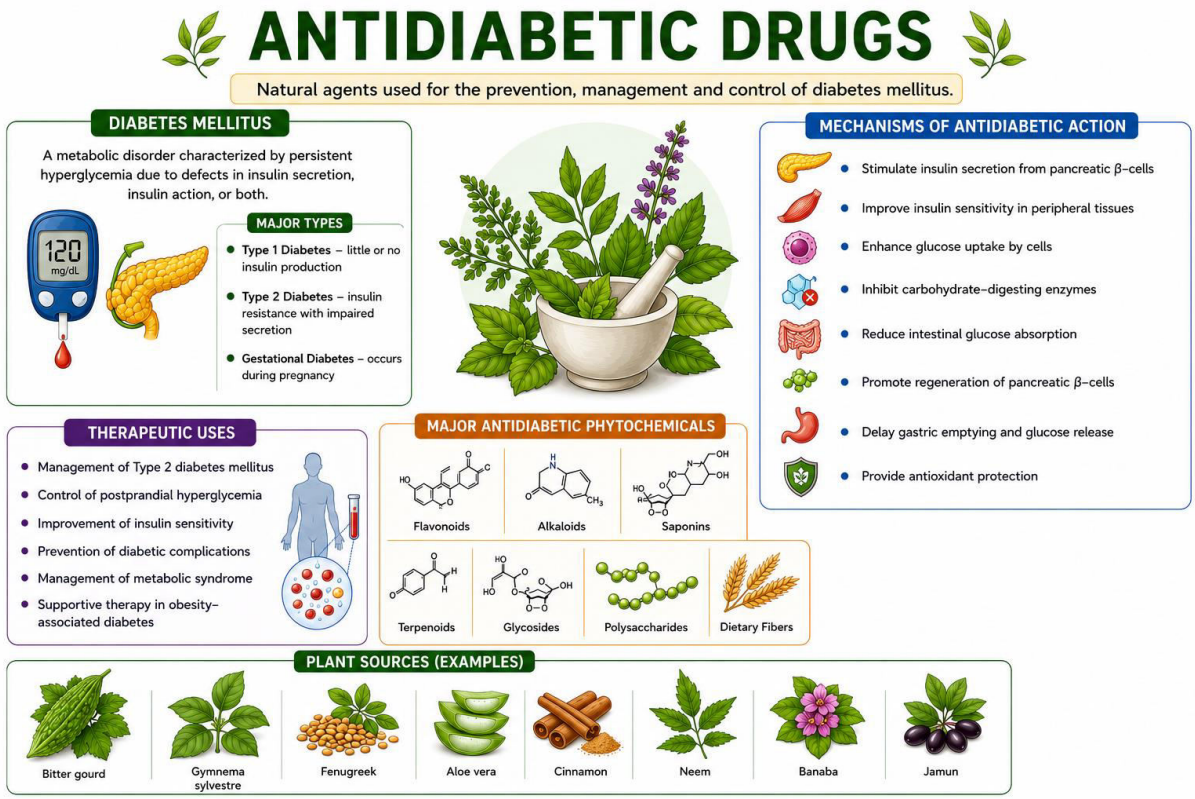

Figure 11: Antidiabetic Drugs

Table 4:Major Antidiabetic Phytochemicals

Phytochemical Class	**Antidiabetic Activity**
Flavonoids	Improve insulin sensitivity and antioxidant defense
Alkaloids	Enhance glucose metabolism
Saponins	Improve glucose utilization
Terpenoids	Stimulate insulin secretion
Glycosides	Reduce blood glucose levels
Polysaccharides	Delay glucose absorption
Dietary Fibers	Improve glycemic control and insulin response

Key Points

- Diabetes mellitus is characterized by elevated blood glucose levels.
- Herbal antidiabetic agents act through multiple mechanisms.
- They improve insulin secretion, insulin sensitivity, and glucose utilization.

- Phytochemicals such as flavonoids, alkaloids, saponins, terpenoids, and fibers contribute to antidiabetic activity.
- These agents play an important role in managing diabetes and preventing its complications.

Gymnema (*Gymnema sylvestre*)

Biological Source

Gymnema consists of the dried leaves of *Gymnema sylvestre* (Retz.) R.Br. ex Sm., belonging to the family Apocynaceae. It is commonly known as "Gudmar" or "Gurmar," meaning “sugar destroyer,” because of its remarkable ability to suppress the sensation of sweetness.

Geographical Source

Gymnema is native to the tropical forests of India, Sri Lanka, Africa, and Australia. In India, it is commonly found in the forests of Madhya Pradesh, Maharashtra, Karnataka, Tamil Nadu, and Uttar Pradesh.

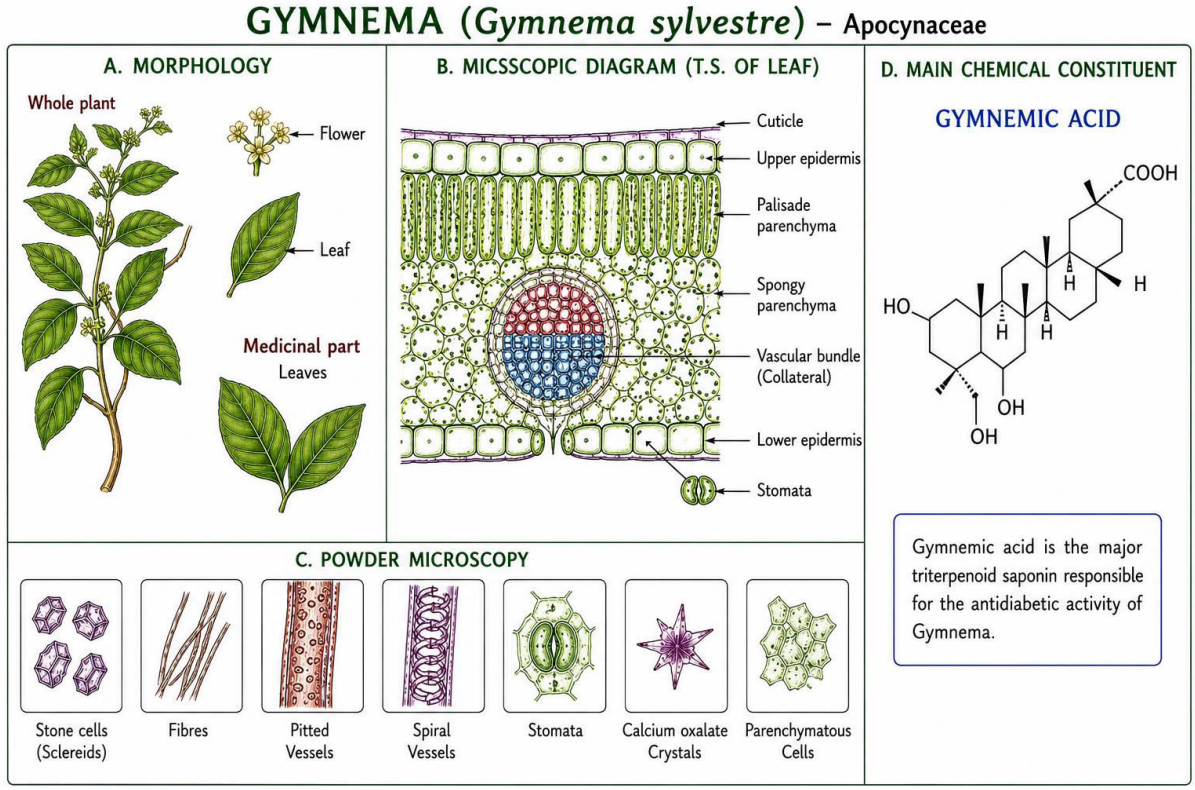

Figure 12: *Morphology, Microscopy and Main active constituent of Gymnema*

Macroscopic Characters

The leaves are simple, opposite, ovate to elliptic in shape, and possess an entire margin. They are dark green on the upper surface and lighter green beneath. The leaves are leathery in texture, with a characteristic slightly bitter and astringent taste. The plant is a woody climbing shrub with slender stems.

Microscopic Characters

A transverse section of the leaf shows a dorsiventral structure with a single-layered upper and lower epidermis covered by a cuticle. The mesophyll is differentiated into palisade and spongy parenchyma. Stomata are mainly present on the lower epidermis. Laticiferous tissues containing latex are distributed throughout the leaf. Calcium oxalate crystals may also be observed.

Chemical Constituents

The principal active constituents are gymnemic acids, a group of triterpenoid saponins responsible for the antidiabetic activity. Other constituents include gurmarin, gymnemagenin, flavonoids, alkaloids, anthraquinones, and resins.

Pharmacological Activities

Gymnema exhibits potent antidiabetic, hypoglycemic, antioxidant, anti-obesity, hypolipidemic, and immunomodulatory activities. Gymnemic acids reduce intestinal absorption of glucose, suppress sweet taste perception, stimulate insulin secretion, and promote regeneration of pancreatic β-cells. These actions contribute to better glycemic control and improved metabolic health.

Uses

Gymnema is widely used in the management of type 2 diabetes mellitus, obesity, metabolic syndrome, and hyperlipidemia. It is frequently incorporated into herbal formulations aimed at controlling blood sugar levels and reducing sugar cravings.

Fenugreek (*Trigonella foenum-graecum*)

Biological Source

Fenugreek consists of the dried ripe seeds of *Trigonella foenum-graecum* L., belonging to the family Fabaceae. It is one of the oldest cultivated medicinal and culinary plants and is widely used in traditional medicine for the treatment of diabetes and digestive disorders.

Geographical Source

Fenugreek is cultivated extensively in India, Egypt, China, Morocco, and Mediterranean countries. India is one of the largest producers and consumers of fenugreek. Major cultivation areas include Rajasthan, Gujarat, Uttar Pradesh, Madhya Pradesh, and Punjab.

Macroscopic Characters

The seeds are hard, yellowish-brown, smooth, and rhomboidal in shape. Each seed possesses a deep groove on one side. They have a characteristic aromatic odor and a slightly bitter, mucilaginous taste. The seeds swell considerably when soaked in water due to their high mucilage content.

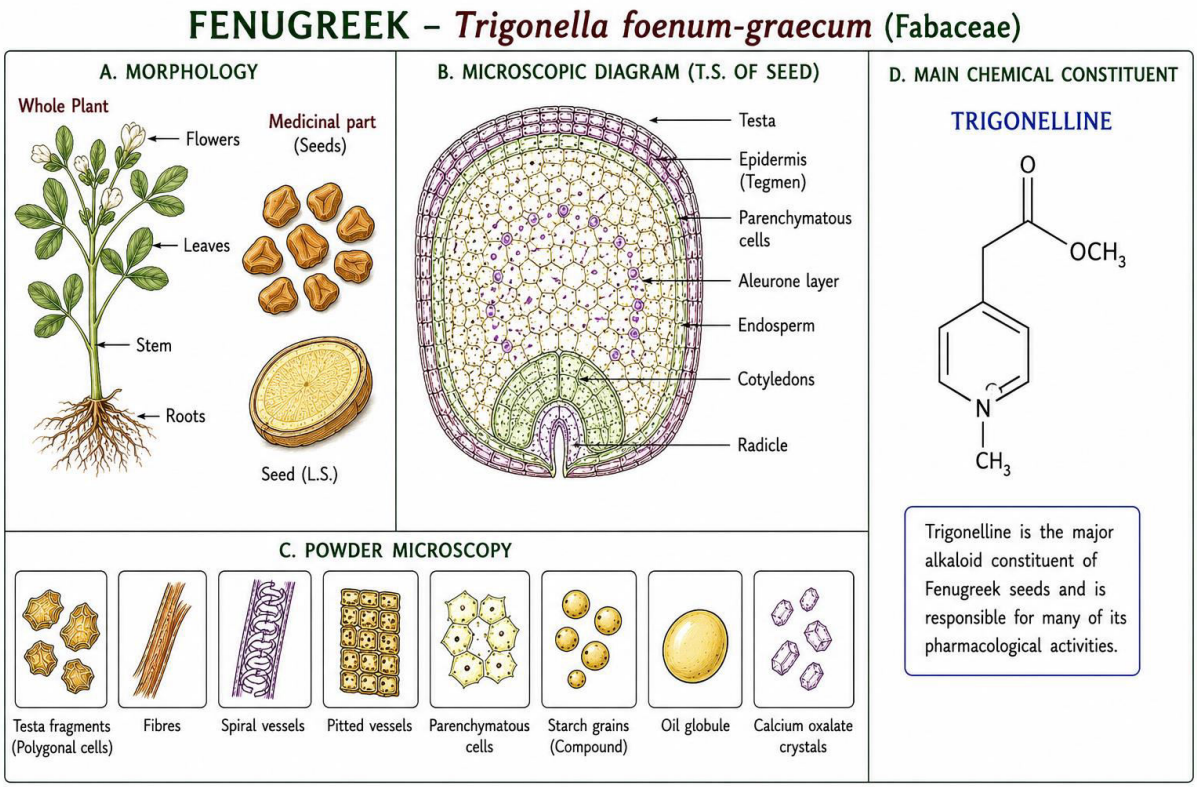

Figure 13: Morphology, Microscopy and Main active constituent of Fenugreek

Microscopic Characters

A transverse section of the seed reveals an outer testa composed of thick-walled epidermal cells. Beneath the testa lies a well-developed endosperm rich in galactomannan mucilage. The embryo is comparatively small and contains abundant protein and lipid reserves. The seed coat exhibits characteristic elongated palisade cells.

Chemical Constituents

Fenugreek seeds contain galactomannan, trigonelline, diosgenin, yamogenin, steroidal saponins, alkaloids, flavonoids, proteins, amino acids, vitamins, and fixed oils. The soluble fiber content and steroidal saponins are primarily responsible for its antidiabetic activity.

Pharmacological Activities

Fenugreek exhibits antidiabetic, hypoglycemic, hypolipidemic, antioxidant, anti-inflammatory, and gastroprotective activities. The high fiber content delays gastric emptying and glucose absorption, while trigonelline and steroidal saponins improve insulin sensitivity and glucose utilization. It also helps reduce serum cholesterol and triglyceride levels.

Uses

Fenugreek is widely used in the management of diabetes mellitus, hyperlipidemia, obesity, digestive disorders, and metabolic syndrome. It is frequently consumed as a dietary supplement or incorporated into herbal formulations for glycemic control.

PHARMACOGNOSTIC PROFILE OF ANTI-INFLAMMATORY AND ANALGESIC DRUGS

Introduction

Anti-inflammatory and analgesic drugs are therapeutic agents used to reduce inflammation and relieve pain associated with various acute and chronic disorders. Inflammation is a protective biological response of the body to injury, infection, toxins, or tissue damage. Although inflammation is essential for healing, prolonged or excessive inflammatory responses can contribute to the development of diseases such as arthritis, cardiovascular disorders, autoimmune diseases, and neurodegenerative conditions. Pain, often accompanying inflammation, serves as an important warning signal indicating tissue injury or dysfunction.

Medicinal plants have been used for centuries to manage pain and inflammatory conditions. Plant-derived anti-inflammatory and analgesic drugs contain a variety of bioactive compounds including polyphenols, flavonoids, terpenoids, curcuminoids, boswellic acids, alkaloids, and glycosides that modulate inflammatory pathways and reduce pain perception. These phytochemicals act through multiple mechanisms, making herbal medicines valuable alternatives or complementary therapies for managing inflammatory disorders.

The increasing incidence of chronic inflammatory diseases and concerns regarding the long-term adverse effects of synthetic non-steroidal anti-inflammatory drugs (NSAIDs) have renewed interest in herbal anti-inflammatory agents. Many medicinal plants possess antioxidant, immunomodulatory, and tissue-protective properties that contribute to their therapeutic efficacy.

Inflammation and Pain

Inflammation

Inflammation is the body's defensive response to harmful stimuli such as:

- Microbial infections
- Physical injury

- Chemical irritants
- Allergens
- Autoimmune reactions

Cardinal Signs of Inflammation

- Redness (*Rubor*)
- Swelling (*Tumor*)
- Heat (*Calor*)
- Pain (*Dolor*)
- Loss of function (*Functio laesa*)

Pain

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage. It may be acute or chronic and often results from inflammatory processes.

Mechanisms of Anti-inflammatory and Analgesic Action

Herbal anti-inflammatory and analgesic drugs exert their effects through several mechanisms:

- Inhibition of inflammatory mediators such as prostaglandins and leukotrienes.
- Suppression of pro-inflammatory cytokines.
- Reduction of oxidative stress through antioxidant activity.
- Inhibition of cyclooxygenase (COX) and lipoxygenase (LOX) pathways.
- Stabilization of cellular and lysosomal membranes.
- Modulation of immune responses.
- Reduction of edema and tissue swelling.
- Interference with pain transmission pathways.

Therapeutic Uses

Anti-inflammatory and analgesic herbal drugs are commonly used for:

- Arthritis and rheumatic disorders
- Joint and muscle pain
- Back pain
- Sports injuries
- Post-traumatic inflammation
- Inflammatory bowel disorders
- Autoimmune inflammatory conditions
- Headache and migraine
- General pain management

Table 5:Major Anti-inflammatory Phytochemicals

Phytochemical Class	Pharmacological Activity
Flavonoids	Anti-inflammatory, antioxidant
Polyphenols	Antioxidant, tissue protective
Curcuminoids	Anti-inflammatory, analgesic
Boswellic acids	Anti-arthritic, anti-inflammatory
Terpenoids	Anti-inflammatory, immunomodulatory
Alkaloids	Analgesic activity
Glycosides	Anti-inflammatory and pain-relieving effects
Tannins	Antioxidant and anti-inflammatory activity

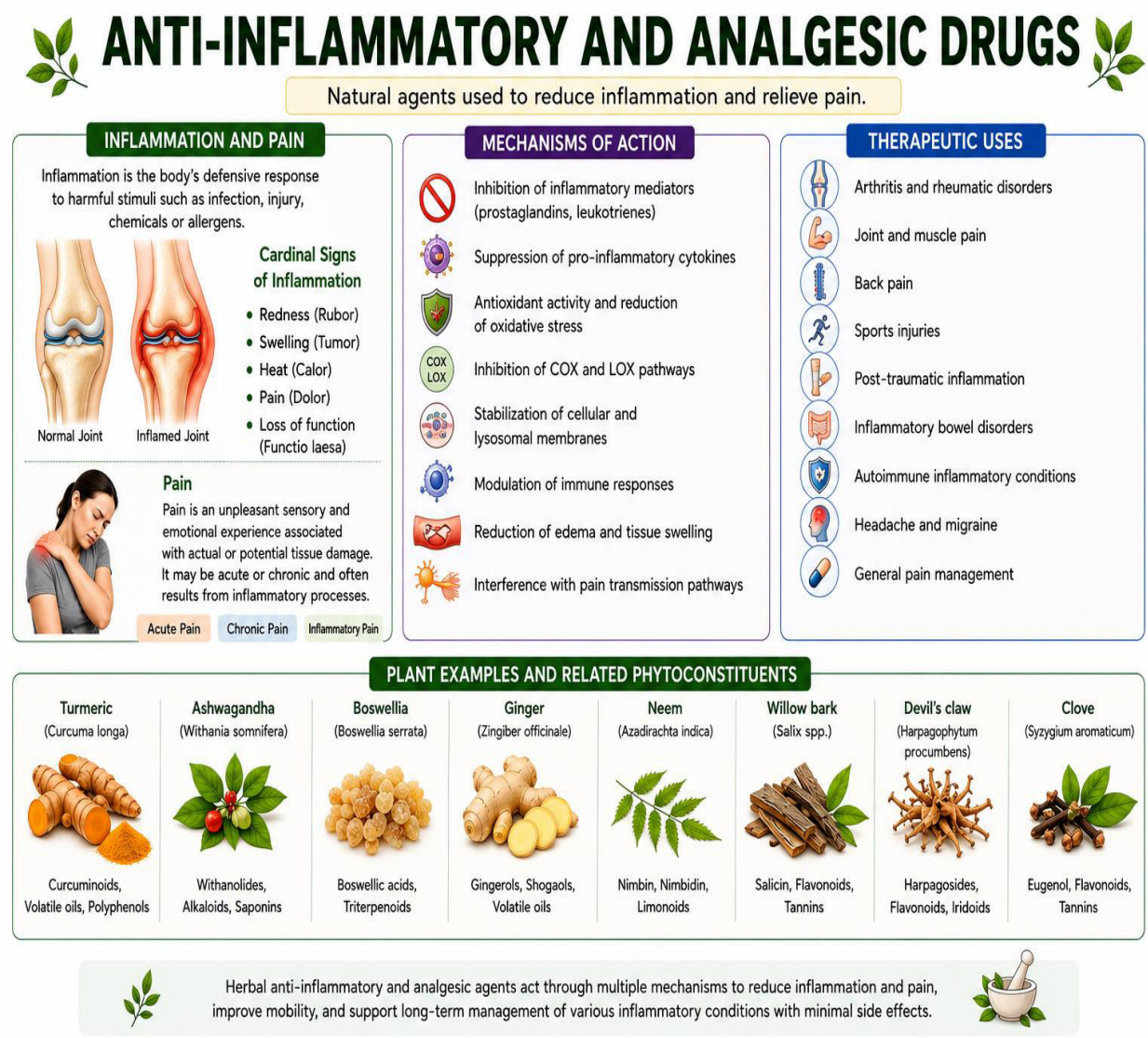

Figure 14: Anti-inflammatory and Analgesic Drugs

Turmeric (*Curcuma longa*)

Biological Source

Turmeric consists of the dried rhizomes of *Curcuma longa* L., belonging to the family Zingiberaceae. It is one of the most widely used medicinal and culinary plants in India and has been an integral part of Ayurvedic medicine for centuries.

Geographical Source

Turmeric is native to South and Southeast Asia and is extensively cultivated in India, China, Indonesia, Sri Lanka, Bangladesh, and other tropical countries. India is the largest producer and exporter of turmeric. Major cultivation areas include Andhra Pradesh, Telangana, Tamil Nadu, Karnataka, Maharashtra, and Odisha.

Macroscopic Characters

The rhizomes are cylindrical, branched, and laterally flattened. Externally, they are yellowish-brown with rough annulations and root scars. The fractured surface is bright yellow to orange-yellow and exhibits a characteristic aromatic odor. The taste is slightly bitter, warm, and pungent.

Microscopic Characters

A transverse section of the rhizome shows an outer cork layer followed by a broad cortex composed of thin-walled parenchymatous cells. Numerous starch grains and oleoresin cells are distributed throughout the ground tissue. Scattered vascular bundles are present within the parenchyma. The rhizome contains characteristic yellow pigment-containing cells responsible for its color.

Chemical Constituents

The principal active constituents of turmeric are curcuminoids, including curcumin, demethoxycurcumin, and bisdemethoxycurcumin. Other important constituents include volatile oils such as turmerone, atlantone, and zingiberene, along with proteins, sugars, and resins.

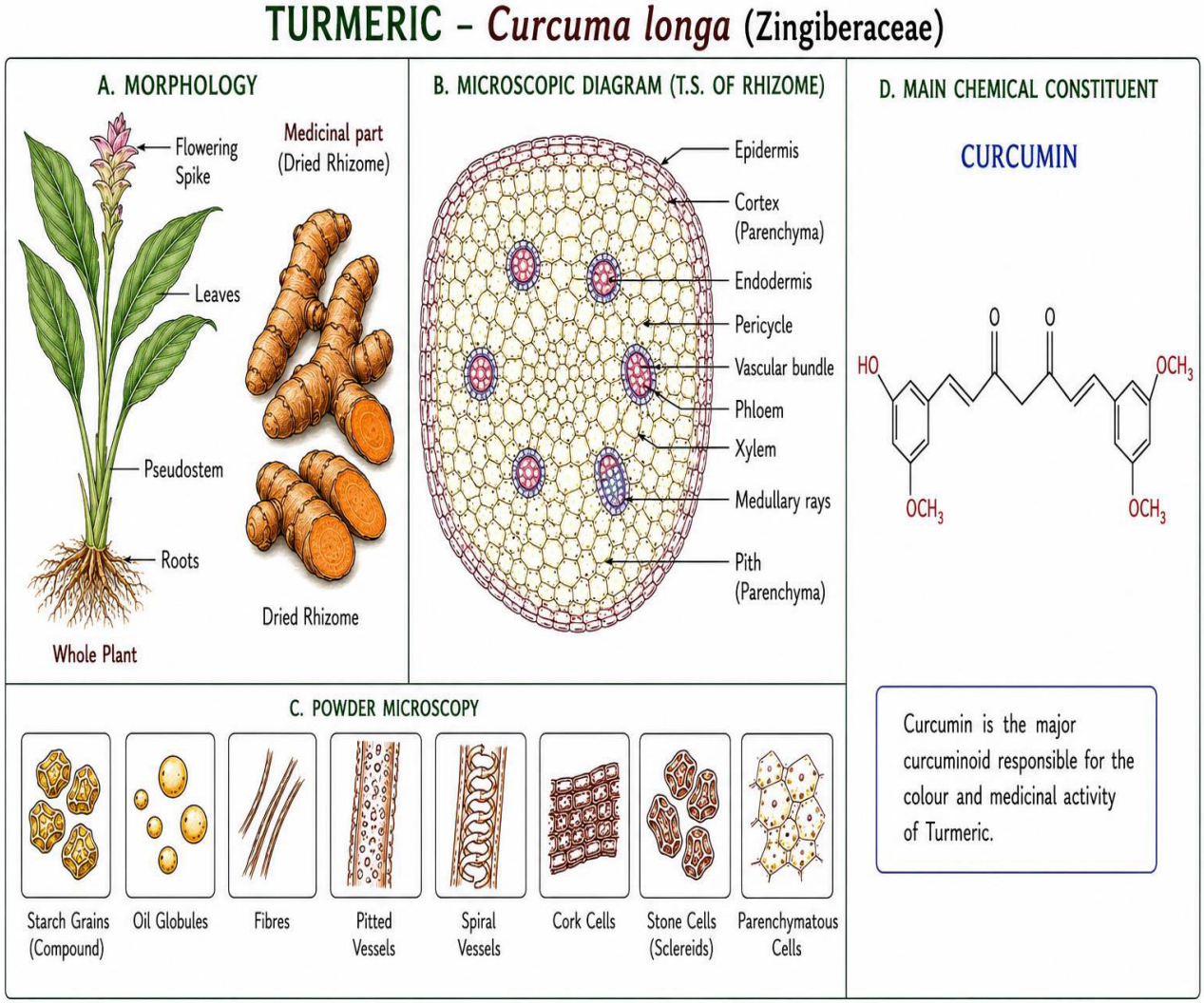

Figure 15: *Morphology, Microscopy and Main active constituent of Turmeric*

Pharmacological Activities

Turmeric exhibits potent anti-inflammatory, analgesic, antioxidant, antimicrobial, anticancer, hepatoprotective, and wound-healing activities. Curcumin inhibits inflammatory mediators such as cyclooxygenase (COX), lipoxygenase (LOX), tumor necrosis factor-alpha (TNF-α), and various cytokines. These actions contribute to reduced inflammation, pain, and tissue damage.

Uses

Turmeric is widely used in the treatment of arthritis, rheumatism, musculoskeletal pain, inflammatory bowel disorders, skin diseases, wound healing, and various chronic

inflammatory conditions. It is also used as a dietary supplement for promoting general health and immunity.

Boswellia (*Boswellia serrata*)

Biological Source

Boswellia consists of the oleo-gum-resin obtained from the stem bark of *Boswellia serrata* Roxb. ex Colebr., belonging to the family Burseraceae. The resin is commonly known as Indian Frankincense or Salai Guggul and has been used traditionally for treating inflammatory disorders.

Geographical Source

The plant is indigenous to India and is distributed in the dry hilly regions of Rajasthan, Madhya Pradesh, Gujarat, Maharashtra, and parts of South India. It is also found in certain regions of Africa and the Middle East.

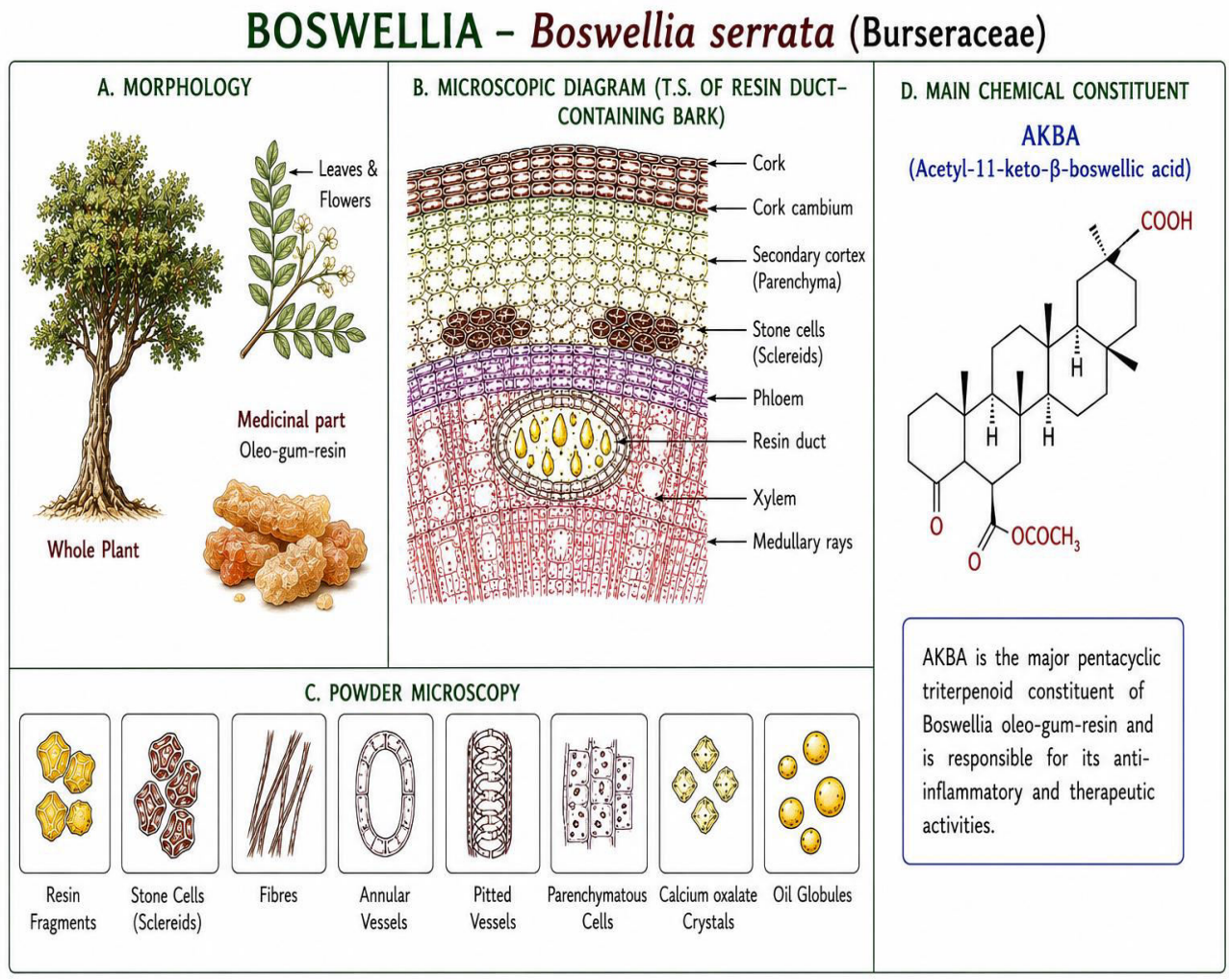

Figure 16: *Morphology, Microscopy and Main active constituent of Boswellia*

Macroscopic Characters

The oleo-gum-resin occurs as irregular tears or masses of varying size. It is yellowish-brown to golden-brown in color and possesses a characteristic balsamic odor. The resin is brittle when dry and becomes soft upon heating. It has a slightly bitter and aromatic taste.

Microscopic Characters

Microscopic Description of Boswellia (*Boswellia serrata*) Bark (T.S. of Resin Duct-Containing Bark)

- **Cork** – Outermost protective layer composed of compact, dead cells.
- **Cork Cambium (Phellogen)** – Meristematic layer responsible for cork formation.
- **Secondary Cortex (Parenchyma)** – Thin-walled parenchymatous cells serving as storage tissue.
- **Stone Cells (Sclereids)** – Thick-walled lignified cells providing mechanical strength.
- **Phloem** – Conducting tissue responsible for translocation of food materials.
- **Resin Duct** – Large secretory cavity containing oleo-gum-resin, the characteristic medicinal constituent of Boswellia.
- **Xylem** – Water-conducting tissue composed of vessels, fibers, and xylem parenchyma.
- **Medullary Rays** – Radially arranged parenchymatous cells involved in lateral transport and storage.

Diagnostic Microscopic Features

- Presence of numerous **resin ducts** filled with oleo-gum-resin.
- Abundant **sclereids (stone cells)** in cortical region.
- Well-developed **secondary phloem and xylem**.
- Distinct **medullary rays** extending through vascular tissues.
- Parenchymatous cells often containing resin and storage materials.

.

Chemical Constituents

The major active constituents are boswellic acids, including β-boswellic acid, acetyl-β-boswellic acid, 11-keto-β-boswellic acid (KBA), and acetyl-11-keto-β-boswellic acid (AKBA). Other constituents include essential oils, polysaccharides, terpenoids, and resin acids.

Pharmacological Activities

Boswellia exhibits strong anti-inflammatory, analgesic, anti-arthritic, antioxidant, immunomodulatory, and anti-edematous activities. Boswellic acids inhibit the enzyme 5-

lipoxygenase (5-LOX), thereby reducing leukotriene synthesis and suppressing inflammatory responses. This mechanism makes Boswellia particularly effective in chronic inflammatory conditions.

Uses

Boswellia is commonly used in the treatment of osteoarthritis, rheumatoid arthritis, gout, inflammatory bowel disease, asthma, musculoskeletal pain, and other chronic inflammatory disorders. It is also used to improve joint mobility and reduce swelling.

PHARMACOGNOSTIC PROFILE OF CNS DRUGS

Introduction

Central Nervous System (CNS) drugs are therapeutic agents that act on the brain and spinal cord to influence neurological functions, cognition, memory, mood, behavior, and motor activities. The central nervous system serves as the body's primary control center, coordinating sensory perception, thought processes, emotions, learning, memory, and voluntary movements. Disorders affecting the CNS can significantly impair quality of life and may lead to cognitive decline, anxiety, depression, insomnia, neurodegenerative diseases, and other neurological conditions.

Medicinal plants have been used for centuries to improve brain function and treat neurological disorders. Plant-derived CNS drugs contain a variety of bioactive compounds such as alkaloids, flavonoids, saponins, terpenoids, glycosides, and polyphenols that exert neuroprotective, antioxidant, anxiolytic, antidepressant, and cognitive-enhancing effects. These phytochemicals influence neurotransmitter systems, protect neurons from oxidative stress, and improve cerebral circulation.

The growing prevalence of neurological disorders and increasing interest in natural therapeutics have stimulated extensive research into herbal CNS agents. Many medicinal plants are now recognized for their ability to support cognitive performance, enhance memory, reduce mental fatigue, and protect against age-related neurodegeneration.

Functions of the Central Nervous System

The central nervous system performs several essential functions:

- Receives and processes sensory information.
- Controls voluntary and involuntary movements.
- Regulates learning, memory, and cognition.
- Coordinates emotions and behavior.

- Maintains consciousness and alertness.
- Controls sleep and wakefulness.
- Regulates autonomic functions through neural pathways.

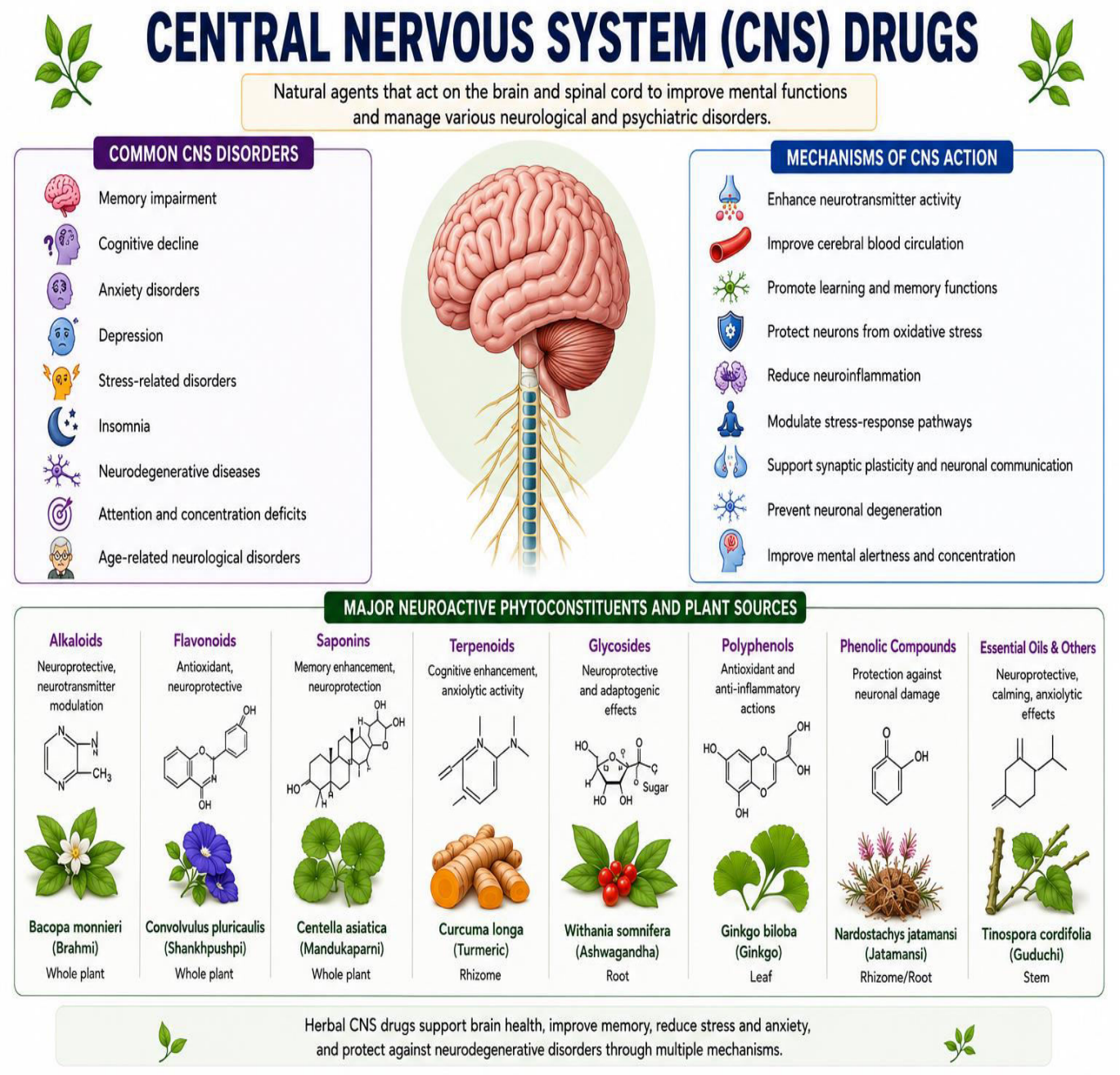

Figure 17: CNS Drugs

Common CNS Disorders

CNS drugs are used in the management of:

- Memory impairment
- Cognitive decline
- Anxiety disorders
- Depression
- Stress-related disorders
- Insomnia
- Neurodegenerative diseases
- Attention and concentration deficits

Age-related neurological disorders

Mechanisms of CNS Action

Herbal CNS drugs exert their therapeutic effects through various mechanisms:

- Enhance neurotransmitter activity.
- Improve cerebral blood circulation.
- Promote learning and memory functions.
- Protect neurons from oxidative stress.
- Reduce neuroinflammation.
- Modulate stress-response pathways.
- Support synaptic plasticity and neuronal communication.
- Prevent neuronal degeneration.
- Improve mental alertness and concentration.

Therapeutic Uses

CNS herbal drugs are commonly used for:

- Memory enhancement
- Cognitive improvement
- Stress management
- Anxiety reduction
- Learning and concentration support
- Neuroprotection
- Age-related cognitive decline
- Mental fatigue and exhaustion

Table 6: Major Neuroactive Phytochemicals

Phytochemical Class	CNS Activity
Alkaloids	Neuroprotective, neurotransmitter modulation
Flavonoids	Antioxidant, neuroprotective
Saponins	Memory enhancement, neuroprotection
Terpenoids	Cognitive enhancement, anxiolytic activity
Glycosides	Neuroprotective and adaptogenic effects
Polyphenols	Antioxidant and anti-inflammatory actions
Phenolic compounds	Protection against neuronal damage

Brahmi (*Bacopa monnieri*)

Biological Source

Brahmi consists of the whole plant of *Bacopa monnieri* (L.) Wettst., belonging to the family Plantaginaceae. It is one of the most important Medhya Rasayana (brain tonic) drugs described in Ayurveda and has been traditionally used to improve memory, intelligence, and mental performance.

Geographical Source

Brahmi is widely distributed throughout India, Nepal, Sri Lanka, China, Australia, and other tropical and subtropical regions. It commonly grows in marshy areas, wetlands, riverbanks, ponds, and damp soils. In India, it is found abundantly in states such as Uttar Pradesh, Punjab, West Bengal, Tamil Nadu, and Kerala.

Macroscopic Characters

Brahmi is a small, creeping, succulent herb with numerous branches. The stems are soft, fleshy, and spread horizontally along the ground. The leaves are simple, opposite, sessile, oblong to spatulate, and light green in color. They are thick and succulent with smooth margins. The flowers are small, solitary, axillary, and pale blue to white with five petals. The plant possesses a slightly bitter taste and a faint characteristic odor.

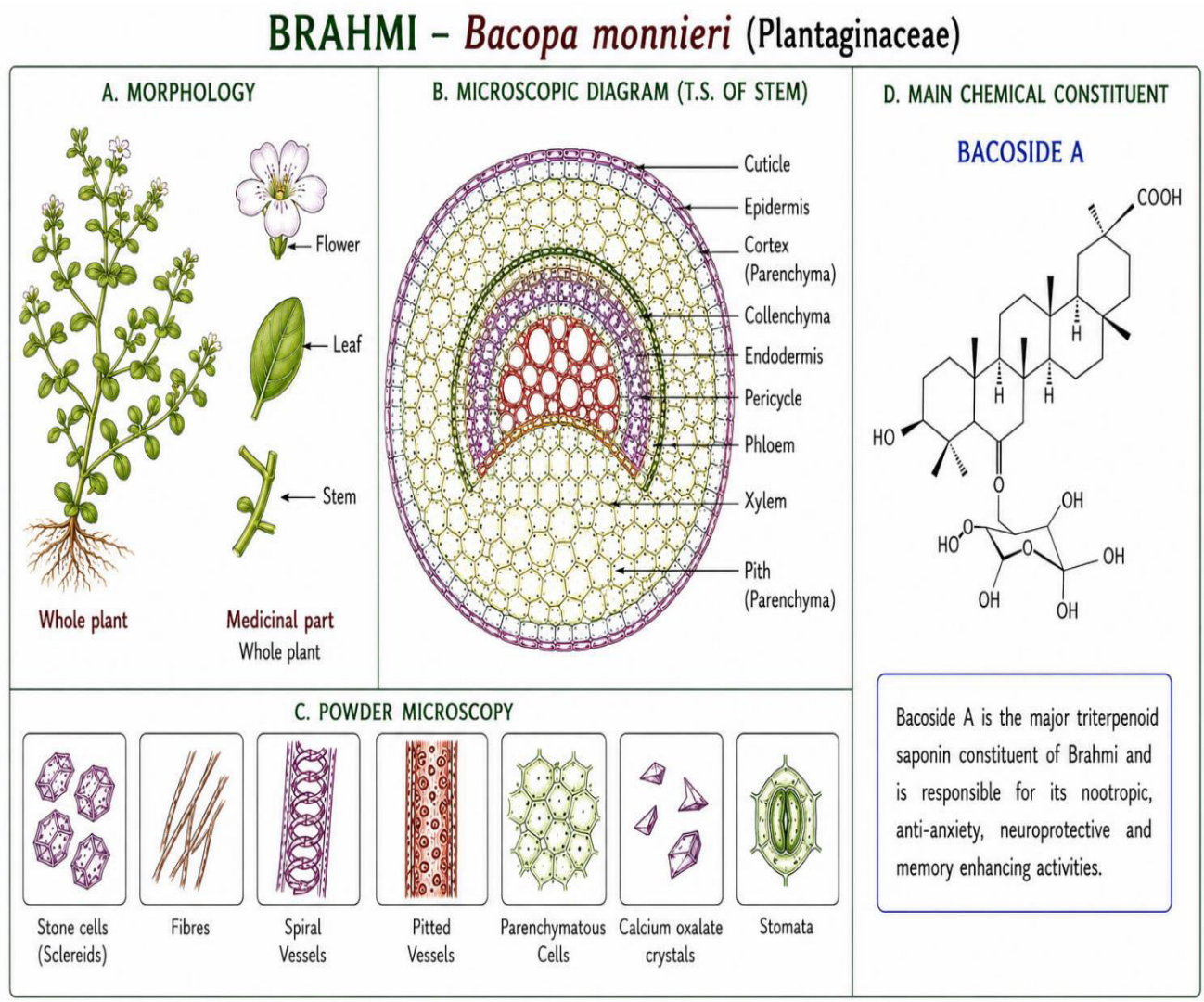

Figure 18: *Morphology, Microscopy and Main active constituent of Brahmi*

Microscopic Characters

A transverse section of the stem shows a single-layered epidermis covered with a thin cuticle. Beneath the epidermis lies the cortex composed of large parenchymatous cells with abundant intercellular spaces. Vascular bundles are arranged in a ring and consist of xylem and phloem tissues. The central pith is broad and composed of thin-walled parenchymatous cells.

The leaf shows a dorsiventral structure with upper and lower epidermis enclosing mesophyll tissue. Stomata are present on both surfaces. The mesophyll is rich in chloroplast-containing parenchymatous cells, and vascular bundles are embedded within the leaf tissue.

Chemical Constituents

The major bioactive constituents of Brahmi are triterpenoid saponins known as bacosides, particularly bacoside A and bacoside B. Other constituents include bacopasaponins, hersaponin, alkaloids such as brahmine and herpestine, flavonoids, sterols, and betulinic acid. Bacosides are considered the principal compounds responsible for the cognitive-enhancing effects of the plant.

Pharmacological Activities

Brahmi exhibits nootropic, neuroprotective, memory-enhancing, anxiolytic, adaptogenic, antioxidant, anticonvulsant, and antidepressant activities. It improves synaptic communication, enhances learning and memory retention, and protects neurons against oxidative stress. Brahmi also helps reduce anxiety and mental fatigue while supporting cognitive performance and concentration.

Research has shown that bacosides promote neuronal repair, improve neurotransmitter function, and enhance cerebral blood circulation, thereby contributing to improved cognitive function and mental alertness.

Uses

Brahmi is widely used in the management of memory impairment, learning difficulties, anxiety, stress, attention deficit disorders, age-related cognitive decline, and neurodegenerative conditions. It is commonly prescribed as a brain tonic for students and elderly individuals to improve concentration, intelligence, and mental performance. Brahmi is also an important ingredient in numerous Ayurvedic formulations designed for enhancing cognition and nervous system health.

Antimicrobial and Antiviral Drugs

Introduction

Antimicrobial and antiviral drugs are therapeutic agents used to prevent, control, and treat infections caused by microorganisms such as bacteria, fungi, viruses, and other pathogens. Infectious diseases remain a major global health challenge, and the emergence of antimicrobial resistance has increased the need for safer and more effective therapeutic alternatives. Medicinal plants have been used traditionally for centuries to combat infections and strengthen the body's natural defense mechanisms.

Plant-derived antimicrobial and antiviral drugs contain a wide variety of bioactive compounds, including alkaloids, flavonoids, terpenoids, tannins, glycosides, phenolic compounds, essential oils, and polysaccharides. These phytochemicals inhibit the growth and multiplication of microorganisms, interfere with pathogen metabolism, enhance immune responses, and protect host tissues from infection-induced damage.

Unlike many conventional antimicrobial agents that act on a single target, herbal drugs often possess multiple mechanisms of action, making them valuable in combating a broad spectrum of pathogens. Their antioxidant, anti-inflammatory, and immunomodulatory properties further contribute to their therapeutic effectiveness.

Microbial and Viral Infections

Microbial Infections

Microbial infections are caused by disease-producing microorganisms such as:

- Bacteria
- Fungi
- Protozoa
- Parasites

Viral Infections

Viral infections occur when viruses invade host cells and utilize cellular machinery for replication.

Common examples include:

- Influenza
- Common cold
- Viral fever
- Hepatitis
- Herpes infections
- Respiratory viral infections

Mechanisms of Antimicrobial and Antiviral Action

Herbal antimicrobial and antiviral drugs exert their effects through various mechanisms:

- Inhibit growth and multiplication of microorganisms.
- Disrupt microbial cell walls and cell membranes.
- Interfere with microbial enzyme systems.
- Inhibit viral attachment and entry into host cells.
- Prevent viral replication and protein synthesis.
- Reduce microbial toxin production.
- Enhance host immune responses.
- Provide antioxidant protection against infection-induced damage.
- Reduce inflammation associated with infections.

Table 7: Major Antimicrobial and Antiviral Phytochemicals

Phytochemical Class	Biological Activity
Alkaloids	Antibacterial, antiviral
Flavonoids	Antimicrobial, antioxidant
Terpenoids	Antiviral, antifungal
Tannins	Antimicrobial, astringent
Phenolic compounds	Antioxidant, antimicrobial
Essential oils	Antibacterial, antifungal, antiviral
Glycosides	Antimicrobial activity
Polysaccharides	Immunomodulatory and antiviral effects

Giloy (*Tinospora cordifolia*)

Biological Source

Giloy consists of the dried mature stems of *Tinospora cordifolia* (Willd.) Miers, belonging to the family Menispermaceae. It is commonly known as Guduchi or Amrita and is highly valued in Ayurveda for its immunomodulatory and anti-infective properties.

Geographical Source

Giloy is distributed throughout tropical and subtropical regions of India, Sri Lanka, Myanmar, and China. It commonly grows as a climbing shrub on large trees, particularly neem and mango trees.

Macroscopic Characters

The stem is succulent, cylindrical, and grayish-brown in color. It bears characteristic warty protuberances and longitudinal wrinkles on the surface. The stem fracture is fibrous and exhibits a mucilaginous texture. The taste is distinctly bitter.

Microscopic Characters

A transverse section of the stem shows a cork layer followed by cortex composed of parenchymatous cells. Numerous starch grains are present throughout the cortex and medullary region. Vascular bundles are arranged radially, and large medullary rays are prominent. The stem contains characteristic rosette-shaped starch grains.

Chemical Constituents

The major constituents include diterpenoid lactones such as tinosporin, tinosporide, cordifolide, and cordifol. Other constituents include alkaloids, glycosides, steroids, polysaccharides, flavonoids, and phenolic compounds.

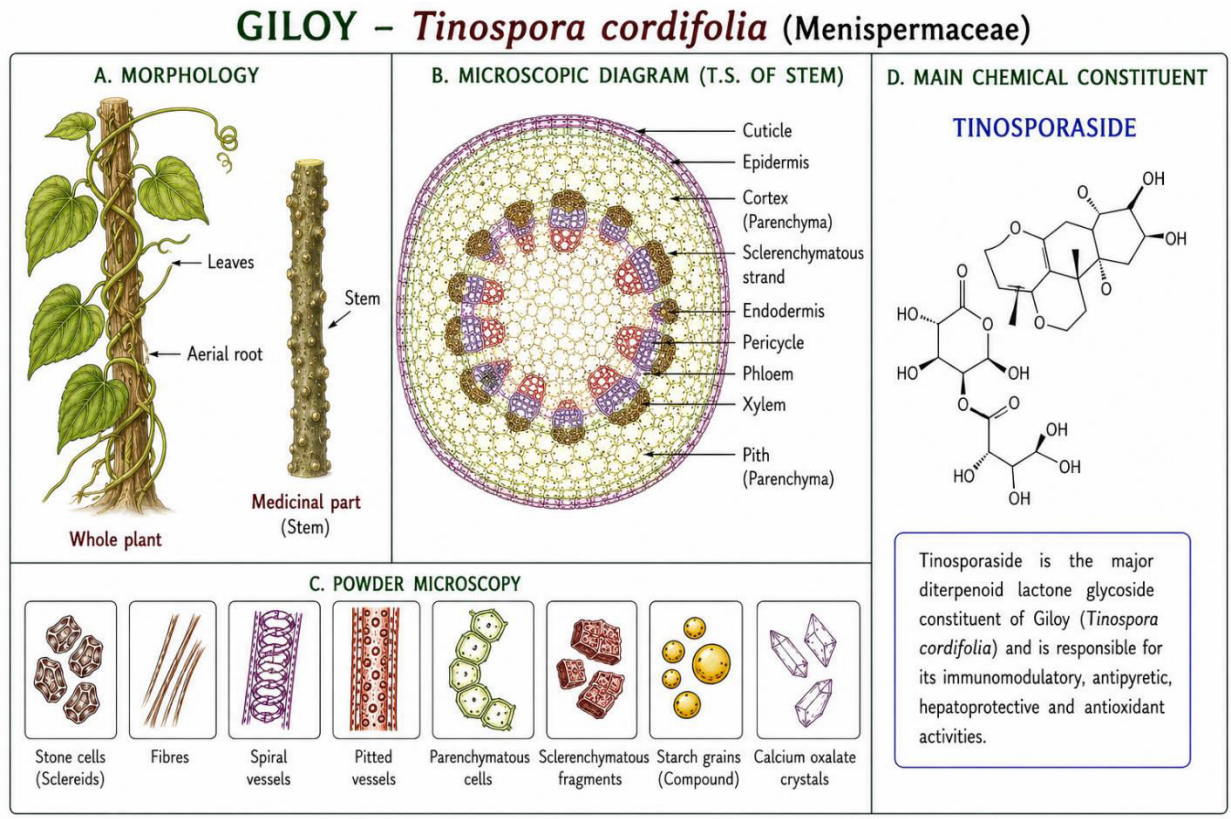

Figure 19 *Morphology, Microscopy and Main active constituent of Giloy*

Pharmacological Activities

Giloy exhibits antimicrobial, antiviral, immunomodulatory, antipyretic, anti-inflammatory, antioxidant, and hepatoprotective activities. It enhances immune responses, inhibits microbial growth, and improves resistance against infections. Its immunostimulatory effects contribute significantly to its antiviral activity.

Uses

Giloy is used in recurrent infections, fever, respiratory tract infections, viral illnesses, immune deficiency conditions, and general debility. It is also widely employed as an immune booster and rejuvenating tonic.

Neem (*Azadirachta indica*)

Biological Source

Neem consists primarily of the leaves, bark, seeds, and seed oil obtained from *Azadirachta indica* A. Juss., belonging to the family Meliaceae. It is one of the most versatile medicinal plants and is widely known for its antimicrobial properties.

Geographical Source

Neem is native to the Indian subcontinent and is extensively distributed throughout India, Pakistan, Bangladesh, Sri Lanka, and many tropical regions of Africa, America, and Australia.

Macroscopic Characters

The leaves are compound, pinnate, and bright green in color. Individual leaflets are lanceolate with serrated margins and pointed apices. The bark is rough, grayish-brown externally, and fibrous internally. The leaves possess a characteristic bitter taste.

Microscopic Characters

The leaf shows a dorsiventral structure with upper and lower epidermis covered by a cuticle. Stomata are mainly present on the lower epidermis. The mesophyll is differentiated into palisade and spongy tissues. Calcium oxalate crystals and vascular bundles are commonly observed.

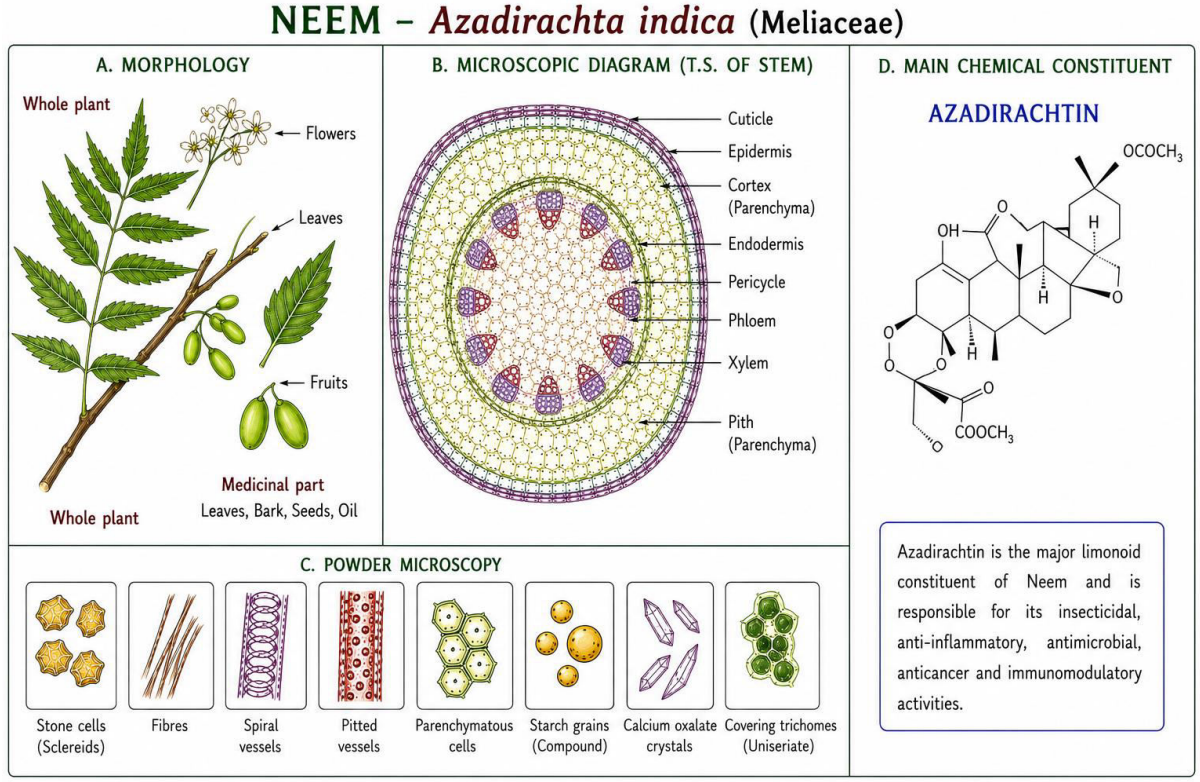

Figure 20: Morphology, Microscopy and Main active constituent of Neem

Chemical Constituents

Neem contains limonoids such as azadirachtin, nimbin, nimbidin, salannin, and gedunin. Other constituents include flavonoids, tannins, steroids, essential oils, and polysaccharides.

Pharmacological Activities

Neem exhibits broad-spectrum antibacterial, antiviral, antifungal, antiparasitic, anti-inflammatory, antioxidant, and immunomodulatory activities. Its bioactive constituents inhibit the growth of various pathogenic microorganisms and contribute to enhanced host defense mechanisms.

Uses

Neem is widely used in skin infections, fungal infections, dental disorders, wound healing, viral infections, and various infectious diseases. It is also employed in personal care products and herbal formulations aimed at improving immunity and skin health.

Andrographis (*Andrographis paniculata*)

Biological Source

Andrographis consists of the dried whole plant or aerial parts of *Andrographis paniculata* (Burm.f.) Nees, belonging to the family Acanthaceae. It is commonly known as Kalmegh and is recognized for its intense bitterness and potent anti-infective properties.

Geographical Source

The plant is widely distributed throughout India, Sri Lanka, China, Thailand, Malaysia, and other tropical Asian countries. It is commonly cultivated as a medicinal herb in many regions.

Macroscopic Characters

Andrographis is an erect annual herb with slender green stems. The leaves are simple, opposite, lanceolate, and dark green in color. The flowers are small, white, and borne in terminal panicles. The entire plant possesses an intensely bitter taste.

Microscopic Characters

A transverse section of the stem shows an epidermis covered with a cuticle, followed by cortex and vascular tissues arranged in a ring. The leaves exhibit dorsiventral anatomy with palisade and spongy mesophyll. Glandular structures and vascular bundles are distinctly visible.

Chemical Constituents

The major active constituents are diterpene lactones, particularly andrographolide, neoandrographolide, deoxyandrographolide, and andrographiside. The plant also contains flavonoids, polyphenols, and other bitter principles.

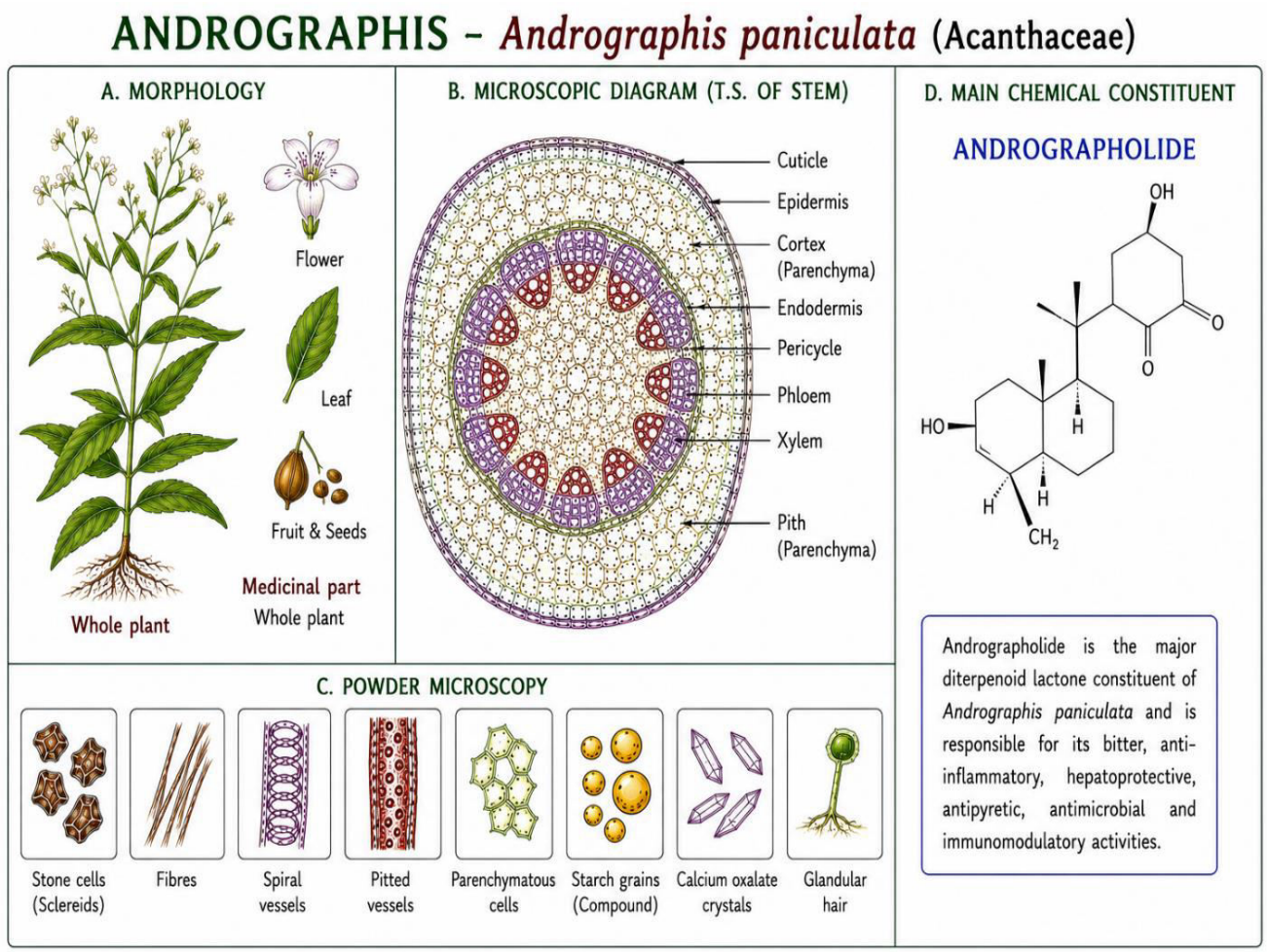

Figure 21: Morphology, Microscopy and Main active constituent of Andrographis

Pharmacological Activities

Andrographis exhibits antiviral, antibacterial, anti-inflammatory, antipyretic, antioxidant, immunomodulatory, and hepatoprotective activities. Andrographolide is responsible for many of its therapeutic effects and has demonstrated activity against several viral and bacterial pathogens.

Uses

Andrographis is used in upper respiratory tract infections, influenza, fever, sore throat, gastrointestinal infections, and various viral illnesses. It is also employed as an immune-enhancing and liver-protective agent.

Gastrointestinal Drugs

Introduction

Gastrointestinal drugs are therapeutic agents used for the prevention and treatment of disorders affecting the digestive system. The gastrointestinal (GI) tract is responsible for digestion, absorption of nutrients, secretion of digestive enzymes, and elimination of waste products. Disorders of the digestive system can impair nutrient absorption and significantly affect overall health.

Medicinal plants have long been used to support digestive health and manage gastrointestinal disorders. Plant-derived gastrointestinal drugs contain bioactive compounds such as mucilage, flavonoids, tannins, alkaloids, terpenoids, glycosides, and essential oils that help protect the gastrointestinal mucosa, regulate bowel movements, reduce inflammation, and improve digestive functions.

Common Gastrointestinal Disorders

- Constipation
- Diarrhea
- Irritable bowel syndrome (IBS)
- Gastritis
- Peptic ulcer
- Indigestion
- Acid reflux
- Inflammatory bowel disorders

Mechanisms of Gastrointestinal Action

- Promote bowel regularity.
- Increase stool bulk and water retention.
- Protect gastrointestinal mucosa.
- Reduce gastric irritation and inflammation.
- Improve digestion and nutrient absorption.
- Regulate intestinal motility.
- Support healthy gut microbiota.

Therapeutic Uses

- Management of constipation
- Relief of indigestion and dyspepsia
- Treatment of gastrointestinal inflammation
- Maintenance of digestive health
- Supportive therapy in bowel disorders

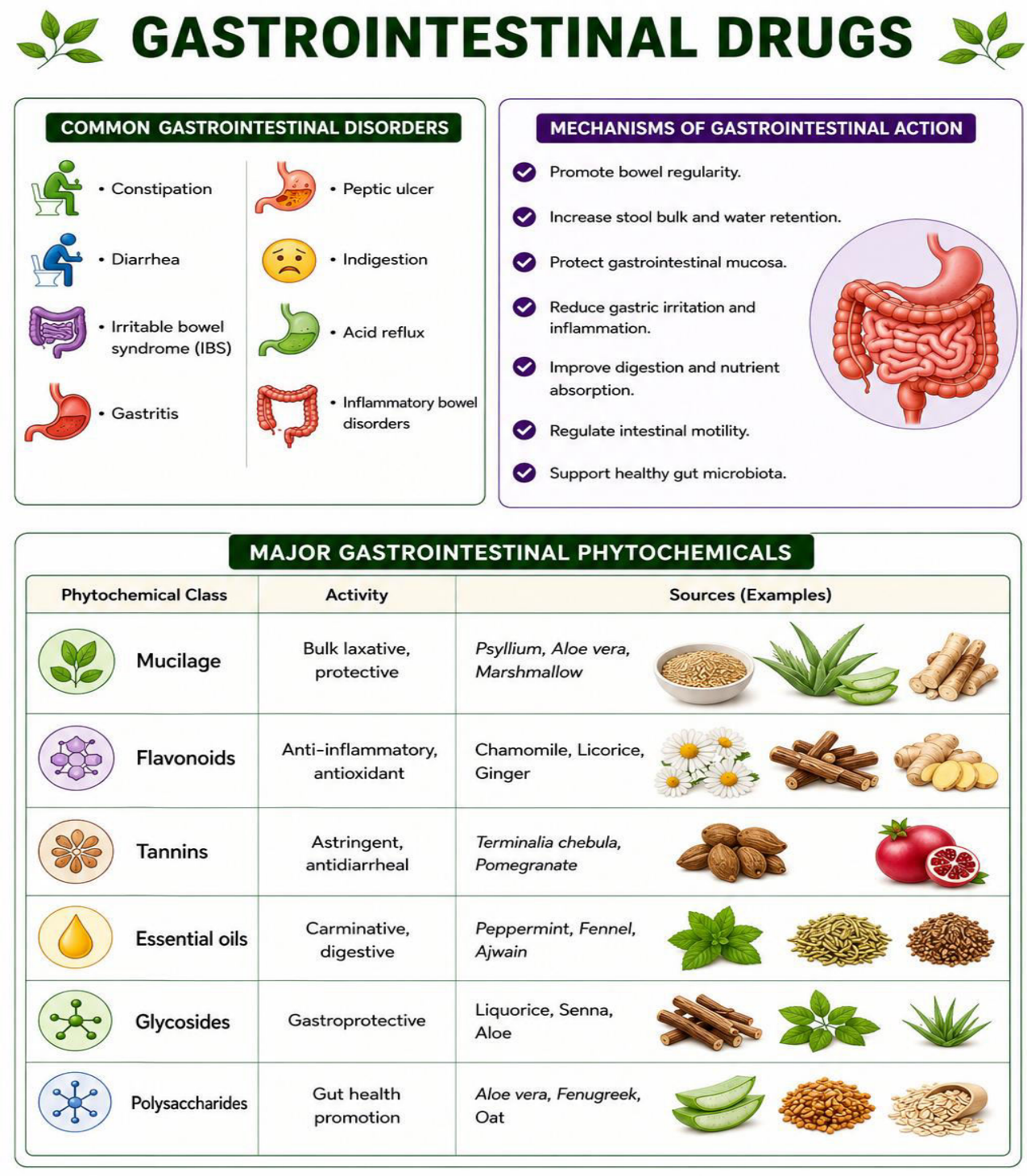

Figure 22: Gastrointestinal Drugs

Table 8: Major Gastrointestinal Phytochemicals

Phytochemical Class	Activity
Mucilage	Bulk laxative, protective
Flavonoids	Anti-inflammatory, antioxidant
Tannins	Astringent, antidiarrheal
Essential oils	Carminative, digestive
Glycosides	Gastroprotective
Polysaccharides	Gut health promotion

Psyllium (*Plantago ovata*)

Biological Source

Psyllium consists of the dried ripe seeds and seed husks obtained from *Plantago ovata* Forssk., belonging to the family Plantaginaceae. The husk, which is the outer epidermal covering of the seed, is particularly valued for its high mucilage content and medicinal properties. Psyllium is commonly known as Isabgol and is extensively used in traditional and modern medicine.

Geographical Source

Psyllium is native to the Mediterranean region and Western Asia but is cultivated extensively in India, Pakistan, Iran, and several other countries. India is the world's largest producer and exporter of Psyllium. Major cultivation areas include Gujarat, Rajasthan, Madhya Pradesh, and Haryana.

Macroscopic Characters

The seeds are small, smooth, boat-shaped, and oval in appearance. They are pale pink, light brown, or grayish-brown in color and possess a glossy surface. One side of the seed is convex, while the other side is slightly concave. The seeds are odorless and nearly tasteless. The husk is thin, translucent, whitish, and swells considerably when placed in water due to its high mucilage content.

Microscopic Characters

A transverse section of the seed reveals an outer epidermis composed of elongated mucilage-containing cells. Beneath the epidermis lies the testa followed by endosperm and embryo. The mucilage cells swell rapidly upon contact with water, forming a gelatinous mass. The endosperm contains reserve food materials, while the embryo occupies the central region of the seed.

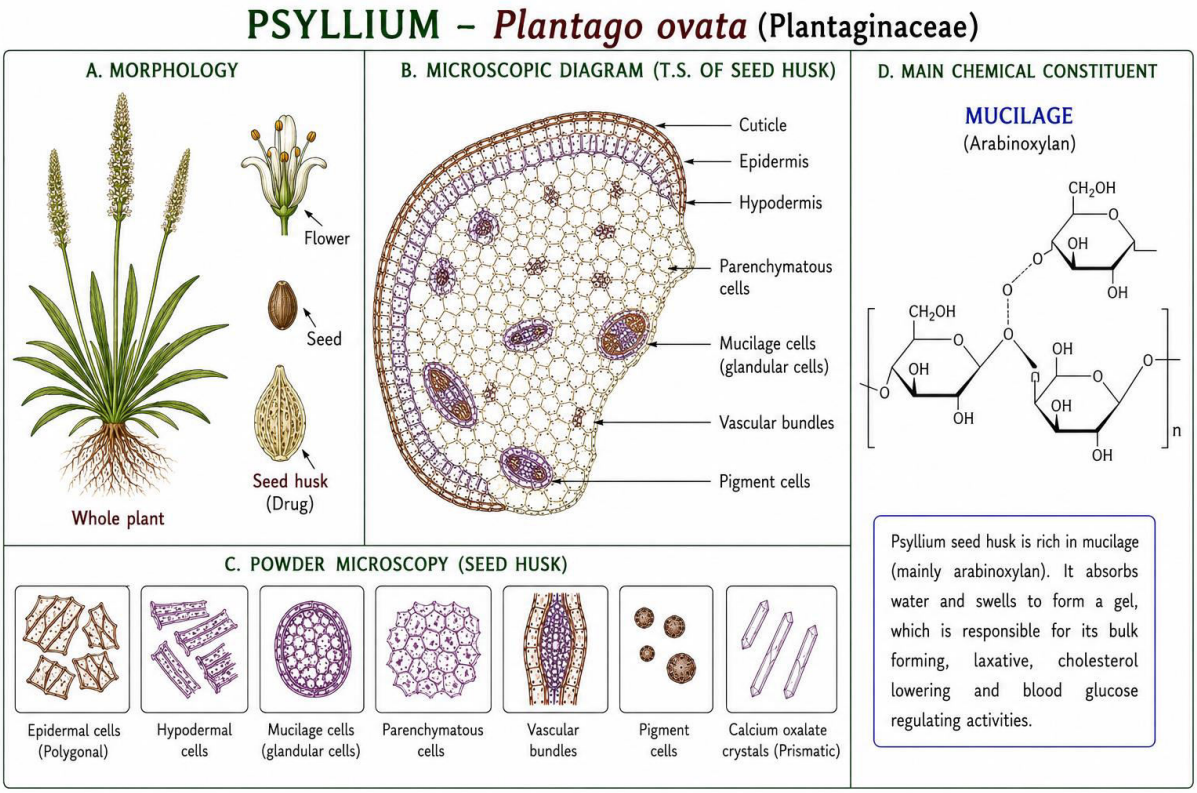

Figure 23: Morphology, Microscopy and Main active constituent of of Psyllium

Chemical Constituents

The principal constituent of Psyllium is mucilage, which consists mainly of arabinoxylans and other polysaccharides. The seeds also contain fixed oils, proteins, sterols, carbohydrates, tannins, and trace amounts of glycosides. The husk contains approximately 20–30% mucilage, which is responsible for its therapeutic activity.

Pharmacological Activities

Psyllium exhibits bulk-forming laxative, demulcent, anti-diarrheal, hypocholesterolemic, prebiotic, and gastroprotective activities. When mixed with water, the mucilage absorbs large amounts of liquid and forms a soft gel-like mass that increases the bulk of intestinal contents and facilitates bowel movements. It also helps regulate intestinal transit time and supports the growth of beneficial gut microorganisms.

In addition to its laxative action, Psyllium has been shown to reduce serum cholesterol levels, improve glycemic control, and contribute to cardiovascular health. Its soothing and protective effect on the gastrointestinal mucosa makes it useful in various digestive disorders.

Uses

Psyllium is widely used in the management of chronic constipation, irritable bowel syndrome (IBS), hemorrhoids, diverticular disease, and other bowel disorders. It is also employed as a dietary fiber supplement to improve digestive health and regulate bowel function. Due to its ability to absorb water and form a gel, it is useful in both constipation and mild diarrhea. Furthermore, Psyllium is frequently recommended for lowering cholesterol levels and supporting metabolic health.

PHARMACOGNOSTIC PROFILE OF DERMATOLOGICAL AGENTS

Introduction

Dermatological agents are therapeutic substances used for maintaining skin health and treating skin disorders. The skin is the largest organ of the body and serves as a protective barrier against physical, chemical, and microbial damage. Medicinal plants are widely used in dermatology due to their wound-healing, antimicrobial, anti-inflammatory, antioxidant, and moisturizing properties.

Plant-derived dermatological agents contain bioactive constituents such as polysaccharides, flavonoids, anthraquinones, tannins, terpenoids, and vitamins that promote skin repair and regeneration.

Common Skin Disorders

- Wounds and burns
- Acne
- Dermatitis
- Eczema
- Psoriasis
- Skin infections
- Dry skin
- Sun damage

Mechanisms of Dermatological Action

- Accelerate wound healing.
- Promote skin regeneration.
- Reduce inflammation and irritation.
- Provide antimicrobial protection.
- Enhance skin hydration.
- Protect against oxidative damage.
- Support collagen synthesis.

Therapeutic Uses

- Wound healing
- Burn management
- Moisturizing dry skin
- Treatment of inflammatory skin disorders
- Management of minor skin infections
- Skin rejuvenation

Table 9: Major Dermatological Phytochemicals

Phytochemical Class	Activity
Polysaccharides	Wound healing, moisturizing
Flavonoids	Antioxidant, anti-inflammatory
Anthraquinones	Antimicrobial
Tannins	Astringent, healing
Terpenoids	Anti-inflammatory
Vitamins	Skin nourishment

Aloe (*Aloe vera*)

Biological Source

Aloe consists of the dried juice and fresh mucilaginous gel obtained from the leaves of *Aloe vera* (L.) Burm.f. (syn. *Aloe barbadensis* Miller), belonging to the family Asphodelaceae. The inner parenchymatous leaf tissue yields the clear gel, whereas the yellow latex present beneath the leaf rind contains anthraquinone compounds.

Geographical Source

Aloe vera is believed to have originated in North Africa and the Arabian Peninsula but is now cultivated worldwide in tropical and subtropical regions. In India, it is extensively cultivated in Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu, and other states due to its medicinal and commercial importance.

Macroscopic Characters

The plant is a perennial succulent herb with a short stem and a rosette of thick, fleshy leaves. The leaves are lanceolate, green to grayish-green in color, and possess serrated margins with small spiny teeth. The leaf surface is smooth and covered by a waxy cuticle. On cutting the leaf, a transparent, colorless, mucilaginous gel is released from the inner tissue, while a yellow bitter latex is obtained from the outer layer beneath the rind.

Microscopic Characters

A transverse section of the leaf shows an outer epidermis covered with a thick cuticle that helps reduce water loss. Beneath the epidermis lies chlorenchymatous tissue followed by large parenchymatous cells containing mucilage. Vascular bundles are scattered within the mesophyll region. The latex-containing pericyclic cells are located near the vascular bundles and contain anthraquinone glycosides. Calcium oxalate crystals may also be present in the parenchymatous tissue.

Figure 24: Dermatological Agents

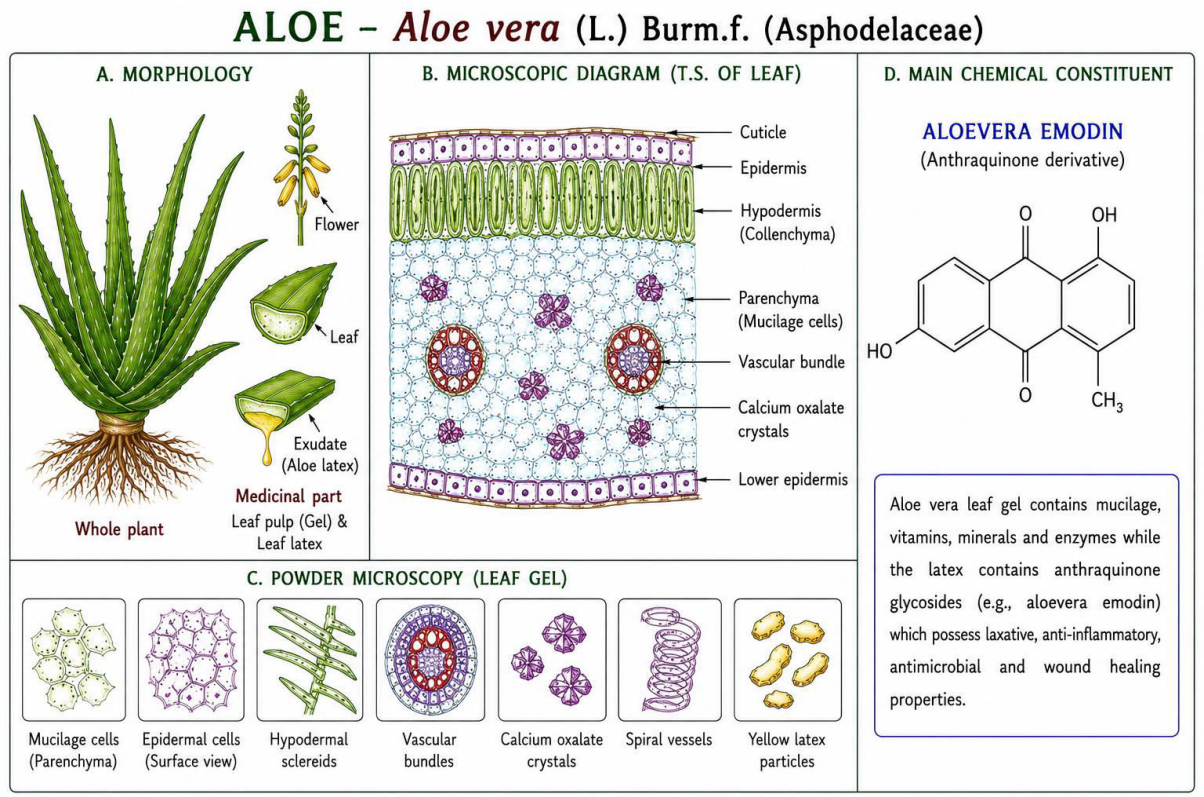

Figure 25: Morphology, Microscopy and Main active constituent of Aloe

Chemical Constituents

Aloe contains numerous biologically active compounds. The gel is rich in polysaccharides, particularly acemannan and glucomannan, along with amino acids, vitamins, enzymes, minerals, and glycoproteins. The latex contains anthraquinone derivatives such as aloin, aloe-

emodin, and barbaloin. Other constituents include sterols, flavonoids, saponins, and phenolic compounds.

Pharmacological Activities

Aloe exhibits wound-healing, anti-inflammatory, antimicrobial, antioxidant, moisturizing, immunomodulatory, and skin-protective activities. The polysaccharides present in the gel stimulate fibroblast proliferation, collagen synthesis, and tissue regeneration, thereby accelerating wound healing. Aloe also reduces inflammation, soothes irritated skin, and provides protection against microbial infections. Its moisturizing properties help maintain skin hydration and elasticity.

Uses

Aloe is widely used in the treatment of burns, sunburns, wounds, cuts, abrasions, psoriasis, eczema, acne, and various inflammatory skin conditions. It is a common ingredient in creams, lotions, gels, shampoos, soaps, and cosmetic preparations. Aloe gel is also applied to promote skin hydration, improve wound healing, reduce scarring, and maintain healthy skin. The latex portion has traditionally been used as a stimulant laxative, although its dermatological applications are primarily associated with the gel.

DRUGS USED IN WOMEN'S HEALTH

Introduction

Drugs used in women's health are phyto-therapeutic agents that support female reproductive health, hormonal balance, pregnancy-related wellness, and menopausal health. These medicinal plants contain various phytochemicals capable of influencing endocrine and reproductive functions.

Plant-derived agents used in women's health are rich in phytoestrogens, saponins, flavonoids, alkaloids, and steroidal compounds that help maintain reproductive well-being and hormonal equilibrium.

Common Women's Health Conditions

- Menstrual disorders
- Premenstrual syndrome (PMS)
- Menopausal symptoms
- Hormonal imbalance
- Infertility
- Reproductive health disorders
- Lactation support

Mechanisms of Action

- Modulate hormonal balance.
- Support reproductive functions.
- Regulate menstrual cycles.
- Reduce menopausal discomfort.
- Promote reproductive tissue health.
- Provide antioxidant and adaptogenic effects.

Therapeutic Uses

- Menstrual health support
- Management of menopausal symptoms
- Reproductive wellness
- Hormonal regulation
- Support during pregnancy and lactation
- Improvement of female vitality

Table 10: Major Phytochemicals

Phytochemical Class	**Activity**
Phytoestrogens	Hormonal regulation
Saponins	Reproductive support
Flavonoids	Antioxidant activity
Steroidal compounds	Endocrine modulation
Alkaloids	Hormonal balance
Glycosides	Reproductive health support

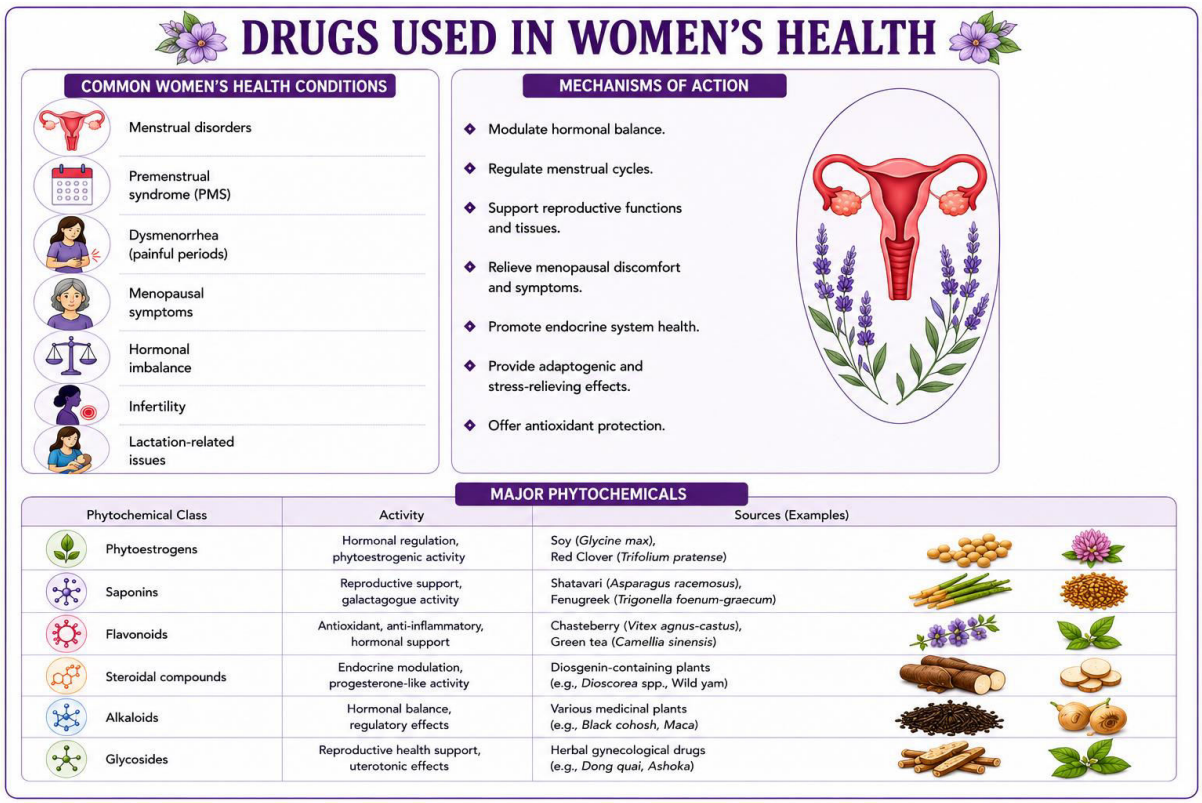

Figure 26: Drugs Used in Wound Healing

Chasteberry (*Vitex agnus-castus*)

Biological Source

Chasteberry consists of the dried ripe fruits of *Vitex agnus-castus* L., belonging to the family Lamiaceae (formerly Verbenaceae). It has been used for centuries in traditional European medicine for the management of various gynecological disorders and hormonal imbalances.

Geographical Source

The plant is native to the Mediterranean region, Southern Europe, and Western Asia. It is cultivated in many temperate regions of Europe, North America, and Australia for medicinal purposes.

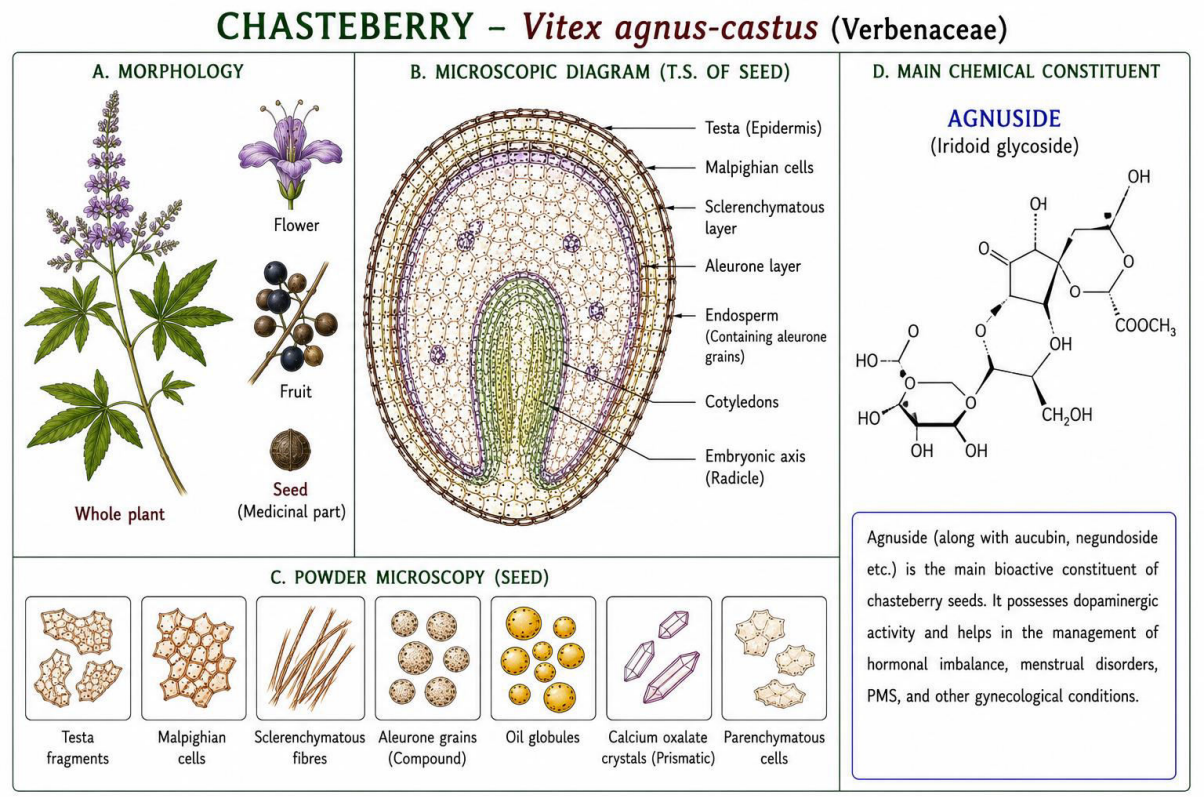

Figure 27: Morphology, Microscopy and Main active constituent of CHestberry

Macroscopic Characters

The fruits are small, spherical to ovoid drupes measuring about 3–5 mm in diameter. They are dark brown to black in color and possess a wrinkled surface. The fruits have a characteristic aromatic odor and a slightly pungent, bitter taste resembling pepper.

Microscopic Characters

A transverse section of the fruit reveals an outer epicarp composed of epidermal cells covered by a cuticle. The mesocarp contains parenchymatous tissue, while the endocarp is hard and sclerenchymatous. Oil glands and secretory cells containing volatile oils are present within the fruit tissues. The seed contains abundant fixed oils and storage materials.

Chemical Constituents

The major constituents of Chasteberry include iridoid glycosides such as agnuside and aucubin, flavonoids including casticin, vitexin, and penduletin, volatile oils, diterpenes, and fixed oils. These compounds contribute to its hormonal regulatory activity.

Pharmacological Activities

Chasteberry exhibits hormonal balancing, dopaminergic, anti-inflammatory, antioxidant, and mild sedative activities. It influences the hypothalamic-pituitary axis and helps regulate prolactin secretion, thereby supporting normal menstrual and reproductive function. It is particularly beneficial in conditions associated with hormonal imbalance.

Uses

Chasteberry is widely used in the management of premenstrual syndrome (PMS), menstrual irregularities, dysmenorrhea, mastalgia (breast pain), infertility associated with luteal phase defects, and menopausal symptoms. It is also used to support overall reproductive health and hormonal balance in women.

Shatavari (*Asparagus racemosus*)

Biological Source

Shatavari consists of the dried tuberous roots of *Asparagus racemosus* Willd., belonging to the family Asparagaceae. It is one of the most important female rejuvenative herbs in Ayurveda and is often referred to as the "Queen of Herbs" for women's health.

Geographical Source

Shatavari is widely distributed throughout India, Sri Lanka, Nepal, and parts of Southeast Asia. It grows naturally in tropical and subtropical forests and is also cultivated for medicinal use.

Macroscopic Characters

The roots are numerous, fleshy, cylindrical, tapering, and tuberous. They are cream to pale yellow in color and possess longitudinal wrinkles on the surface. The roots are soft when fresh but become hard upon drying. They have a mild characteristic odor and a slightly sweet, bitter taste.

Microscopic Characters

A transverse section of the root shows a multilayered epidermis followed by cortex composed of thin-walled parenchymatous cells containing starch grains. Vascular tissues are arranged radially. Mucilage cells and calcium oxalate crystals are commonly present. The root contains abundant storage tissue rich in carbohydrates and medicinal constituents.

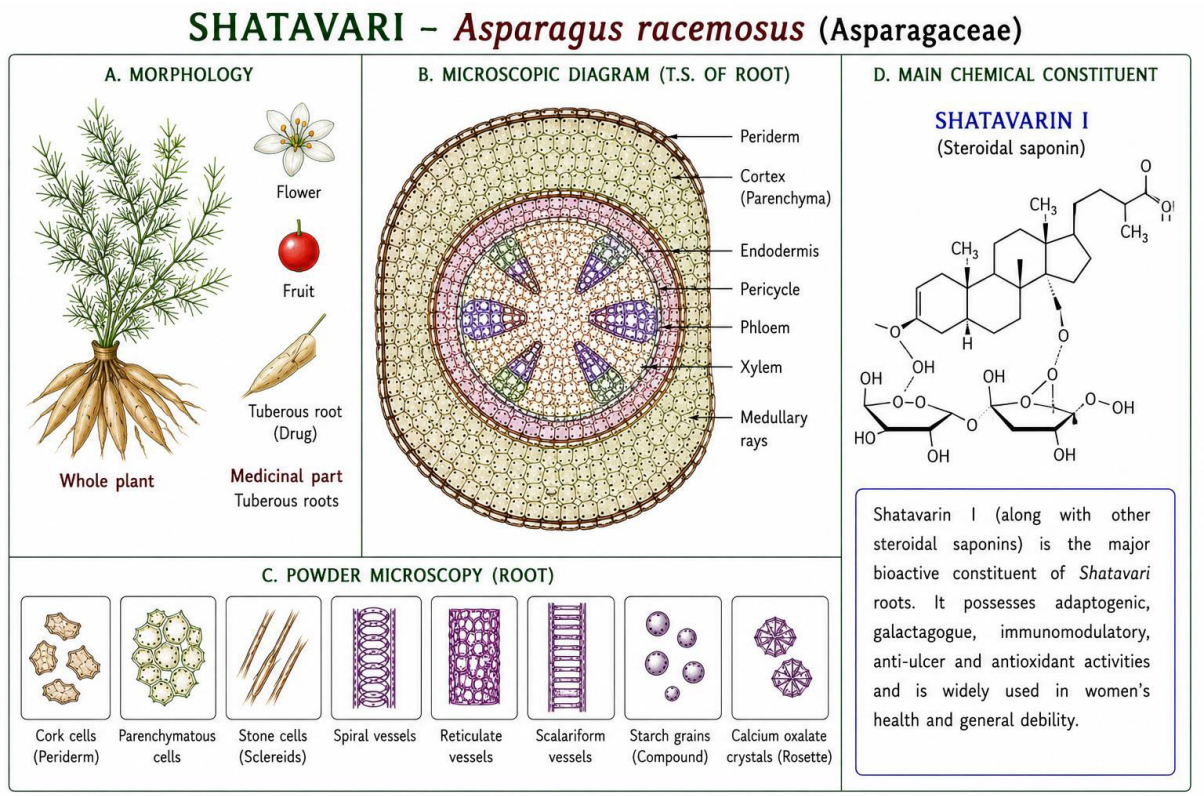

Figure 28: Morphology, Microscopy and Main active constituent of Shatavari

Chemical Constituents

The major active constituents of Shatavari are steroidal saponins known as shatavarins, particularly shatavarin I–IV. Other constituents include flavonoids, alkaloids, mucilage, isoflavones, polysaccharides, amino acids, and essential minerals.

Pharmacological Activities

Shatavari exhibits galactagogue, adaptogenic, immunomodulatory, antioxidant, anti-inflammatory, reproductive tonic, and hormone-modulating activities. It supports female reproductive health by nourishing reproductive tissues, promoting hormonal balance, and enhancing fertility. Its adaptogenic properties also help the body cope with physical and emotional stress.

Uses

Shatavari is widely used in the management of menstrual disorders, infertility, menopausal symptoms, leucorrhoea, recurrent reproductive tract problems, and hormonal imbalances. It is particularly valued as a galactagogue to enhance breast milk production in nursing mothers. The herb is also used as a general female tonic for promoting reproductive and overall health.

Respiratory Drugs

Introduction

Respiratory drugs are therapeutic agents used for the prevention and treatment of diseases affecting the respiratory tract. The respiratory system is responsible for gas exchange and maintaining oxygen supply to body tissues. Respiratory disorders are among the most common health problems worldwide and include conditions affecting the upper and lower respiratory tract.

Medicinal plants used as respiratory drugs contain alkaloids, essential oils, flavonoids, saponins, terpenoids, and phenolic compounds that help relieve cough, clear mucus, reduce airway inflammation, and improve breathing.

Common Respiratory Disorders

- Cough
- Common cold
- Bronchitis
- Asthma
- Allergic rhinitis
- Respiratory infections
- Chronic obstructive pulmonary disease (COPD)

Mechanisms of Respiratory Action

- Promote mucus expulsion (expectorant action).
- Dilate bronchial airways (bronchodilator action).
- Reduce airway inflammation.
- Suppress excessive coughing.
- Provide antimicrobial protection.
- Improve respiratory function.
- Support immune defense against respiratory infections.

Therapeutic Uses

- Relief of cough and cold
- Management of bronchitis
- Supportive therapy in asthma
- Reduction of respiratory congestion
- Prevention of respiratory infections
- Improvement of breathing capacity

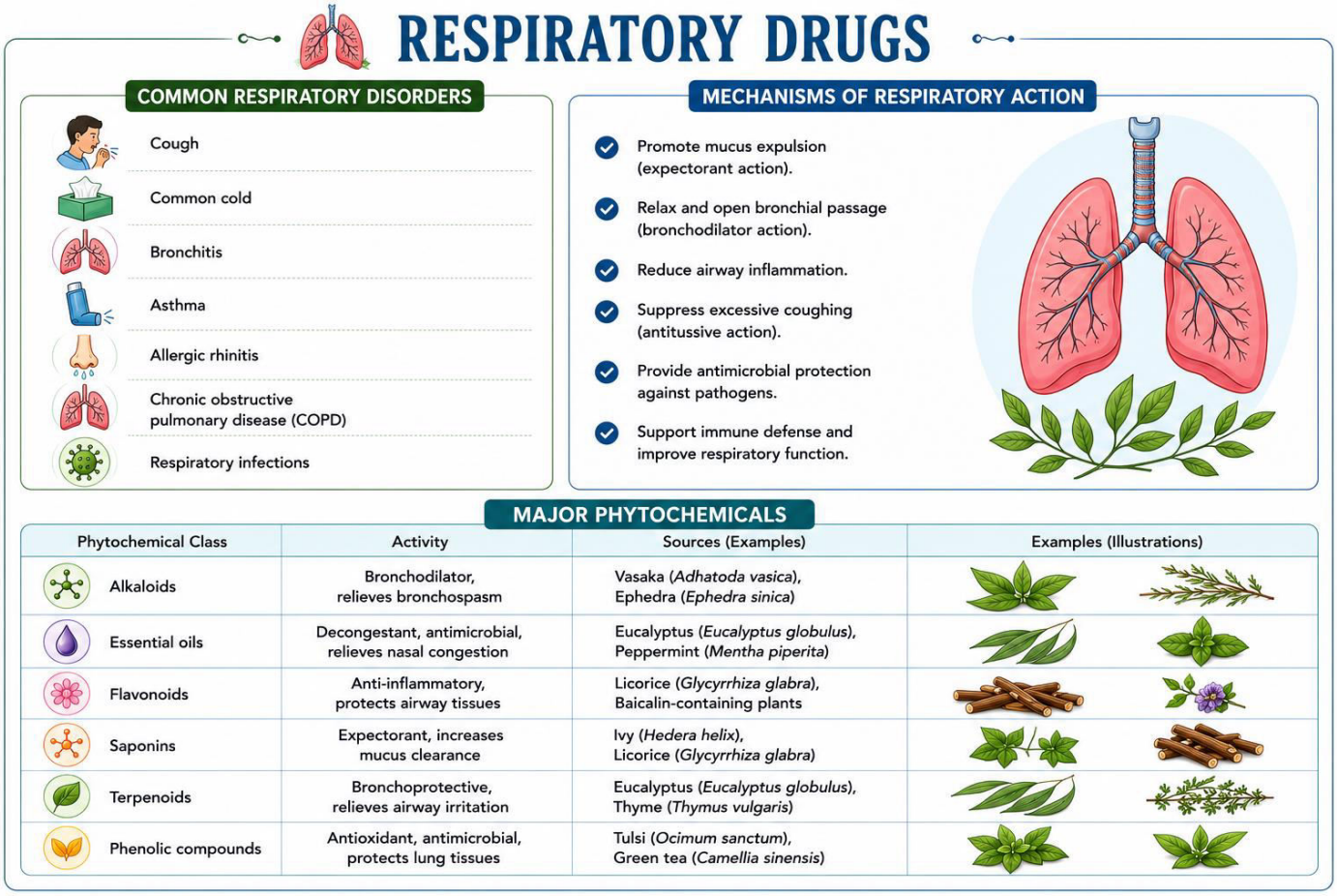

Figure 29: Respiratory Drugs

Table 11: Major Respiratory Phytochemicals

Phytochemical Class	Activity
Alkaloids	Bronchodilator, expectorant
Essential oils	Decongestant, antimicrobial
Flavonoids	Anti-inflammatory
Saponins	Expectorant
Terpenoids	Bronchoprotective
Phenolic compounds	Antioxidant, antimicrobial

Vasaka (*Justicia adhatoda* / *Adhatoda vasica*)

Biological Source

Vasaka consists of the fresh or dried leaves of *Justicia adhatoda* L. (syn. *Adhatoda vasica* Nees), belonging to the family Acanthaceae. The leaves are the principal medicinal part,

although roots, flowers, and bark are also used in certain traditional preparations. Vasaka is commonly known as Malabar Nut and is highly regarded in Ayurveda for its beneficial effects on the respiratory system.

Geographical Source

Vasaka is widely distributed throughout India, Sri Lanka, Nepal, Pakistan, Bangladesh, and Southeast Asian countries. It grows abundantly in plains, foothills, and tropical regions and is often cultivated in medicinal plant gardens. In India, it is commonly found in Punjab, Uttar Pradesh, West Bengal, Tamil Nadu, Kerala, and other states.

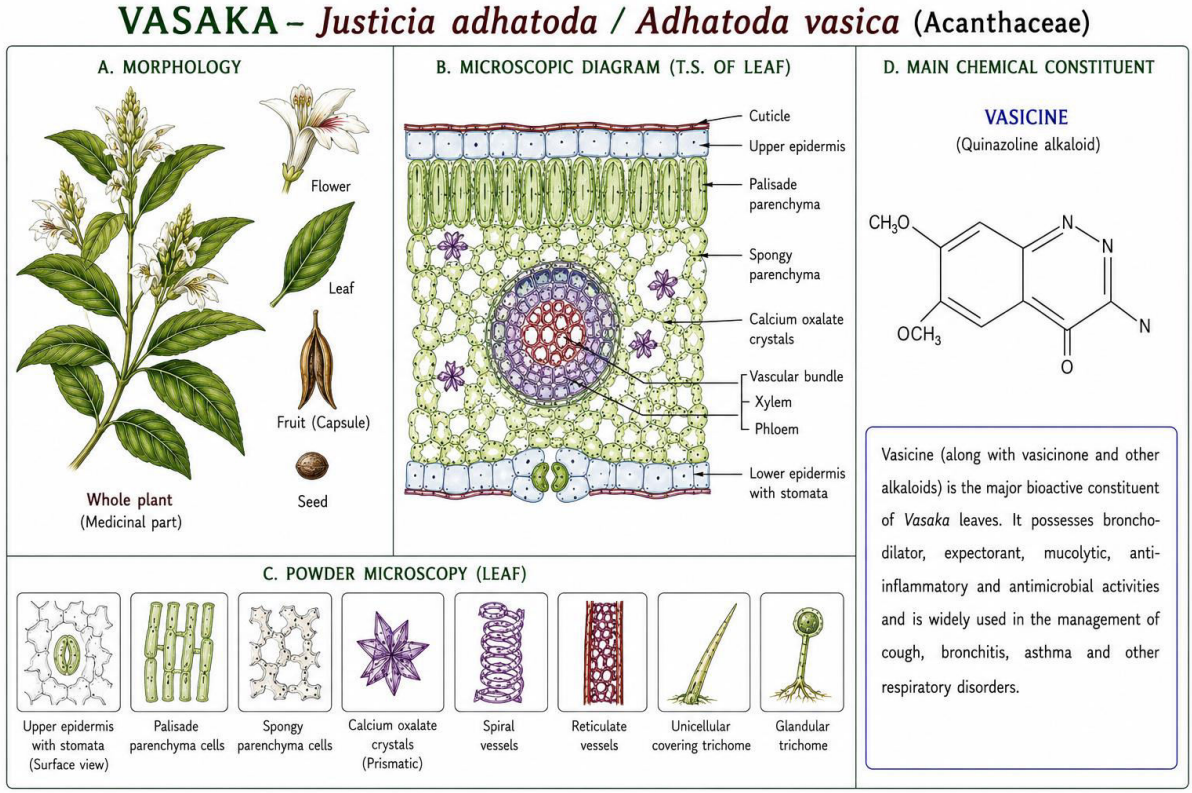

Figure 30: Morphology, Microscopy and Main active constituent of Vasaka

Macroscopic Characters

The plant is a dense evergreen shrub that grows up to 2–3 meters in height. The leaves are large, simple, opposite, lanceolate to elliptic-lanceolate, and dark green in color. They possess a characteristic bitter taste and a faint odor. The leaf surface is smooth, with prominent reticulate venation visible on the lower surface. The flowers are white with purple markings and occur in dense spikes.

Microscopic Characters

A transverse section of the leaf shows a dorsiventral structure with distinct upper and lower epidermis covered by a thin cuticle. Numerous diacytic stomata are present, particularly on the lower epidermis. The mesophyll is differentiated into palisade and spongy parenchyma. Calcium oxalate crystals, cystoliths, and vascular bundles are present within the leaf tissue. Covering trichomes may also be observed on the epidermal surface.

Chemical Constituents

The principal active constituents of Vasaka are quinazoline alkaloids, particularly vasicine and vasicinone. Other constituents include vasicinol, vasicinolone, essential oils, flavonoids, tannins, saponins, and phenolic compounds. Vasicine is considered the major bioactive constituent responsible for most of the plant's respiratory effects.

Pharmacological Activities

Vasaka exhibits bronchodilator, expectorant, antitussive, anti-asthmatic, anti-inflammatory, antimicrobial, and mucolytic activities. Vasicine helps dilate bronchial passages, facilitates the expulsion of mucus, and reduces airway congestion. The plant also helps soothe irritated respiratory passages and supports normal lung function. Its antimicrobial activity contributes to the management of respiratory infections.

Uses

Vasaka is widely used in the treatment of cough, bronchitis, asthma, whooping cough, tuberculosis, common cold, and other respiratory tract disorders. It is a common ingredient in herbal cough syrups, expectorants, lozenges, and Ayurvedic formulations designed to relieve respiratory congestion. The herb is also employed to improve breathing and reduce excessive mucus accumulation in the airways.

Table 12: A combined overview of Drugs from various categories

Category	Drug	Botanical Name (Family)	Part Used	Major Chemical Constituents	Activity / Use
Adaptogen & Immuno-modulator	Ashwagandha	*Withania somnifera* (Solanaceae)	Root	Withanolides, Withaferin A	Adaptogen; used for stress, fatigue, and immunity
	Tulsi	*Ocimum sanctum* (Lamiaceae)	Leaves, Flowering Tops	Eugenol, Ursolic Acid, Rosmarinic Acid	Immunomodulator; used for cough, cold, and infections
	Amla	*Phyllanthus emblica*	Fruit	Vitamin C, Emblicanin A & B, Gallic Acid	Antioxidant; used for

		(Phyllanthaceae)			immunity and rejuvenation
Hepatoprotective	Milk Thistle	*Silybum marianum* (Asteraceae)	Fruit	Silymarin, Silybin	Liver protector; used for hepatitis and cirrhosis
	Kutki	*Picrorhiza kurroa* (Plantaginaceae)	Rhizome, Roots	Picroside I, Picroside II, Kutkoside	Liver disorders and jaundice
Cardiovascular Drug	Garlic	*Allium sativum* (Amaryllidaceae)	Bulb	Allicin, Alliin, Ajoene	Hypertension and high cholesterol
	Arjuna	*Terminalia arjuna* (Combretaceae)	Bark	Arjunolic Acid, Arjunic Acid, Flavonoids	Cardiotonic; used for heart diseases
Antidiabetic	Gymnema	*Gymnema sylvestre* (Apocynaceae)	Leaves	Gymnemic Acids, Gurmarin	Diabetes management
	Fenugreek	*Trigonella foenum-graecum* (Fabaceae)	Seeds	Trigonelline, Diosgenin, Galactomannan	Diabetes and hyperlipidemia
Anti-inflammatory & Analgesic	Turmeric	*Curcuma longa* (Zingiberaceae)	Rhizome	Curcumin, Turmerones	Arthritis, inflammation, pain
	Boswellia	*Boswellia serrata* (Burseraceae)	Oleo-gum-resin	Boswellic Acids (AKBA, KBA)	Arthritis and joint pain
CNS Drug	Brahmi	*Bacopa monnieri* (Plantaginaceae)	Whole Plant	Bacoside A, Bacoside B	Memory enhancement and cognition
Antimicrobial & Antiviral	Giloy	*Tinospora cordifolia* (Menispermaceae)	Stem	Tinosporide, Cordifolide	Fever, infections, immunity
	Neem	*Azadirachta indica* (Meliaceae)	Leaves, Bark, Seeds	Azadirachtin, Nimbin, Nimbidin	Skin diseases and infections
	Andrographis (Kalmegh)	*Andrographis paniculata* (Acanthaceae)	Whole Plant	Andrographolide, Neoandrographolide	Viral infections and fever
Gastrointestinal Drug	Psyllium (Isabgol)	*Plantago ovata*	Seeds, Husk	Mucilage (Arabinoxylans)	Constipation and IBS

		(Plantaginaceae)			
Dermatological Agent	Aloe Vera	*Aloe vera* (Asphodelaceae)	Leaf Gel	Acemannan, Aloin, Aloe-emodin	Burns, wounds, skin disorders
Women's Health Drug	Chasteberry	*Vitex agnus-castus* (Lamiaceae)	Fruits	Agnuside, Casticin, Aucubin	PMS and menstrual disorders
	Shatavari	*Asparagus racemosus* (Asparagaceae)	Tuberous Roots	Shatavarins, Flavonoids	Fertility, lactation, menopause
Respiratory Drug	Vasaka	*Justicia adhatoda* (Acanthaceae)	Leaves	Vasicine, Vasicinone	Asthma, bronchitis, cough

Multiple Choice Questions (MCQs)
Phyto-Therapeutic Agents

1.
Which of the following is classified as an adaptogen?
A. Garlic
B. Ashwagandha
C. Aloe
D. Psyllium

2.
The major active constituents of Ashwagandha are:
A. Bacosides
B. Curcuminoids
C. Withanolides
D. Picrosides

3.
Tulsi belongs to the family:
A. Solanaceae
B. Lamiaceae
C. Fabaceae
D. Apiaceae

4.
Amla is particularly rich in:
A. Vitamin A
B. Vitamin B12
C. Vitamin C
D. Vitamin D

5.
Which herb is widely used as a hepatoprotective agent?
A. Brahmi

B. Milk Thistle
C. Fenugreek
D. Vasaka

6.
Silymarin is obtained from:
A. Kutki
B. Tulsi
C. Milk Thistle
D. Arjuna

7.
The biological source of Kutki is:
A. *Picrorhiza kurroa*
B. *Plantago ovata*
C. *Bacopa monnieri*
D. *Azadirachta indica*

8.
The major constituents of Kutki are:
A. Bacosides
B. Curcuminoids
C. Picrosides
D. Allicin

9.
Garlic is scientifically known as:
A. *Allium cepa*
B. *Allium sativum*
C. *Terminalia arjuna*
D. *Ocimum sanctum*

10.
The principal active constituent of Garlic is:
A. Vasicine
B. Allicin
C. Eugenol
D. Gymnemic acid

11.
Arjuna belongs to the family:
A. Fabaceae
B. Rutaceae
C. Lamiaceae
D. Combretaceae

12.
The cardioprotective constituent of Arjuna is:
A. Arjunolic acid
B. Curcumin
C. Silymarin
D. Aloin

13.
Gymnema is mainly used in:
A. Respiratory disorders
B. Skin disorders

C. Diabetes
D. Liver disorders

14.
Gymnemic acids are obtained from:
A. Fenugreek
B. Gymnema
C. Garlic
D. Neem

15.
Fenugreek belongs to the family:
A. Solanaceae
B. Rutaceae
C. Lamiaceae
D. Fabaceae

16.
The antidiabetic activity of Fenugreek is mainly attributed to:
A. Galactomannan
B. Bacosides
C. Curcuminoids
D. Picrosides

17.
Turmeric is obtained from:
A. Leaves
B. Fruits
C. Rhizomes
D. Seeds

18.
The yellow pigment of Turmeric is:
A. Boswellic acid
B. Curcumin
C. Allicin
D. Eugenol

19.
Boswellia is commonly used as:
A. Anti-inflammatory agent
B. Laxative
C. Expectorant
D. Hepatoprotective

20.
The major constituents of Boswellia are:
A. Bacosides
B. Gymnemic acids
C. Picrosides
D. Boswellic acids

21.
Brahmi is scientifically known as:
A. *Ocimum sanctum*
B. *Bacopa monnieri*
C. *Withania somnifera*
D. *Plantago ovata*

22.
The major active constituents of Brahmi are:
A. Withanolides
B. Saponins
C. Bacosides
D. Curcuminoids
23.
Neem belongs to the family:
A. Meliaceae
B. Fabaceae
C. Lamiaceae
D. Apiaceae
24.
The principal bioactive constituent of Neem is:
A. Vasicine
B. Eugenol
C. Curcumin
D. Azadirachtin
25.
Giloy is scientifically known as:
A. *Azadirachta indica*
B. *Tinospora cordifolia*
C. *Bacopa monnieri*
D. *Asparagus racemosus*
26.
Andrographis is mainly used as:
A. Cardiovascular drug
B. Dermatological agent
C. Antimicrobial and antiviral drug
D. CNS drug
27.
The major constituent of Andrographis is:
A. Andrographolide
B. Allicin
C. Aloin
D. Curcumin
28.
Psyllium is obtained from:
A. Roots
B. Leaves
C. Bark
D. Seeds
29.
Psyllium is primarily used as:
A. Expectorant
B. Bulk-forming laxative
C. Antidiabetic
D. Analgesic
30.

The activity of Psyllium is due to:
A. Tannins
B. Flavonoids
C. Mucilage
D. Alkaloids

31.
Aloe is mainly used as:
A. Hepatoprotective
B. Cardiovascular drug
C. Adaptogen
D. Dermatological agent

32.
The major constituent of Aloe is:
A. Aloin
B. Curcumin
C. Vasicine
D. Silymarin

33.
Chasteberry is scientifically known as:
A. *Asparagus racemosus*
B. *Vitex agnus-castus*
C. *Plantago ovata*
D. *Tinospora cordifolia*

34.
Chasteberry is mainly used for:
A. Liver disorders
B. Women's health
C. Respiratory disorders
D. Diabetes

35.
Shatavari is scientifically known as:
A. *Bacopa monnieri*
B. *Terminalia arjuna*
C. *Ocimum sanctum*
D. *Asparagus racemosus*

36.
The major constituents of Shatavari are:
A. Shatavarins
B. Bacosides
C. Boswellic acids
D. Gymnemic acids

37.
Vasaka is scientifically known as:
A. *Justicia adhatoda*
B. *Withania somnifera*
C. *Picrorhiza kurroa*
D. *Plantago ovata*

38.
The major alkaloid present in Vasaka is:
A. Allicin

B. Azadirachtin
C. Vasicine
D. Curcumin

39.

Vasaka is primarily used as:
A. Hepatoprotective
B. Antidiabetic
C. Dermatological agent
D. Respiratory drug

40.

Which herb is known for memory-enhancing properties?
A. Tulsi
B. Brahmi
C. Garlic
D. Aloe

41.

Which herb is commonly used for stress management?
A. Ashwagandha
B. Psyllium
C. Vasaka
D. Arjuna

42.

Which plant is known as Indian Gooseberry?
A. Neem
B. Amla
C. Tulsi
D. Giloy

43.

Which herb is most commonly associated with immune enhancement?
A. Psyllium
B. Aloe
C. Tulsi
D. Vasaka

44.

Which herb is used for wound healing and burns?
A. Fenugreek
B. Aloe
C. Arjuna
D. Kutki

45.

Which phytotherapeutic agent is used in jaundice and liver disorders?
A. Brahmi
B. Garlic
C. Kutki
D. Vasaka

46.

The family of Ashwagandha is:
A. Solanaceae
B. Fabaceae

C. Lamiaceae
D. Meliaceae

47.

The family of Brahmi is:
A. Plantaginaceae
B. Apiaceae
C. Rutaceae
D. Combretaceae

48.

Which drug contains eugenol as a major constituent?
A. Tulsi
B. Amla
C. Arjuna
D. Brahmi

49.

Which medicinal plant belongs to the Menispermaceae family?
A. Neem
B. Giloy
C. Garlic
D. Fenugreek

50.

Which drug is used as an expectorant and bronchodilator?
A. Aloe
B. Tulsi
C. Vasaka
D. Chasteberry

Answer Key

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Answer	B	C	B	C	B	C	A	C	B	B	D	A	C	B	D	A	C	B	A	D	B	C	A	D	B

Q.No.	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Answer	C	A	D	B	C	D	A	B	B	D	A	A	C	D	B	A	B	C	B	C	A	A	A	B	C

2 Marks Questions

Q. No.	Question	Bloom's Taxonomy
1	Define adaptogens with one example.	Remembering
2	Name the major active constituent of Milk Thistle.	Remembering
3	What is the biological source of Brahmi?	Remembering

4	Name the major alkaloid present in Vasaka.	Remembering
5	What is the primary medicinal use of Psyllium?	Remembering
6	A patient suffering from chronic stress is advised to take Ashwagandha. Justify its use.	Applying
7	A patient with constipation is prescribed Psyllium. Explain the basis for its therapeutic application.	Applying
8	Analyze the differences between adaptogens and immunomodulators with suitable examples.	Analyzing
9	Evaluate the suitability of Gymnema and Fenugreek in the management of diabetes mellitus based on their mechanisms of action.	Evaluating
10	Design a herbal therapeutic regimen for a patient suffering from stress, impaired memory, and reduced immunity using appropriate medicinal plants discussed in the chapter. Justify your selection.	Creating

5 Marks Questions

Q. No.	Question	Bloom's Taxonomy
1	Write a note on Ashwagandha, including its biological source, major constituents, and uses.	Remembering
2	Discuss Milk Thistle as a hepatoprotective agent.	Remembering
3	Describe Garlic as a cardiovascular drug.	Remembering
4	Explain the biological source, constituents, and uses of Gymnema.	Understanding
5	Write a note on Brahmi as a CNS drug.	Understanding
6	Apply the mechanisms of herbal antidiabetic drugs to explain how they help control blood glucose levels.	Applying
7	Analyze the therapeutic significance of antimicrobial and antiviral medicinal plants in the management of infectious diseases.	Analyzing
8	Apply the knowledge of phytochemicals to explain the anti-inflammatory activity of medicinal plants.	Applying
9	Evaluate the suitability of Milk Thistle and Kutki as hepatoprotective agents for a patient with liver dysfunction and justify your recommendation.	Evaluating
10	Design a herbal treatment plan for a woman experiencing menopausal symptoms using Chasteberry and Shatavari, and justify the inclusion of each drug.	Creating

10 Marks Questions

Q. No.	Question	Bloom's Taxonomy
1	Discuss Ashwagandha, Tulsi, and Amla as adaptogens and immunomodulators, highlighting their biological sources, major constituents, and uses.	Remembering
2	Describe Milk Thistle and Kutki as hepatoprotective drugs.	Remembering
3	Explain Garlic and Arjuna as cardiovascular drugs.	Understanding
4	Discuss Gymnema and Fenugreek as antidiabetic agents.	Understanding

5	Describe the biological source, major constituents, and uses of Turmeric and Boswellia.	Remembering
6	Apply the classification of phyto-therapeutic agents to classify medicinal plants based on their therapeutic applications with suitable examples.	Applying
7	Analyze the role of phytochemicals in the therapeutic activity of medicinal plants.	Analyzing
8	Apply the mechanisms of action of herbal antimicrobial and antiviral agents to explain their therapeutic importance in disease management.	Applying
9	A healthcare practitioner wishes to develop a herbal formulation for stress management, immune enhancement, and cognitive improvement. Evaluate the suitability of medicinal plants discussed in the chapter and justify your selection based on their constituents and therapeutic activities.	Evaluating
10	A patient presents with diabetes, cardiovascular risk factors, and chronic inflammation. Design an evidence-based herbal management plan using appropriate phyto-therapeutic agents discussed in this chapter and justify the inclusion of each drug.	Creating

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Phyto-Therapeutic Agents

Case-Based Learning (CBL) Questions

A. True/False Questions

Case 1: A patient suffering from chronic stress and fatigue is prescribed Ashwagandha.

1. Ashwagandha belongs to the hepatoprotective class of medicinal plants. (True/False)

Case 2: A patient with liver cirrhosis is advised to take a preparation containing Milk Thistle.

2. Silymarin is the major hepatoprotective constituent present in Milk Thistle. (True/False)

Case 3: A diabetic patient is prescribed Gymnema capsules.

3. Gymnema is mainly used as a cardiovascular drug for reducing blood pressure. (True/False)

Case 4: An elderly patient with declining memory is advised to consume Brahmi regularly.

4. Brahmi is used to improve cognition and memory functions. (True/False)

Case 5: A patient suffering from constipation is advised to take Psyllium husk.

5. Psyllium acts primarily as a bulk-forming laxative due to its mucilage content. (True/False)

B. Match the Columns

Column A (Case)	**Column B (Drug)**

A. Patient with liver cirrhosis	1. Psyllium
B. Patient suffering from constipation	2. Brahmi
C. Patient with memory impairment	3. Milk Thistle
D. Patient with inflammatory arthritis	4. Turmeric
E. Patient with menopausal symptoms	5. Shatavari

C. Fill in the Blanks

1. A patient suffering from hypercholesterolemia is advised to consume Garlic. The major sulfur-containing constituent responsible for its cardiovascular activity is _____.
2. A patient with liver dysfunction is prescribed Kutki. The major active constituents responsible for hepatoprotective activity are _____.
3. A patient with recurrent infections is advised to use Neem. The major bioactive constituent is _____.
4. A patient suffering from constipation is advised to increase intake of Psyllium. Its therapeutic activity is mainly due to the presence of _____.
5. A woman experiencing hormonal imbalance and PMS is prescribed Chasteberry. The biological source is _____.

Problem-Based Learning (PBL) Questions

A. True/False Questions

Problem 1: A patient with rheumatoid arthritis seeks herbal therapy for inflammation and pain relief.

1. Boswellic acids are important active constituents of Boswellia. (True/False)

Problem 2: A patient suffering from respiratory congestion is prescribed Vasaka syrup.

2. Vasaka is mainly used as a dermatological agent for wound healing. (True/False)

Problem 3: A patient with recurrent viral infections is advised to take Andrographis.

3. Andrographolide is a major constituent responsible for the antimicrobial and antiviral activity of Andrographis. (True/False)

Problem 4: A woman experiencing menopausal symptoms is advised to use Shatavari.

4. Shatavari is commonly used to support women's reproductive health. (True/False)

Problem 5: A patient with hypercholesterolemia is advised to consume Garlic.

5. Allicin is the major bioactive constituent associated with the cardiovascular benefits of Garlic. (True/False)

B. Match the Columns

Column A (Problem)	Column B (Major Constituent)
A. Ashwagandha	1. Gymnemic acids
B. Gymnema	2. Curcumin
C. Turmeric	3. Withanolides
D. Vasaka	4. Vasicine
E. Garlic	5. Allicin

C. Fill in the Blanks

1. A patient with cardiovascular disease is advised to use Arjuna. The major active constituent is _____ acid.
2. A patient requiring memory enhancement is prescribed Brahmi. The major active constituents are _____.
3. A patient suffering from respiratory congestion is prescribed Vasaka. The biological source is _____.
4. A patient with inflammatory bowel conditions is advised to take Boswellia. Its major active constituents are _____.
5. A patient seeking an immunomodulatory herb is prescribed Tulsi. The major phenolic constituent is _____.

Answers for CBL Questions

A. True/False

Q1	Q2	Q3	Q4	Q5
F	T	F	T	T

B. Match the Columns

A	B	C	D	E
3	1	2	4	5

C. Fill in the Blanks

Q1	Q2	Q3	Q4	Q5
Allicin	Picrosides	Azadirachtin	Mucilage	*Vitex agnus-castus*

Answers for PBL Questions

A. True/False

Q1	Q2	Q3	Q4	Q5
T	F	T	T	T

B. Match the Columns

A	B	C	D	E
3	1	2	4	5

C. Fill in the Blanks

Q1	Q2	Q3	Q4	Q5
Arjunolic acid	Bacosides	*Justicia adhatoda*	Boswellic acids	Eugenol