

PHARMACOGNOSY-I

UNIT 5 NOTES

PLANT PRODUCTS

- COTTON
- JUTE
- HEMP
- HALLUCINOGENS
- TERATOGENS
- NATURAL ALLERGENS

PRIMARY METABOLITES

- CARBOHYDRATES
- PROTEINS AND ENZYMES
- LIPIDS
- MARINE DRUGS



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PLANT PRODUCTS

FIBERS

- Fibers are long, thin and flexible thread-like structures.
- They are made up of natural or synthetic materials and are used mainly to make fabrics, ropes, papers, and other useful products.

TYPES OF FIBERS

Fibers can be classified into:

① Natural Fibers

- Obtained from plant and animals.
- Example: Cotton, Jute, Hemp, Silk, wool etc.

② Synthetic Fibers

- Man-made using chemicals.
- Example: Nylon, Polyester, Acrylic etc.

COTTON

- Biological source -
- Cotton is obtained from the epidermal hairs (seed hairs) of the seeds of the plant.
 - *Gossypium* species (Family: Malvaceae)
 - Common species: *Gossypium hirsutum*, *Gossypium barbadense*, *Gossypium arboreum*.

- Chemical Nature -
- Cotton is mainly made up of cellulose {about (90-95%)}.
 - Cellulose is a carbohydrate (polysaccharide) made of glucose units.
 - It also contains small amounts of waxes, proteins and pectins.

- Uses -
- Used in textile industry to make clothes, bed sheets and towels.
 - Used to make absorbent cotton for medical and surgical purposes.
 - Used in making bandages and cotton swabs.
 - Used in paper industry for high-quality paper.

② JUTE

Biological source - • Jute is obtained from the bast fibers (outer layer of the stem)

- Corchorus species (Family: Tiliaceae or sometimes Malvaceae).
- Common species: Corchorus capsularis and Corchorus olitorius.

Chemical nature- Jute mainly contains:

- Cellulose (60-70%)
- Hemicellulose (20-25%)
- Small amounts of lignin and pectins.

Uses - • Used to make gunny bags, ropes, sacks and mats.
• Used in packaging industry.
• Used in making carpets, handicrafts and eco-friendly bags.
• It is biodegradable and eco-friendly, so used as a replacement for plastic in packaging.

③ HEMP

- Biological source -
- Hemp fibre is obtained from the stem of the plant.
 - *Cannabis sativa* (Family: Cannabaceae).
 - Fibre is extracted from the phloem or bast part of the stem.

Chemical nature - Hemp contains:

- Cellulose (about 70-75%)
- Hemicellulose (15-20%)
- Small amounts of lignin

- Uses -
- Used to make textiles, cordage, canvas and sailcloth.
 - Used in construction as insulation material (hempcrete).
 - Used in paper manufacturing.
 - Hemp fibres are strong, durable and resistant to pests.

HALLUCINOGENS

Hallucinogens are substances that affect the brain and cause hallucinations – meaning they make a person see, hear, or feel things that are not real.

BIOLOGICAL SOURCE

Hallucinogens can be obtained from natural sources like:

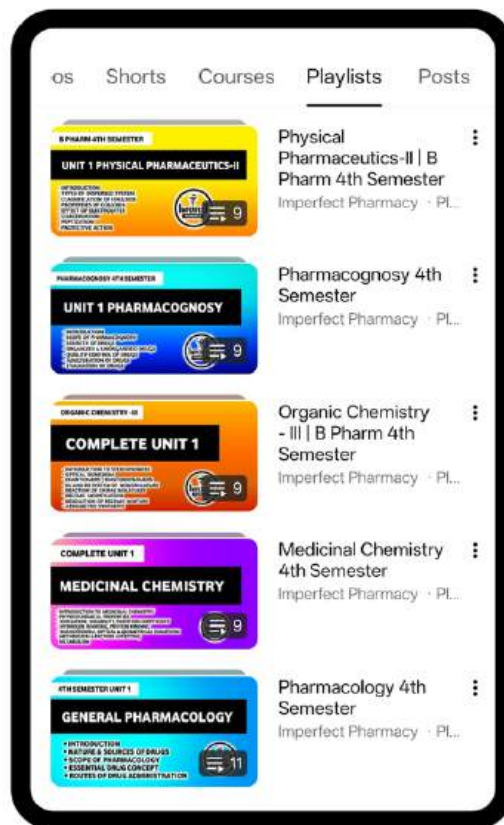
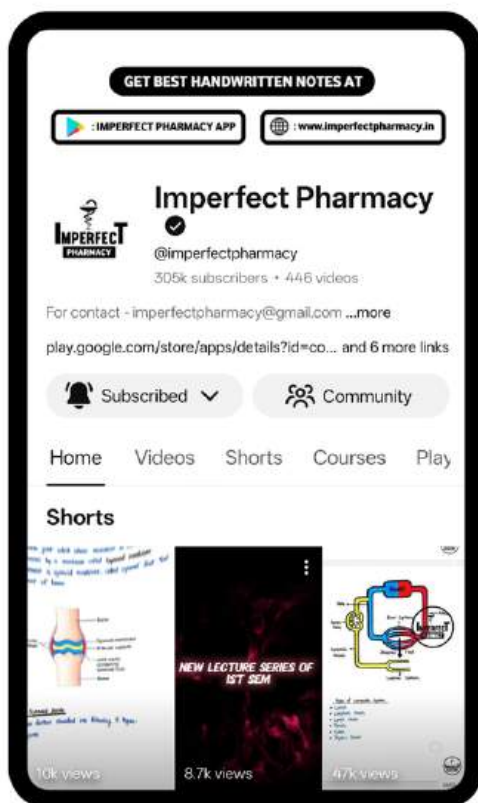
- *Lophophora williamsi* (Peyote cactus) – contains Mescaline.
- *Psilocybe* species (Magic mushrooms) – contains Psilocybin
- *Cannabis sativa* – contains THC (Tetrahydrocannabinol)
- *Claviceps purpurea* (fungus on rye) – source of LSD (from ergot alkaloids)

CHEMICAL NATURE

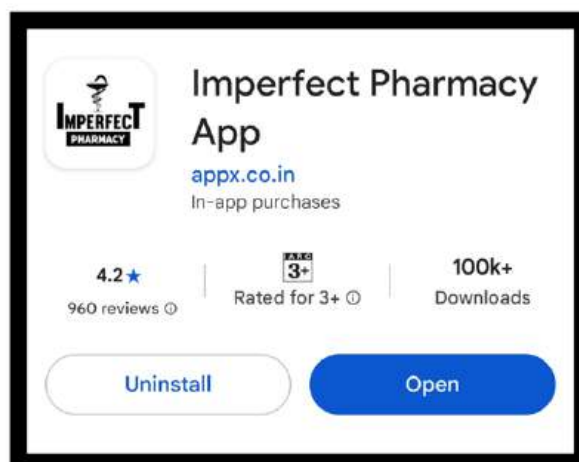
Hallucinogens mainly contains:

- Alkaloids (like Mescaline, Psilocybin, LSD)
- Cannabinoids (like THC)
- Most are nitrogen-containing compounds affecting the central
- nervous system (CNS)

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Uses

- In psychiatry research for mental health conditions (under strict control).
- Some used in religious or spiritual rituals (ethnobotany).
- Limited therapeutic potential in treating depression, PTSD, anxiety (still under research).
- Abused as drug for recreational purposes – illegal and harmful in most cases.

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TERATOGENS

Teratogens are substances or agents that can cause abnormal developments of birth defects in a developing foetus (baby inside the womb).

In short, they interfere with the normal growth of an embryo or foetus during pregnancy.

SOURCES, NATURE & USES OF SOME TERATOGENS

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EXAMPLE	BIOLOGICAL SOURCE / TYPE	CHEMICAL NATURE	USE/EFFECT
Thalidomide	Synthetic drug	Phthalimide derivative (organic compound)	Used for leprosy, but causes birth defects.
Alcohol (Ethanol)	Fermentation of sugar by yeast	Organic compound (C_2H_5OH)	No medical use during pregnancy.
Retinoic Acid (Vitamin A derivatives)	Synthetic or from animal liver oils	Fat-soluble compound (Retinoid)	Used for Acne, but high doses cause malformations.
Rubella virus	Viral infection	RNA Virus	No use - causes birth defects if infection occurs during pregnancy.
Mercury	Natural element	Heavy metal	No medical use; found in polluted fish - causes brain defects.
Radiation (X-Rays, Gamma rays)	Physical agent	Electromagnetic waves	Used in diagnostics, but harmful to foetus in large exposure.

NATURAL ALLERGENS

- Natural allergens are substances found in nature that can cause allergic reactions in some people.
- These reactions happen when the immune system treats a harmless substance as if it's dangerous.

ALLERGY

- An allergy is the body's overreaction to a normal substance.
- When someone allergic comes into contact with an allergen, their body releases chemicals like histamine, which causes symptoms like:
 - Sneezing
 - Running Nose
 - Skin rash
 - Itching
 - Breathing Problems

TYPES OF NATURAL ALLERGENS

Here are common types of natural allergens and where they come from:

① Pollen (from Plants)

- Comes from flowers, trees, grasses and weeds.
- Causes seasonal allergies or hay fever.
- Symptoms: sneezing, watery eyes, blocked nose.

② Dust mites

- Tiny bugs that live in dust, beds and carpets.
- Their waste products cause allergies.
- Can trigger asthma and runny nose.

③ Animal Dander

- Comes from the skin flakes, saliva and urine of animals (like cats and dogs).
- Very small and easily float in the air.
- Causes sneezing, itchy eyes, and coughing.

④ Mold Spores

- Mold is a type of Fungus that grows in damp places (like bathrooms and basements).
- Mold release tiny spores into the air.
- Can cause coughing, wheezing, and asthma.

⑤ Insect Stings

- Bees, wasps, ants and other insects can cause allergic reactions through their stings.
- In severe cases, can lead to anaphylaxis (life-threatening allergic shock).

⑥ Natural Food Allergens

- Some natural food contains proteins that trigger allergies.
- Common examples:
 - Milk
 - Eggs
 - Peanuts
 - Tree nuts like (almonds, walnuts)
 - Wheat
 - Fish and Shellfish
- Can cause rashes, swelling, stomach pain, or breathing problems.

⑦ Natural Latex

Comes from the rubber tree (*Hevea brasiliensis*).

Found in gloves, balloons and medical items.

Can cause skin rashes or breathing problems in sensitive people.

PRIMARY METABOLITES

Primary metabolites are compounds that are directly involved in the normal growth, development and reproduction of an organism. They are essential for survival.

SECONDARY METABOLITES

Secondary metabolites are compounds that are not directly involved in growth or reproduction but help the organism interact with its environment (eg., defense, attraction).

They are not essential for survival, but beneficial.

DIFFERENCE BETWEEN PRIMARY AND SECONDARY METABOLITES

FEATURE	PRIMARY METABOLITES	SECONDARY METABOLITES
Function	Essential for growth and metabolism	Not essential, but aid in ecological functions
Occurrence	Found in all living cells	Found in specific organisms or species.
Time of Formation	During growth phase	Usually in stationary or late growth phase.
Quantity produced	Produced in large amounts	Produced in small amounts.
Examples	Amino acids, Glucose, Ethanol, vitamins, nucleotides	Alkaloids, Flavonoids, tannins, essential oils etc.
Used in Industry	Use in food, pharmaceuticals, Fermentation	Use in drugs, dyes, pesticides, perfumes etc.

CARBOHYDRATES

- Carbohydrates are organic compounds made up of carbon (C), hydrogen (H) and Oxygen (O), usually in the ratio $C_n(H_2O)_n$.
- They are a major source of energy for living organisms.

CLASSIFICATION OF CARBOHYDRATES

- ① Monosaccharides
 - Single sugar units (simple sugars)
 - Example: Glucose, Fructose
- ② Disaccharides
 - Two monosaccharides links together
 - Example: Sucrose (Glucose + Fructose), Lactose (Glucose + Galactose)
- ③ Oligosaccharides
 - 3-10 monosaccharides units.
 - Example: Raffinose
- ④ Polysaccharides
 - Long chains of monosaccharides
 - Example: Starch, Cellulose, Glycogen

ACACIA (GUM ACACIA / GUM ARABIC)

① BIOLOGICAL SOURCE

- Scientific name: *Acacia senegal* (L.) Willd. or other species of *Acacia*.
- Family: *Fabaceae* (*Leguminosae*).
- Part used: Dried gummy exudate obtained from the stems and branches.

② PREPARATION

- Collection: The gum is obtained by making incisions in the bark of *Acacia* trees. The exudate dries naturally into tears or nodules.
- Purification: The collected gum is cleaned to remove bark and debris.
It is then powdered or processed into a fine, uniform product.
Sometimes, it is dissolved in water, filtered and spray-dried to obtain a purified form.

③ EVALUATION

- Organoleptic Evaluation:
 - Color - Pale yellow to amber
 - Odor - Colorless
 - Taste - Bland and mucilaginous

- **Physical Tests:**
 - Solubility - Soluble in water, insoluble in alcohol.
 - Viscosity - Forms a viscous solution in water.
- **Chemical Test:**
 - Identification test - With lead acetate solution, it forms a white precipitate.
 - Absence of starch - No blue color with iodine solution.

④ STORAGE

- Store in a cool, dry place in airtight containers to prevent moisture absorption and microbial growth.
- Protect from heat and direct sunlight to avoid degradation.

⑤ THERAPEUTIC USES

- **Demulcents** - Soothes irritated mucous membranes (used in throat lozenges and cough syrups).
- **Emulsifying Agents** - Used in pharmaceuticals to stabilize membranes.
- **Suspending Agents** - Helps in uniform dispersion of insoluble drugs in liquid formulations.
- **Binder** - Used in tablet formulations.
- **Dietary fiber** - Act as a prebiotic, promoting gut health.

AGAR

BIOLOGICAL SOURCE

- Agar is a dried gelatinous substance obtained from the cell walls of certain red algae, mainly:
 - *Gelidium amansli*, *Gracilaria* species etc.
 - Family: *Gelidiaceae*/*Gracilariaceae*

PREPARATION

- Algae are collected, washed to remove sand, salts and debris.
- Boiled in water to extract the gelatinous material.
- The hot solution is filtered, cooled to form a gel and frozen.
- The Frozen gel is thawed and dried in thin sheets or bars.
- Finally, it is cut and packed for use.

EVALUATION

① Physical Test:

- Appearance - Transparent, colourless to pale yellow strips or flakes.
- Odorless and tasteless.
- Swells in cold water and dissolves in hot water to form a gel.

② Chemical Test:

- Contains polysaccharides mainly agarose and agaropectin.
- Positive Molisch's test (carbohydrate test).

STORAGE

- Store in airtight containers, in a cool, dry place.
- Protect from moisture, light and microbial growth.

THERAPEUTIC USES

- Laxative: Act as bulk-forming laxative (non-digestible fiber).
- Demulcent: Soothes mucous membrane.
- Used as a suspending agent and emulsifier in pharmaceutical formulations.
- Employed in culture media for microbiological work (like nutrient agar).
- Sometimes used as dietary fiber supplement in constipation.

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TRAGACANTH

BIOLOGICAL SOURCES

- Tragacanth is natural gum obtained from the dried gummy exudate of the stem and branches of *Astragalus gummifer* and other species of *Astragalus* (Family : Leguminosae / Fabaceae).

PREPARATION

- Incisions are made on the bark of the plant.
- Gum exudates slowly and dries on exposure to air.
- The dried gum is collected in ribbon or flake form.
- It's then cleaned, graded and packed.

EVALUATION

Tragacanth is evaluated based on:

- Physical appearance (ribbon / Flake form, white to pale yellow).
- Solubility test (swells in water but not soluble).
- Viscosity (forms a highly viscous colloidal solution).
- Purity (free from dust, dirt and adulterants).
- Microscopy (For starch and other impurities).

STORAGE

- Store in airtight containers.
- Keep in cool, dry places away from moisture.
- Avoid exposure to insects and direct sunlight.

HONEY

BIOLOGICAL SOURCE

- Honey is sweet, viscous liquid produced by honeybees (*Apis Mellifera* and other species).
- It is obtained from the nectar of flowers, which bees collect, enzymatically change, and store in honeycombs.

PREPARATION

- Collected from honeycombs by:
 - Centrifugation or crushing of honeycombs.
- The raw honey is then filtered to remove wax, pollen and other impurities.
- Sometimes mildly heated to prevent crystallization shelf-life.
- Packed in clean, dry, airtight containers.

EVALUATION

④ Physical Tests :

- Appearance - Clear, golden to amber-coloured viscous liquid.
- Odor - Pleasant and characteristic.
- Taste - Sweet
- Solubility - Soluble in water.

⑥ Chemical Tests:

- Fiehe's test - Detects artificial invert sugar (pure honey gives no red color with resorcinol).
- Diastase activity - Measures enzyme activity (low in adulterated/overheated honey).
- HMF (Hydroxymethylfurfural) test - High HMF indicates over-heating or aging.

STORAGE

- Store in airtight glass or food - grade plastic containers.
- Keep in a cool, dry place away from sunlight.
- Avoid exposure to moisture, as it may ferment due to natural yeast.

THERAPEUTIC USES

- Demulcent: Soothes sore throat and cough.
- Wound healing: Applied topically on burns and cuts due to its antibacterial properties.
- Mild laxatives and nutritive agent.
- Used in ayurvedic and traditional medicine as a carrier for herbs.
- Has antioxidant, antimicrobial and anti-inflammatory effects.

PROTEIN AND ENZYMES

PROTEINS

Proteins are large, complex molecules made up of amino acids linked by peptide bonds.

They are essential for body structure, function and regulation of tissues and organs.

Examples - Hemoglobin, Insulin, Collagen.

ENZYMES

Enzymes are biological catalysts, usually proteins, that speed up chemical reactions in the body without being consumed.

They are highly specific to substrates.

Examples - Amylase, Lipase, Pepsin.

GELATIN

BIOLOGICAL SOURCE

- Gelatin is a protein substance obtained by the partial hydrolysis of collagen from the skin, bones and connective tissues of animals like cattle, pigs & fishes.
- It is derived from collagen, a fibrous protein found in animal tissues.

PREPARATION

- Animals bones and skins are first cleaned and treated with either:
 - Acid (Type A gelatin) or
 - Alkali (Type B gelatin) to break down collagen.
- The treated material is then boiled in water to extract gelatin.
- The extract is filtered, evaporated, cooled to form a jelly and dried into sheets, flakes, or powder.

EVALUATION

- ① Physical tests :
- Appearance - Colorless to pale yellow, transparent, brittle sheets or powder.
 - Odorless and tasteless.
 - Soluble in hot water; forms a gel on cooling.

⑥ Chemical Tests :

- Biuret test - Violet color (confirms protein presence).
- Ash content - $\leq 2\%$ (indicates purity).
- Microbial Limits - Should comply with USP/EP standards.

STORAGE

- Store in cool, dry place, away from moisture and light.
- Use airtight containers to prevent absorption of moisture and microbial growth.
- Should be protected from insects and rodents.

THERAPEUTIC USES

- Used as a plasma expander in emergency fluid loss (e.g., burns, trauma).
- Act as a stabilizer, thickener, and base in pharmaceutical preparations (capsules, lozenges, suppositories).
- Used in wound dressings and skin care products (collagen sources).

CASEIN

BIOLOGICAL SOURCE

- Casein is phosphoprotein obtained from the milk of mammals, especially cow's milk.
- It is the main protein of milk, constituting about 80% of total milk protein.
- Precipitated from milk by acid or rennet enzyme.

PREPARATION

- Skimmed milk is used (fat removed).
- Milk is acidified (using lactic acid or dilute HCl) or treated with rennet enzyme, causing casein to precipitate as curd.
- The curd is separated, washed with water, and dried to obtain casein in solid form.
- Then it's ground into powder or flakes.

EVALUATION

① Physical Tests :

- Appearance - White or cream-colored, tasteless and odorless powder.
- Insoluble in water and alcohol; soluble in alkali.

⑥ Chemical Tests :

- Biuret test - Positive (violet color for proteins).
- Kjeldahl Method - Measures nitrogen content ($\sim 15.7\%$ N in pure casein).

STORAGE

- Store in airtight containers, in a cool, dry place.
- Protect from moisture, insects and microbial growth.
- Should be away from strong odors as it can absorb them.

THERAPEUTIC USES

- Used as nutritional supplement, especially in infant food and dietary protein formulas.
- Used in tablet coatings and microencapsulation of drugs.
- Acts as a binder and base for slow-release formulations.

PROTEOLYTIC ENZYMES

Proteolytic enzymes (also called protease or peptidases) are enzymes that break down proteins by hydrolyzing peptide bonds b/w amino acids.

KEY POINTS

- Function: Digest proteins into peptides or amino acids.
- Site of action: Stomach, Intestine, Lysosomes (inside cells).
- Example: Papain, Bromelain, Serratiopeptidase, Urokinase, streptokinase, pepsin.
- Uses: Protein digestion, Wound healing, inflammation control.

① PAPAIN

- Biological source: Latex of Carica Papaya (Papaya).
- Preparation: Collected latex is dried and powdered.
- Evaluation: Proteolytic activity on casein.
- Storage: Airtight container, cool and dry place.
- Uses: Digestive aid, wound debridement, anti-inflammatory.

② BROMELAIN

- Biological source: Stem and fruit of *Ananas comosus* (Pineapple).
- Preparation: Juice extraction, filtration, drying.
- Evaluation: Casein digestion activity.
- Storage: Moisture-free container, cool-place.
- Uses: Anti-inflammatory, sinusitis, arthritis, digestive aid.

③ SERRATIOPEPTIDASE

- Biological source: *Serratia marcescens* bacteria (from silkworm gut).
- Preparation: Fermentation and purification.
- Evaluation: Enzyme assay using protein substrates.
- Storage: Airtight, dry container, low temp.
- Uses: Anti-inflammatory, pain-relief, post-surgery swelling.

④ UROKINASE

- Biological source: Human kidney cells or urines.
- Preparation: Cell culture or extraction, purified.
- Evaluation: Fibrinolytic activity test.
- Storage: Refrigerated or freeze-dried.
- Uses: Dissolves blood clots (pulmonary embolism, MI).

⑤ STREPTOKINASE

- Biological source: *Streptococcus* bacteria.
- Preparation: Fermentation, followed by purification.
- Evaluation: Clot lysis/fibrinolytic assay.
- Storage: Stored at 2-8°C or freeze-dried.
- Uses: Thrombolytic (used in heart attack, DVT).

⑥ PEPSIN

- Biological source: Stomach lining of pigs (porcine source).
- Preparation: Extraction from gastric mucosa, activated by HCl.
- Evaluation: Proteolytic assay with casein.
- Storage: Airtight, moisture-free, dry container.
- Uses: Digestive enzyme in hypoacidity and indigestion.

LIPIDS

Lipids are organic compounds that are insoluble in water but soluble in organic solvents like ether, chloroforms and alcohol. They include fat, oil, waxes and steroids, and serve as energy, storage, structural components of cell membranes and hormones.

① CASTOR OIL

Biological source: Castor oil is fixed oil obtained from the seeds of *Ricinus communis*.
Family: Euphorbiaceae.

Preparation: Seeds are cleaned, dehulled, and cold-pressed to extract oil.
Oil is then filtered and sometimes steam-heated to remove toxins (like ricin).
Settled and refined to get clear, pale-yellow oil.

Evaluation:

Physical Test - Appearance: Viscous, Pale-yellow, Odorless or slightly oily smell.
Soluble in alcohol and ether.

Chemical Tests :

- Saponification value - 176-187
- Iodine value - 82-90 (indicates high unsaturation due to ricinoleic acid).
- Acid value - ≤ 2.0
- Viscosity - Very high due to ricinoleic acid content.

- Storage :
- Store in well-closed containers, away from light and heat.
 - Should be kept in a cool, dry place to avoid rancidity.

- Therapeutic uses :
- Act as purgative/laxative (stimulates bowel movement).
 - Used in skin disorders, burns and wounds (emollient).
 - Vehicle for topical medicines and eye drops.
 - Used in cosmetics, ointments and hair oils.
 - Traditionally used to induce labor (under medical supervision).

CHAULMOOGRA OIL

- Biological source:
- Chaulmoogra oil is obtained from the seeds of *Hydnocarpus wittiana* and other species like *Hydnocarpus anthelmintica*.
 - Family: Achariaceae

- Preparation:
- The seeds are crushed and subjected to expression (cold-pressing) or solvent extraction to obtain the crude oil.
 - The oil is then refined and filtered to remove impurities.

Evaluation:

- Physical Tests -
- Appearance: Pale-yellow to brownish oil with unpleasant odor.
 - Thick, sticky consistency.

Chemical Test -

- Saponification value - 198 - 213
- Iodine value - 90 - 104 (indicates unsaturation)
- Acid value - ≤ 10
- Identification test - Contains chaulmoorgic acid and hydnocarpic acid (cyclic fatty acids unique to this oil).

- Storage:
- Store in airtight, amber-coloured bottles.
 - Keep in a cool, dry place away from light and air to prevent oxidation and rancidity.

- Therapeutic uses:
- Traditionally used in treatment of leprosy and skin disease.
 - Possesses antibacterial and anti-inflammatory properties.
 - Used in formulation of ointments and emulsions for chronic skin conditions.

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③ WOOL FAT (LANOLIN)

- Biological source:
- Wool fat is natural fat-like substance obtained from the sebaceous glands of wool-bearing animals, especially sheep (*Ovis aries*).
 - Family: Bovidae.

- Preparation:
- Extracted during the scouring (washing) of raw sheep wool.
 - The wool is washed with hot water and detergent, which separates the lanolin.
 - The lanolin is then purified and dehydrated to get anhydrous wool fat.

Evaluation:

- Physical Test -
- Yellow, waxy, soft mass with a faint characteristic colour.
 - Insoluble in water but absorbs water up to twice its weight (important for emulsions).

Chemical Tests -

- Acid value - ≤ 1.0 (indicates free fatty acids).
- Saponification value - 90-105
- Iodine value - 18-36 (indicates degree of unsaturation).
- Water Absorption Capacity - Hydrus lanolin can absorb $\sim 2x$ its weight in water.

- Storage:
- Store in tightly closed containers, in a cool, dry place, protected from light and heat.
 - Avoid contamination with dust and moisture.

- Therapeutic uses:
- Used as an emollient and moisturizer in ointments, creams and lotions.
 - Acts as a base for topical pharmaceutical preparations (e.g., hydrophilic ointments).
 - Soothes dry, itchy or cracked skin and nipple soreness in breastfeeding mothers.
 - Used in cosmetics, lip balms and hair products.

④ BEESWAX

- Biological source:
- Beeswax is natural wax secreted by the wax glands of worker bees (*Apis mellifera*).
 - Family : Apidae.

- Preparation:
- Collected from honeycombs after removing honey.
 - The combs are melted in hot water, filtered to remove impurities.
 - On cooling, wax solidifies and is collected in blocks.

Evaluation:

- Physical Tests -
- Appearance : Yellowish or white solid (depending on bleaching).
 - Slightly honey-like odor, non-sticky, softens at body temperature.
 - Insoluble in water, soluble in ether and chloroform.

Chemical Tests -

- Solubility - Insoluble in water; soluble in chloroform, ether.
- Adulteration Test - Pure beeswax burns with little smoke.

- Storage:
- Store in cool, dry place, in airtight containers.
 - Protect from heat, light and insects (e.g. wax moths).
 - Should not be stored near strong-smelling substances (it absorbs odors).

- Therapeutic uses:
- Used as stiffening agent in ointments, creams, and suppositories.
 - Act as a protective covering for wounds and burns.
 - Commonly used in lip balms, cold creams, cosmetics.

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NOVEL MEDICINAL AGENTS FROM MARINE SOURCES

- Marine organisms are a rich source of structurally unique and biologically active compounds.
- The marine environment - covering over 70% of the Earth's surface - is home to a wide diversity of life forms such as sponges, algae, mollusks, tunicates, corals and marine bacteria, many of which produce secondary metabolites with potential medicinal properties.

SOURCE OF MARINE - DERIVED DRUGS

① MARINE ALGAE (SEAWEEDS)

- Types: Red, Brown, and green algae.
- Bioactive compounds: Polysaccharides (e.g., alginate, carrageenan), sterols and polyphenols.
- Activities: Antiviral, antioxidant, anticoagulant.

② MARINE SPONGES

- Rich source of alkaloids, peptides, terpenoids and sterols.
- Many FDA - approved drugs have sponge origin.

③ MARINE MICROORGANISMS

- Includes bacteria, fungi and actinomycetes.
- Important in antibiotic and anticancer compound production.

④ MARINE MOLLUSKS AND TUNICATES

- These produce toxins and peptides for self-defense, useful in neurological research and drug development.

EXAMPLES OF MARINE-DERIVED MEDICINAL AGENTS

DRUG NAME	SOURCE ORGANISM	ACTIVITY / USE
Cytarabine (Ara-c)	Sponge (Tethya crypta)	Anticancer (leukemia)
Vidarabine (Ara-A)	Sponge (Tethya crypta)	Antiviral (herpes)
Trabectedine (Yondelis®)	Tunicate (Ecteinascidia turbinata)	Anticancer (soft tissue sarcoma)
Eribulin (Halaven®)	Sponge derivative (Halichondrin B)	Anticancer (Breast cancer)
Ziconotide (Prialt®)	Cone snail (Conus magus)	Analgesic (chronic pain)
Brentuximab vedotin	Sea hare toxin (Dolastin derivative)	Anticancer (lymphoma)
Plitidepsin (Aplidin®)	Tunicate (Aplidium albicans)	Antiviral and Anticancer

THERAPEUTIC USES

- Anticancer agents (Cytarabine, Trabectedin, Eribulin)
- Antiviral agents (Vidarabine, Plitidepsin)
- Pain management (Ziconotide)
- Anti-inflammatory and antioxidant agents
- Antimicrobial and antifungal agents.

ADVANTAGES

- Unique structures not found in terrestrial organisms.
- High potency and specificity.
- New mechanisms of action.
- Potential against resistant pathogens and cancers.

CHALLENGES IN MARINE DRUG DEVELOPMENT

- Sustainable supply: Many organisms are difficult to harvest in large quantities.
- Complex structures: Difficult and costly to synthesize.
- Environmental concerns: Over-harvesting can harm marine biodiversity.
- Regulatory - hurdles: Long clinical development time and high cost.

FUTURE PROSPECTS

- Marine biotechnology : Use of fermentation and synthetic biology to produce marine compounds.
- Genomics and metagenomics : Help in discovering genes responsible for bioactive compounds.
- Nanotechnology and drug delivery : Improves solubility and targetting of marine drugs.

CONCLUSION

- Marine natural products have become a promising frontier in drug discovery.
- With advances in marine biotechnology and sustainable harvesting methods, more -marine drugs are expected to enter clinical use , offering novel solutions for unmet medical needs.

THANK YOU

FOR CHOOSING IMPERFECT PHARMACY AS YOUR STUDY PARTNER



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