BALAJI COLLEGE OF PHARMACY

COURSE:B-PHARMACY

SUBJECT: PHARMACOGNOSY-1

2ND YEAR-II SEM

PHARMACOGNOSY-I Unit V

Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs Plant Products:
Fibers - Cotton, Jute, Hemp
Hallucinogens, Teratogens, Natural allergens

Primary metabolites: General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites:

Carbohydrates: Acacia, Agar, Tragacanth, Honey

Proteins and Enzymes : Gelatin, casein, proteolytic enzymes (Papain, bromelain,

serratiopeptidase, urokinase, streptokinase, pepsin).

Lipids(Waxes, fats, fixed oils) : Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax

Marine Drugs: Novel medicinal agents from marine sources

Fibers

- Definition: Any hair-like raw material directly obtainable from an animal, vegetable, or mineral source and convertible into nonwoven fabrics such as felt or paper or, after spinning into yarns, into woven cloth.

  Classification of Natural fibres based on origin:

1. The vegetable or cellulose-base: includes cotton, flax, and jute, banana, hemp
2. The animal or protein-base fibres: wool, silk.
3. Regenerated and synthetic fibres: Nylon, Terylene, Orlon, Viscose, Alginate fibres, etc.
4. Mineral fibre: Asbestos, glass

Cotton : Absorbent/ Raw/purified cotton

- *Biological source:* Epidermal trichomes of the seeds of cultivated species of the *Gossypium herbaceum and other species of Gossypium* (*G. hirsutum, G. barbadense) freed from impurities, fats and* sterilized, belonging to family Malvaceae.
- Chemical Constituents : **90% of cellulose, 7–8% of moisture, wax, fat** and oil 0.5% and cell content about 0.5%. Purified cotton has almost cellulose and 6–7% of moisture.
- **Chemical Tests:**

1. Dry cotton + N/50 I_2 + 80% w/w H_2SO4 → Blue color
2. Dry cotton + ammon. Copper oxide → Dissolves with ballooning
3. Dry cotton + Phloroglucinol+ HCl → No red color

USES: Used in surgical dressing, filtering media, insulation, absorbent cotton used for absorbing blood, mucus, pus.

JUTE : Gunny

- *Biological source:* consists of phloem fibres from the stem of various species of the *Corchorus; C. capsularis Linn*, *C. olitorius Linn*, *and* other species like *C. cunninghamii*, *C. junodi etc.*, *belonging* to family Tiliaceae.
- Chemical Constituents : composed of 50–53% cellulose, 20% hemicellulose & 10–11% lignin, moisture not more than 12–13%, fats, wax, and ash contributing to 1% each.
- **Chemical Tests:**
- **Middle lamella is lignified, gives red color with** Phloroglucinol+ HCl.
- USES: used in the manufacture of tows, padding splints, filtering, and straining medium. Jute is used for the preparation of coarse bags.

HEMP:

- ***Biological source:*** Hemp **is the pericyclic fibre obtained from *Cannabis sativa*** Linn., belonging to family Cannabinaceae..
- **Chemical Constituents** : mainly consist of cellulose and lignin.
- **USES**: printing, inks, paints, varnishes, paper, bibles, bank notes, food,, textiles (the original Levi's jeans were made from Hemp cloth), canvas and building materials. Due to its high tensile strength, bast fibres are ideal for such specialized paper products as: tea bags, industrial filters, currency paper, or cigarette paper.

COTTON

JUTE

HEMP

HALLUCINOGENS

- Hallucinogens are natural and synthetic (synthesized) substances.
- When Taken into the body they alter state of consciousness.
- Hallucinogenic compounds cause people to see/ think to see random colours, patterns, events and objects that do not exist.
- Other names of hallucinogens are Cartoon acid, Microdot, California sunshine, Psilocybin, Magic mushrooms.
- Marijuana and hashish—two substances derived from the hemp plant (*Cannabis sativa)*- feeling of relaxation, faster heart rate
- Form of LSD first produced in 1938, Albert Hoffman, a Swiss research chemist at Sandoz Laboratories, synthesized many important ergot alkaloids (organic plant bases), including Hydergine, LSD-25 and psilocybin.
- LSD is so powerful that a tiny amount can have a hallucinogenic effect.

HALLUCINOGENS: **Datura**

- **Biological source**: Datura consists of the dried leaves and flowering tops of Datura metel and D. metel var. fastuosa Safford. It belongs to family Solanaceae. contain not less than 0.20 per cent of total alkaloids of Datura, calculated as l-hyoscyamine.
- **Chemical Constituents :** upto 0.5 per cent of total alkaloids, among which hyoscine (scopolamine) is the main alkaloid, while l-hyoscyamine (scopoline) and atropine are present in very less quantities (see belladonna herb).
- **USES:** its main alkaloid hyoscine are parasympatholytic with anticholinergic and central nervous system depressant effects. The drug is **used in cerebral excitement**. used in treatment of asthma and cough. Hyoscine hydrobromide is used in motion sickness, gastric or duodenal ulcers.

HALLUCINOGENS: **BETEL NUT**

- ***Biological source:*** *dried ripe seeds of Areca catechu, belonging to family Palmae.*
- **Chemical Constituents** : arecaine and arecoline alkaloids which are comparable to nicotine in its stimulating, mildly intoxicating and appetite-suppressing effects on the mind. It also contains the alkaloids arecaidine, arecolidine, guracine (guacine) and guvacoline.
- **USES**: Arecoline: parasympathomimetic.
- Sialogogue properties, consumed as masticatory in India. May cause oral leukoplakia. anthelmentic drug and used as vermicide and taenifuge in veterinary practice.
- Other Hallucinogenics: KAVA KAVA, Henbane, Belladona, *Hyoscyamus niger*, *Argemone mexicana* etc.

TERATOGENS:

- Teratogen is a an agent that can disturb the development of embryo/ fetus. They halt pregnancy or produce a congenital malformation i.e. birth defect. Classes of teratogens : Radiation, chemicals and drugs
- **1. Tobacco:** It consists of dried leaves of *Nicotiana tobaccum*, *belonging* to *family Solanaceae*.
- CC: alkaloids nicotine, nicotianin, nicotinine, nicoteine, nicoteline. After leaves are smoked the nicotine decomposes into pyridine, furfurol, collidine, hydrocyanic acid, carbon monoxide, etc.
- USES: sedative, diuretic, expectorant, discutient and sialagogue
- Nicotine is vasoconstrictor, results in uterine vascular cnstriction and intrauterine growth retardation. Ciggarette smoking during pregnancy results in perinatal mortality & morbidity risk, CO from smoke crosses placenta & ↑ses blood carboxyhemoglobin with long half life in fetal blood.

TERATOGENS: Marijuana or Cannabis

- **B.S.** dried flowering tops of the pistillate plants of *Cannabis sativa Linn.*, *belonging to family Cannabinaceae.*
- **C.C : 1**5 to 20% resin, The most important active constituents present in cannabis are: cannabidiol, cannabidolic acid, cannabinol, cannabichromene, and *trans-tetrahydrocannbinol.* Cannabis also contains Cannabidiolic acid, cannabidiol A ,

  8, 9, tetrahydrocannabinol, cannabinol A9, Tetrahydrocannabinol (THC), volatile oil, trigonelline, and cholene.
- it is psychotive drug- tetrahydrocannbinol
- 8,9 tetrahydrocannbinol crosses placenta & persists in fetus for around 30 days. Growth retardation in first trimester
- Uses: Cannabis resin is tonic, sedative, analgesic, intoxicant, stomachic,

  antispasmodic, antianxiety, anticonvulsant, antitussive, and narcotic. Cannabis causes only pshycic dependence and act upon the nervous system.

TERATOGENS:

- Ergotamine from Ergot
- Fenugreek: Trigonella foenum
- Asparagus racemosus
- Malus domestica seeds of apple
- Prunus cerasus cherry seeds
- Solanum tuberosum , Solanum melangena Lycopersicon esculentum : suspected teratogens: solanidines, spirosolanes
- Astragalus
- Colchicum autuminale
- Vinca rosea
- Veratrum
- Indigofera spicata
- Datura stramonium ETC.

NATURAL ALLERGENS

- Allergens are inciting agents of allergy, i.e. the substances capable of sensitizing the body in such a way that an unusual response occurs in hypersensitive person.
- may be biologic, chemical or of synthetic origin.
- Defined as a specific immunologic reaction to an immunogen—a normally harmless substance (allergen).
- First defined in 1906 by von Pirquet who described allergy as changed or altered reaction in the body of an individual, in response to a substance or condition that is harmless to others.

NATURAL ALLERGENS

- Types of Allergens

1. **Inhalant allergens**: airborne substances as chemicals, include pollens, dust, mites, mould spores and animal allergy (epidermis or dander).

- Pollens produced by plain looking plants, e.g. trees (oak, walnut); grasses (bermuda grass and timothy) and weeds (ragweed, plantain). Alfalfa, almond, apple, acacia, barley, blue grass, canary grass, cherry, eucalyptus, gladiolus, hazelnut, juniper, mulberry, mustard, lemon and related species of citrus.

2. **Ingestant allergens**: in food stuff and swallowed: skin rash, puffed lips and tongue, migraine, rhinitis or symptoms like severe eczema of hand and feet.

- Tomato rash, strawberry rash, eating oranges, chocolate or shellfish, walnut, cashew nut, etc. soy lecithin, gluten, soy flour, rice flour, alfalfa, potato starch and gum acacia.

NATURAL ALLERGENS

3. Injectant zallergens: Injectant allergens cause symptoms similar to those of the antibiotics, e.g. penicillin, cephalosporin and semisynthetic penicillin, etc. natural sources of injectable allergens are produced by the sting of bees, hornets and wasps.

4. Contactant allergens: Ancardiaceae *family, primarily the genus Toxicodendron* (Rhus) and includes poison ivy, oak and sumac.

- called urushiols (a phenolic compound) are found in the oleoresin fraction and are derivatives of pentadecylcatechol or heptadecylcatechol.
- *Ruta graveolens, asparagus, ornamental* ‘dumb cane’ *(Dieffenbachia seguine), buck wheat, butter cups,* catalpa leaves, chrysanthemums, ginkgo leaves, lobelia, marigolds etc

5. Infectant allergens : caused by the metabolic product of living microorganism: bacteria, protozoas, moulds, helminthes parasites

Natural allergens: Dieffenbachia seguine (dumb cane)

- It is the plant *Dieffenbachia seguine belonging to family araceae*
- *CC.* proteolytic enzyme (named dumbcain), a cyanogenic glycoside, a substance which causes contraction of smooth muscles , asparagine protoaenomoine: swelling of larynx & pharynx
- *Uses:* treat gout, dropsy, sexual impotence, and frigidity

Natural allergens :Ruta graveolens

- *Ruta graveolens* L., is a odoriferous herb belonging to the family Rutaceae.
- CC: acridone alkaloids, coumarins, essential oils, flavonoides, and fluoroquinolones have been found in the roots and aerial parts
- USES: potassium channel blocker, neuromuscular problems,
- antispasmodic effect
- Abortifacient

  Causes photodermatitis

CARBOHYDRATES AND DERIVED PRODUCTS

CREATED BY-

MAYANK MEHENDIRATTA

DEFINITION

✓Groups of compounds composed of carbon, hydrogen and oxygen in which the latter two elements are in same proportion as in water, i.e. hydrates of carbon.

✓These are polyhydroxy aldehyde or polyhydroxy ketone or a compound that on hydrolysis produces either of the above.

CLASSIFICATION

1) Simple sugar (saccharides)
    i. Monosaccharides
        - Tetroses e.g erythose
        - Pentoses e.g ribose
        - Hexoses
            - Aldoses e.g glucose
            - Ketoses e.g fructose
        - Heptoses e.g glucoheptose
    ii. Disaccharides e.g sucrose, maltose, lactose
    iii. Trisaccharides e.g raffinose
    iv. Tetrasaccharides e.g stachyose
2) Polysaccharides e.g starch, cellulose

TESTS FOR CARBOHYDRATES

1) Fehling's Test
2) Molisch Test
3) Osazone formation
4) Selivanoff's Test
5) Test for pentoses
6) Keller-Killiani Test for deoxysugars
7) Furfural Test

AGAR

SYNONYM

✓ Agar-agar, japanese isinglass, vegetable gelatin

Agar-agar algae

BIOLOGICAL SOURCE

✓ Dried gelatinous substance obtained from *Gelidium amansii* (f: Gelidiaceae)

✓

Powdered agar

CHEMICAL CONSTITUENTS

✓Agarose & agaropectin

Agar jelly

✓Agarose is a neutral galactose polymer (free from sulphate) responsible for gel strength & contains alternate residues of 3,6-anhydro-L-galactose & D-galactose(AGAROBIOSE)

✓Agaropectin is sulphonated polysaccharide in which galactose & uronic acids partly esterified with sulphuric acid and is responsible for agar's viscosity

IDENTIFICATION TESTS

✓Solubility test (swells in cold water & dissolves in hot water and forms gel on cooling)

✓Test for mucilage (pink colour with ruthenium red)

✓Test for sugars (Positive Fehling's Test-red ppt)

✓With KOH (candy yellow colour)

✓With Iodine solution (deep crimson to brown colour)

USES

✓Emulsifying agent

✓Bulk laxative

ACACIA

Acacia tree

SYNONYMS

✓Gum acacia, gum arabic, Indian gum

BIOLOGICAL SOURCE

✓ it is the dried gum obtained from the stem & branches of *Acacia arabica* (f: Leguminosae)

Gum exuding from Acacia tree

Acacia gum & powder

CHEMICAL CONSTIUENTS

- ✓Arabin, calcium (with traces of Mg & K) salts of arabic acid
- ✓Arabic acid is a branched polysaccharide that yields L-arabinose, D-galactose, D-glucouronic acid and L-rhamnose on hydrolysis.
- ✓Also contains enzymes - oxidase, peroxidase and pectinases.
- ✓About 14% water

IDENTIFICATION TESTS

- ✓Solubility test(soluble in water)
- ✓With lead acetate(no ppt)
- ✓With iodine solution(no reaction)

USES

- ✓General stabilizer in emulsions
- ✓Demulscent

HONEY

SYNONYMS

✓Madhu, Honey purified, Mel

BIOLOGICAL SOURCE

✓It is a sugar secretion deposited by the hive bee, *Apis mellifera* (f: Apidae) in the cells of the honeycomb.

Bee Hive

Honey

Collection & Preparation of Honey

- ✓The worker bee sucks the nectar of flower (25% sucrose & 75% water) through its hollow tube of mouth (proboscis) and deposits in honey-sac located in abdomen
- ✓The enzyme present in saliva of bee converts nectar into invert sugar which is partially utilized by bee & remaining deposited into honey-comb.
- ✓Honey comb smoked to remove the bees & honey obtained by applying the pressure or by allowing it to drain naturally
- ✓The honey of commerce heated to 80 degrees & allowed to stand.
- ✓Purified Honey BP prepared by melting honey at a moderate temperature, skimming off any impurities which collect on standing & diluting with water to a weight of 1.35-1.36 g/ml at 20 degrees.

CHEMICAL CONSTITUENTS

✓Honey is an aqueous solution of glucose 35%, fructose 45% and sucrose 2%

✓Also contains small amounts of essential oils, beeswax, pollen grains, colouring pigments, enzymes-diastase, invertase etc.

IDENTIFICATION TESTS

✓Solubility test(soluble in water)

✓Fiehe's Test-for knowing the purity of Honey.

Impure honey contains furfural which gives a red colour with resorcinol in HCl.

USES

✓Demulscent and sweetening agent

✓Common ingredient of cough mixtures

✓Antibacterial

TRAGACANTH

Tragacanth tree

SYNONYMS

✓Gum tragacanth, Tragacantha, gum dragon

BIOLOGICAL SOURCE

✓It is the dried gummy exudation by incision from stems and branches of *Astragalus gummifer* (f: Leguminosae)

Tragacanth gum

CHEMICAL CONSTITUENTS

✓Tragacanthin 8-10% - water soluble fraction & it contains 15% methoxy groups which swell in water & causes high viscosity of gum

✓Bassorin 60-70% - water insoluble fraction

✓The hydrolytic products of Tragacanth are galactouronic acid, D-Galactopyranose, L-arabino-rhamnose and D-xylopyranose

IDENTIFICATION TESTS

✓With ferric chloride(deep yellow ppt.)

✓With ruthenium red(no pink stain)

✓With potash(canary yellow colour)

✓With iodine solution(green colour)

USES

✓Demulscent & emollient

✓Thickening, suspending and emulsifying agent

Proteins & enzymes
Gelatin, caesin,
Proteolytic enzymes (papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin)

PROTEIN

- It is a complex, high mol. Wt. Organic compound, consists of amino acids joined by peptide bonds.
- Word protein derived greek: '*protos'* = '*of primary importance'.*
- Essential for structure and function of all living cells, for growth and repair
- Are enzymes or subunits of enzymes.
- Large molecules, having molecular masses of up to 3,000,000 (the muscle protein titin has a single amino-acid chain 27,000 subunits long).
- Long chains of amino acids are called proteins, shorter chain lengths are polypeptides', 'peptides', or rarely, 'oligopeptides
- 8 essential amino acids required by humans are: leucine, isoleucine, valine, threonine, methionine, phenylalanine, tryptophan, and lysine.

GELATIN: Syn: Gelatina, Gel foam, puragel

- B.S. : Obtained by evaporating an aqueous extract made from bones, skins, and tendons of various domestic animals. Some important sources are: Ox, *Bos taurus*, *and Sheep*, *Ovis aries belonging to family* Bovidae
- **Preparation:**
- **1. *Raw material:*** Bones, skins, and tendons of Bovideans
- ***2. Liming Process:*** skins and tendons are steeped for 15-20 or for 40 days in a dilute milk of lime. Fleshy matter dissolves, chondroproteins of connective tissues gets removed & fatty matter is saponified, then skin is thoroughly washed in running water.
- ***3. Defattying***
- bones is properly ground and defatted in close iron cylinders by treatment with organic solvents such as benzene. The mineral and inorganic part of the bone is removed by treatment with HCl

GELATIN: Syn: Gelatina, Gel foam, puragel

- 4. ***Extraction: T***reated material from bones, skins and tendons is boiled with water in open pans with perforated false bottom. The clear liquid runs of again and again and is evaporated until it reaches to above 45 per cent gelatin content.
- ***5. Setting:*** The conc. gelatin extract transferred to shallow metal trays/ trays with glass bottom. Allowed to set as a semisolid jelly.
- 6. ***Drying:*** The jelly, transferred to trays with a perforated wire netting bottom and passed through series of drying compartments of 30–60°C increasing each time with 10°C. For complete drying, it takes about month.
- ***Bleaching: If*** dark colour, finished product is subjected to bleaching by sulphur dioxide. Bleaching affords a light coloured gelatin.

GELATIN: Syn: Gelatina, Gel foam, puragel

- ***DESCRIPTION:*** colorless/slightly yellow, transparent, brittle, practically odorless, tasteless sheet, flakes or Course granular powder.
- In water it swells and absorbs 5–10 times its weight of water to form a gel in solutions below 35–40°C. It is insoluble in cold water and organic solvents, soluble in hot water, glycerol, acetic acid; and is amphoteric.
- Gelatinizing property of Gelatin is reduced by boiling for long time.
- quality of gelatin: jelly strength (Bloom strength) Bloom gelometer
- two types of gelatin, A and B: A has an isoelectric point between pH 7 and 9. incompatible with anionic compounds such as Acacia, Agar and Tragacanth.
- Type B has an isoelectric point between 4.7 and 5, and it is used with anionic mixtures

GELATIN: Syn: Gelatina, Gel foam, puragel

- **Chemical Constituents**
- Consist of protein glutin which on hydrolysis gives a mixture of amino acids.
- Approximate amino-acid are: glycine (25.5%), alanine (8.7%), valine (2.5%), leucine (3.2%), isoleucine (1.4%), cystine & cysteine (0.1%), methionine (1.0%), tyrosine (0.5%), aspartic acid (6.6%), glutamic acid (11.4%), arginine (8.1%), lysine (4.1%), and histidine (0.8%).
- gelatinizing nature is due to chondrin & adhesive nature due to glutin.
- ***USES:*** to prepare pastilles, pastes, suppositories, capsules, pill-coatings, gelatin sponge; as suspending agent, tablet binder, coating agent, as stabilizer, thickener and texturizer in food; for manufacturing rubber substitutes, adhesives, cements, lithographic and printing inks, plastic compounds, artificial silk, photographic plates and films, light filters for mercury lamps, clarifying agent, sizing paper and textiles, for inhibiting crystallization in bacteriology, for preparing cultures and as a nutrient.

GELATIN: Syn: Gelatina, Gel foam, puragel

- **Chemical Test**
- *Biuret reaction : 2ml* alkaline solution of a protein+ dil. Sol. $CuSO_4$ → red or violet color (if peptides have at least two peptide linkages).
- *Xanthoproteic reaction: Sample + Conc. HNO_3+ warm → yellow + alkali → o*range color
- *Millon's reaction: Millon's reagent (mercuric nitrate in HNO_3 +* trace of *HNO_2*)+ Sample solution → white precipitate + Heat→ Red
- *Ninhydrin test: Aq. Sample sol.*+ alcoholic sol. of ninhydrin + heat→ Red to violet colour
- 1g Gelatin + soda lime + heat → smell of ammonia
- 0.5g Sample+ 10ml H2O+ 10& tannic acid → buff col. Ppt
- Sample solution + picric acid solution→ yellow ppt

CASEIN:

- proteolytic enzyme obtained from the stomachs of calves. It is extracted from the proteins of the milk; in the milk, casein is structured in voluminous globules.
- It comprises about 80 per cent total protein content of milk. There are two types of casein in the market.
- Acid Casein: Warm skimmed milk is acidified with dilute acid, the whey is separated, curd is washed several times, dried and pulverised.
- Rennet Casein: Skimmed milk is treated with an enzyme, rennet extract; product is separated, and purified.
- Principal casein fractions are alpha (s1) and alpha (s2)-caseins, ß-casein and κ-casein. All have low solubility at pH 4.6.

CASEIN:

- **Description**: It is white, slightly yellow, tasteless, odourless, amorphous solid, hygroscopic, stable when dry but deteriorates rapidly when damp.
- **Solubility** : insoluble in H2O, sol. in dil. alkalies, conc. acids, precipitates from dil. acid solutions.
- **Chemistry of Casein**: Casein is a phosphoprotein, contain about 0.85% P & 0.75% S. Contains about 15 amino acids also rich in essential amino acids. Molecular weight 75000 - 3,70,000, Isoelectric point 4.7, Nitrogen content 15 – 16%.
- **Standards of Quality**:
- **Loss on drying**: Not more than 6.0 %
- **Sulphated ash**: Not more than 1.5%
- **Specific gravity**: 1.25 - 1.31.

CASEIN:

- **Chemical Constituents**
- Milk consists of 80% of milk proteins (casein). The major constituents of casein are alpha (s1) and alpha (s2)-caseins, ß-casein and kappa-casein. These caseins are conjugated proteins with phosphate group(s) which are esterified into serine residues they have a low solubility at pH 4.6.
- **Uses:** Useful dietary supplement source of protein in pre and post operative care; as a base in standardisation of proteolytic enzymes and as emulsifying agent. Industrially, used in sizing of textile and paper, as an adhesive, in preparation of casein plastic and casein paints. used by bodybuilders as a slow-digesting source of amino acids

ENZYMES

- Enzymes are the proteins which act as biological catalysts.
- Most enzymes act best at temperatures 35-40°C; above 65°C, & presence of moisture, destroy them, activity is negligible at 0°C.
- Although, they are soluble in water and dilute alcohol, concentrated alcohol precipitates them.
- pH of medium directly effect their action. Enzymatic activity reduces by HCHO, free iodine, heavy metals and tannins.
- enzymatic reactions proceed 8 to 10 times more rapidly than the corresponding non-enzymatic reactions.
- Classification of Enzymes:

ENZYMES

- **Classification of Enzymes:**

1. Hydrolases for catalysis of hydrolytic reactions.
2. Transferases for transfer of chemical group from 1 molecule to another.
3. Oxido-reductases catalyse the oxidation-reduction reactions.
4. Lyses catalyse the addition of groups to double bonds vice-versa.
5. Isomerases are responsible for intramolecular rearrangements.
6. Synthetases catalyse the condensation of two molecules coupled with the cleavage of pyrophosphate bond of ATP or similar triphosphate.

ENZYMES

On the basis of site of action:

Endoenzymes/intracellular: act only inside of cell: ex: synthetases, Isomerases, phosphorylases

Exoenzymes: secreted outside cell, ex: proteases, lipases, amylases acting on proteins, lipids or starch

Many of the enzymes also possess non-protein chemical groups. An enzyme moiety comprises a protein component 'apoenzyme', and a prosthetic group representing non-protein component.

The prosthetic group is also referred as cofactor or coenzyme. Certain metals and vitamins are coenzymes.

PAPAIN ENZYME

Biological Source: Mixture of proteolytic enzymes from latex of unripe fruit tree Carica papaya, family Caricaceae

Method of Preparation: latex of fruits is collected in aluminium trays + potassium metabisulphite (5 g/kg of latex) is added to latex. Extraneous matter is cleared by passing through sieves. latex is dried in vacuum shelf drier at 55-60°C. By spray-drying method can be done. Dried latex is called papain.

Description: light brown or white colored amorphous powder, typical odor & taste. Maximum proteolytic activity between pH 5 - 6. Soluble in water and glycerine.

Chemical Nature: Proteolytic enzymes present in papain are mixture of papain and chymopapain, proteolytic enzymes act on polypeptides and amides.

PAPAIN ENZYME

Identification Test:

1. It decolorises aqueous potassium permanganate solutions.
2. It causes curdling of milk (Proteolytic activity).

- It may digest about 35 times its weight of lean meat. Best grades
- render digestion of 200–300 times their weight of coagulated egg albumin in alkaline media.

Uses

Used in clarification of beverages & a meat tenderiser.

Employed in cheese manufacture as a substitute of rennin.

Used for degumming of silk fabrics in textile industry and in leather industry for removing hairs of skins and hides.

Medicinally, used as an anti-inflammatory agent.

One NF unit of papain represents the activity which releases equivalent of 1 µg of tyrosine from a standard casein substrate.

BROMELAIN ENZYME

- **Biological Source:** Bromelin is a mixture of proteolytic enzymes isolated from the stem & ripen fruit juice of *Ananas comosus (pineapple), family* Bromeliaceae.
- Preparation: fruits are left on plant to ripen to full flavor. Dark green unripe fruits gradually change to yellow and finally to deep orange. The fruits are cut off. The enzyme bromelin does not disappear as the fruit ripens. It is isolated from pineapple juice by precipitation with acetone and also with ammonium sulphide.
- **Characteristics**
- Optimum pH of enzyme 5.0–8.0. pH below 3.0 & above 9.5 inactivates the enzyme. Optimum temperature 50 & 60°C, effective between 20-65°C too. The moisture content should not exceed 6%.
- Odorless to slightly putrid , buff colored powder , with irritating taste.
- Slightly soluble in water. Insoluble in organic solvents : ether, chloroform, alcohol

BROMELAIN ENZYME

- **Chemical Constituents**
- not a single substance, but collection of enzymes & other compounds. It is a mixture of sulphur-containing protein-digesting enzymes, called proteolytic enzymes or proteases. It also contains several other substances in smaller quantities, including peroxidase, acid phosphatase, protease inhibitors, and calcium.
- **Uses**
- Fibrinolytic agent; inhibits platelet aggregation, antiinflammatory effect, Antibiotic potentiation: can modify permeability of organs & tissues to different drugs may be due to enhanced absorption, as well as increased permeability of the diseased tissue which enhances the access of the antibiotic to the site of the infection, digestive enzyme following pancreatectomy, minimizes the severity of angina pectoris and transient ischemic attacks, to treat oedema due to surgery and injury.

SERRATIOPEPTIDASE ENZYME

- **Biological Source:** proteolytic enzyme derived from the bacteria belonging to genus Serratia, present in the gut of silk worm. Originally, it was discovered in Serratia E15 species. Now-a-days, it is produced by fermentation bio-technology.
- **Preparation**
- Produced by fermentation technology by using nonpathogenic enterobacteria species such as *Serratia E 15. The larvae of silk moth produce this enzyme in* their intestine to break down cocoon walls. It can thus be obtained from the silk moth larvae.
- **Characteristics**
- vulnerable to degradation in acidic pH. destroyed by acid in stomach. By Enteric coated tablets absorption through intestine. One unit of the enzyme hydrolyses casein to produce color equivalent to 1.0 µmol of tyrosine per minute at pH 7.5 and 35°C.

SERRATIOPEPTIDASE ENZYME

- **Chemical Constituents**
- It is a proteolytic enzyme of protease type XXVI. The preparation contains 7.1 units/mg solid.
- **Uses**
- Widely prescribed antiinflammatory enzyme, Eliminates inflammatory oedema & swelling, accelerate liquefaction of pus and sputum, & enhance the action of antibodies.
- Used as fast wound healing agent. Proving to be a superior alternative to the nonsteroidal antiinflammatory drugs used to treat rheumatoid arthritis and osteoarthritis. Applications in trauma surgery, plastic surgery, Respiratory medicine, obstetric and gynaecology.

UROKINASE ENZYME

- **Synonym:** Uroquinase.
- **Biological Source: It** is serine protease enzyme isolated from human urine and from human kidney cells by tissue culture or by recombinant DNA technology.
- **Preparation**
- It is afibrinolytic enzyme produced by recombinant DNA using genetically manipulated *E. coli cells. P*roduced 1st as prourokinase, then converted to active form by plasmin or kallikrein. For medicinal use it is purified directly from human urine. A range of adsorbents like silica gel or kaolin can be used to concentrate and purify the product. Can further be purified by precipitation with NaCl or ethanol or by chromatography. Human urokinase needs sterile filtration, a septic filling and freeze drying.

UROKINASE ENZYME

- **DESCRIPTION**
- It occurs in 2 different forms : single and double polypeptide chain forms. Has a half-life of 10–16 minutes after I.V. administration.
- It is lyophilised white powder, soluble in water. It is an activator of endogenous fibrinolytic system, which converts plasminogen to plasmin and degrades fibrinogen, fibrin clots and other plasma proteins.
- **Chemical Constituents**
- They are serine proteases occur as a single low molecular weight (33 kDa) and double, high molecular weight (54 kDa) polypeptide chain forms.
- **Uses:** used to dissolve (lyse) fibrin or blood clots in anterior chamber of eye and in acute massive pulmonary emboli. administered I.V. dose of 4,400 units/kg body wt./ hr for 12 hrs.

STREPTOKINASE ENZYME

- **Synonym:** Estreptokinase, plasminokinase.
- **Biological Source:** It is purified bacterial protein produced from the strains of group C β-haemolytic *S.griseus*.
- **Preparation**
- It is a bacteria derived enzyme of serine protease group. It is produced by fermentation using streptococcal culture and isolated from the culture filtrate. It is produced in the form of a lyophilized powder in sterile vials containing 2,50,000 to 7,50,000 IUs.
- **Description**: Sterile, friable solid or white powder. Soluble in water with maximum activity at pH 7. Solution at higher conc. is stable for 6 hours at 4°C, otherwise dilute solutions are unstable.
- **USES:** Treatment of thromboembolic disorders for the Lysis of pulmonary emboli, arterial thrombus, deep vein thrombus & acute coronary artery thrombosis. Activity is due to activation of plasminogen to a proteolytic enzyme namely plasmin which degrades fibrin clots, fibrinogen and other plasma proteins.

PEPSIN ENZYME

- **Biological Source:** animals. It is obtained from the glandular layer (mucous membranes) of fresh stomach of hog, Sus scrofa var–domesticus, belonging to family Suidae.
- **Preparation**
- Minced stomach linings are digested with HCl, 37°C, 2hr followed by clarification, controlled evaporation, dialysis and concentration of the digested solution. When processed, solution is subjected carefully to vacuum evaporation, spongy pepsin is obtained.
- **Description**: Light buff or white coloured amorphous powder. Also occurs as translucent scales. Has a little acidic or saline taste with slightly meaty odour. Soluble in water, insoluble in alcohol, ether & chloroform. If heated with alkali or pancreatic enzymes, biological activity is lost. Shows maximum activity at pH 1.8. Pepsin has the capacity to digest 2500 times its weight of coagulated egg albumin. It is also available in other forms which may digest even up to 10,000 times their weight of coagulated egg albumin.

PEPSIN ENZYME

- USES:
- It is used in the deficiency of gastric secretion. Pepsin is also used in the laboratory analysis of various proteins; in the preparation of cheese, and other protein-containing foods.

LIPIDS
(Waxes. Fats & Fixed Oils)
Castor oil, Chaulmoogra oil, Wool Fat & Beeswax

LIPIDS

- Substances of animal or plant origin and comprise of fixed oils, fats and waxes.
- Large and diverse group of naturally occurring organic compounds that are related by their solubility in nonpolar organic solvents
- **FIXED OR FATTY OILS:** They are reserve food materials of plants and animals.
- When liquid at 15.5° -16.5°C, **called fixed oils;**
- Which are solid or semi-solid at above **temperature are fats.**
- Fixed oils, derived from plant sources, occur generally in seeds.
- **Properties:**

1. **Fixed oils** are thick, viscous, yellow coloured liquids with characteristic odor.
2. They are non-volatile and cannot be distilled.
3. They do have food value and can be saponified.
4. They turn rancid on storage due to free acidity.
5. Fixed oils and fats are insoluble in water and ethyl alcohol, but soluble in organic solvents like chloroform; ether; petroleum-ether and benzene.

LIPIDS

6. Fats and oils are esters of glycerol (three carbon trihydric alcohol) and various straight chained monocarboxylic acids, known as fatty acids. The fatty acids of natural fats have 4 - 24 carbon atoms (and any even number). These fatty acids may be saturated, monounsaturated, polyunsaturated or cyclic unsaturated. The cyclic unsaturated fatty acids are hydnocarpic, chaulmoogric and prostanoic.
7. They also contain various components in minor quantities such as vitamins, sterols, anti-oxidants, phospholipids, pigments and traces of hydrocarbons, and ketones, which are responsible for specific odours and flavours of these oils.
8. Fats have more % of saturated acids

LIPIDS

Chemical Tests for Identification of Fixed Oils or Fats

Fixed oils or fats can be confirmed by chemical test for glycerine which is produced by their hydrolysis.

The test is performed as under:

1. **Using Sodium Hydroxide**: Mix 1 ml 1% $CuSO_4$ solution + 5 drops of fixed oil/fat + add 5 drops of 10 % NaOH→ clear blue solution (glycerine is present) The cupric hydroxide formed in the reaction does not precipitate out as it is soluble in glycerine.

2. **Using Sodium Hydrogen Sulphate**: 5 drops of sample in test tube + add pinch of sodium hydrogen sulphate →Pungent odor indicates glycerine is present. The pungent odor is due to the formation of acrolein.

LIPIDS

ADULTERATION IN OILS/FATS/WAXES

1. Detection of sesame oil as adulterant: 2 ml oil + 1 ml HCl, 1 % sucrose, keep aside for 5 min. → pink color in the acid layer → presence of sesame oil.
2. Detection of cotton seed oil as adulterant by Halphen's test:

   2 ml oil + 2.5 ml alcohol +2.5 ml sol. of S in CS_2 (1%) + Heat → pink or red color → presence of cotton seed oil
3. Detection of karanja oil as adulterant:

   5 ml sample oil + 10 ml ethyl alcohol +5 drops of $FeCl_3$, Shake vigorously for 2 min. allow to stand for 2 hours → light blue to dark color in alcoholic layer → presence of karanja oil or any other oil containing phenolic group.
4. Detection of castor oil as adulterant:

   1 ml sample + acidified petroleum ether (60 - 80°C), Shake, + add drop of ammonium molybdate solution → white turbidity indicates the presence of castor oil.

LIPIDS

ADULTERATION IN OILS/FATS/WAXES

5. Detection of argemone oil as adulterant:

   It is an adulterant to mustard oil. $FeCl_3$reacts with argemone oil in HCl medium to produce small needle shaped reddish brown crystals. However, if content of argemone oil is less than 1 per cent, needle-shaped crystals can be observed under microscope.

6. Detection of linseed oil as adulterant:

   1 ml sample + dissolved in 5 ml $CHCl_3$ + 1 ml liq. Br_2, stopper, cool in ice bath + add1.5 ml rectified spirit +10 ml ether, shake for 30 min. → appearance of precipitate (due to formation of hexabromide) → presence of linseed oil.

7. Detection of mineral oil as adulterant:

   1 ml oil or fat + add 25 ml alcoholic KOH + Boil in water bath till clear. Transfer to wide mouth test tube + add 25 ml dist. H_2O along side of the test tube, shake tube during addition of H_2O → turbidity indicates presence of mineral oil.

WAXES

- Waxes are unctuous, fusible, variably viscous solid substances, with characteristic waxy lustre.
- These are esters of fatty acids with high weight monohydric alcohol, such as cholesterol, cetyl alcohol, melissyl alcohol, etc.
- They are insoluble in H_2O, soluble in most organic solvents.
- Obtained from vegetable and animal sources
- (a) Vegetable: Seasal wax, carnauba wax, Japan wax, bayberry wax
- (b) Animal: Spermaceti, bees wax, wool fat
- Difference between fats and waxes: fats may be saponified by either aqueous or alcoholic alkali, but waxes are only saponified by alcoholic alkali.
- Waxes are unsuitable for internal consumption, as no enzyme in human body to hydrolyse

Analytical Parameters for Oils and Fats

1. Iodine value: Defined as weight of I_2 absorbed by 100 parts by weight of the sample of fat or oil. I_2 value is a measure of the extent of unsaturation. Susceptibility to rancidity ↑ses for the oil or fat with higher I_2 values.
2. Saponification value: Defined as the number of mg of KOH required to neutralize the fatty acids resulting from complete hydrolysis of 1 g of the sample of oil or fat. Applied for butterfat, coconut oil in which lower fatty acids glycerides occur in high content.
3. Hydroxyl value: Defined as number of mg of KOH required to neutralise the CH_3COOH capable of combining by acetylation with 1 g sample of fat or oil.

Analytical Parameters for Oils and Fats

4. Acetyl value: Number of mg of KOH required to neutralize CH_3COOH obtained when 1 g of sample acetylated oil is saponified. Except castor oil (acetyl value 150), most of the oils and fats have low acetyl value (3 - 15).

5. Unsaponifiable matter: It is the matter present in fats and oil, which after saponification by caustic alkali and subsequent extraction with an organic solvent, remains non-volatile on drying at 80°C. It includes sterols (phytosterol and cholesterol), oil soluble vitamins, hydrocarbons and higher alcohols. Paraffin hydrocarbons can be detected by this method as adulterants.

6. Acid value: Defined as the number of mg of KOH required to neutralise the free acids present in 1 g sample of fat or oil. Rancidity causes free fatty acids liberation, hence acid value is used as an indication of rancid state.

7. Peroxide value: It is a measure of peroxides present in oil. A peroxide value is generally less than 10 meq/kg in fresh samples of oil. Due to temperature or storage, rancidity occurs causing increase in peroxide values.

Analytical Parameters for Oils and Fats

8. Kreis test (rancidity index): Due to rancidity, epihydrin aldehyde or malonaldehyde are increased which are detected by Kreis test using phloroglucinol which produces red color with oxidized fat.
9. Ester value: Defined as number of mg of KOH required to combine with fatty acids which are present in glyceride form in 1 g sample of oil or fat. Difference between saponification value and acid value is ester value.
10. Reichert Meissle Value: This value is a measure of volatile water soluble acid contents of the fat. It is defined as number of ml N/10 KOH required to neutralise the volatile water soluble fatty acids obtained by 5 g fat.
11. Polenski value: It is defined as the number of ml of N/10 KOH solution required to neutralise water insoluble, steam distillable acids liberated by hydrolysis of 5 gm of fat.

CASTOR OIL: RICINUS OIL

Castor oil is fixed oil obtained by cold expression of seeds of *Ricinus communis*, family Euphorbiaceae.

Preparation : Prepared by 2 methods

1st : By crushing whole or decorticated seeds in hydraulic presses

2nd known as Ghani: manually operated screw press driven by bullocks. Obtained oil is Non-medicinal castor oil.

Seeds are graded, made free of impurities, decorticated , hulls are removed. If seeds not decorticated, the manurial value of the cake ↑ses.

For medicinal purposes, seeds are decorticated, it improves the color of oil & helps control acid value. Decorticated seeds are pressed at pressure of 2 tonnes/ sq. inch, helps in extracting out 30% of the oil present in the seeds at room temperature.

The oil is called as cold drown oil, steamed at 80°C, destroys the enzyme lipase & ricin (toxic protein), bleached, de acidified with Na_2CO_3 to remove free fatty acid, washed with hot water before steaming to remove the mucilagenous matter, finally treated with activated charcoal, filled

CASTOR OIL: RICINUS OIL

Description : Color: Pale yellow or almost colorless liquid. Odor: Slight and characteristic. Taste: First bland then acrid, nauseating. It is viscous, transparent liquid. Soluble in alcohol; miscible in $CHCl_3$, ether, gl. CH_3COOH, insoluble in mineral oil.

Chemical Constituents: Seeds contain 35 – 50% of castor oil. Triglyceride of ricinoleic acid (80%). Fatty acids represented by isoricinoleic, linoleic, stearic and isostearic acids. Viscosity of the castor oil is due to ricinoleic acid. Ricinoleic acid: $CH_3(CH_2)_6CHOHCH_2CH=CH(CH_2)_7COOH$. Also contain heptaldehyde (heptanal) undecenoic acid and sebacic acid.

Identification Test:

1.It mixes with ½ its volume of light petroleum ether (40 – 60°C) but insoluble in double the volume of petroleum ether.

2. Oil+ equal volume of ethanol→ clear liquid obtained → cool at 0°C, → store for 3 hrs → liquid remains clear (distinction from other fixed oils).

CASTOR OIL: RICINUS OIL

USES:

Fatty acid : ricinoleic; heptaldehyde and undecenoic acid prepared from castor oil. Used in preparation of paints, enamel, varnishes, grease, polishes, printing ink, hydraulic, brake spirit.

cathartic property is due to irritant action of ricinoleic acid. Used in abortificient paste and ricinoleic acid is used in contraceptive creams and jellies. Atropine and cocaine for opthalmic use are suspended in castor oil. As an emollient in preparation of lipsticks, imparts transparency to soaps, for manufacture of sebacic acid (raw material for resins), in production of rigid, semi-rigid foams and urethanes called elastomers, used for trolley wheels, as basic raw material to mfg. nylon - 11. Castor cake used as source of enzyme lipase. Castor oil does not freeze at lower temperature, is valuable as lubricant.

Chaulmoogra oil/ Hydnocarpus Oil/ Gynocardia Oil

Biological Source: It is fixed oil obtained by cold expression method from ripe seeds of the plant *Taraktogenos Kurzii*, *and Hydnocarpus anthelmintic*, *Hydnocarpus heterophylla* & other species of the *Hydnocarpus*, family Flacourtriaceae.

Method of Preparation: Seeds are sub-ovoid, obtusely angular and 2 cm in length. The seeds contain 40-45% fixed oil. Seeds are decorticated by machine after grading the kernels are pressed with the hydraulic press and the oil obtained is filtered.

Description: Color: Yellow to brownish-yellow liquid

Odor: Characteristic, Taste: Somewhat acrid, Solubility:slightly soluble in alcohol, soluble in $CHCl_3$, ether, benzene & CS_2. It is soft white solid below 25°C.

Chaulmoogra oil/ Hydnocarpus Oil/ Gynocardia Oil

Chemical Constituents: Contains chemical esters of unsaturated fatty acids of chaulmoogric acid (27%) & hydnocarpic acid (48%), gorlic acid, about 20.0% of proteins, cyanophoric glycosides & glycerides of palmitic acid and oleic acids.

Uses: Strong bactericidal effect, against Mycobacterium leprae, & M. tuberculosis, treatment of TB, leprosy, psoriasis & rheumatism, seeds contain cyanophoric glycosides oil cake is not edible and can not be used as food for animals.

Storage: stored in closed containers away from light and in cool place.

Substituted plants in India: Hydnocarpus wightiana (WestBengal) Hydnocarpus alpine (Karnataka, Kerala & Tamil Nadu).

Dose: 0.3 to 1 ml; intramuscular or subcutaneous injection.

WOOL FAT: Lanolin, Adeps Lanae

Botanical Source: Hydrous wool fat is purified fat like substance obtained from the wool of the sheep Ovis aries Linn. family Bovidae. It contains between 25-30% of water. It is the secretion of sebaceous glands of sheep deposited onto the wool fibres.

Method of Preparation: Raw wool contains about 31% wool fibres, suint or wool sweat (K salts of fatty acids), about 32 % earthy matter and about 25% wool grease or crude lanolin. Crude lanolin is separated by washing with H_2SO_4 or suitable organic solvent or soap solution., purified and bleached. The product known as anhydrous lanolin or wool fat. The hydrous wool fat is produced by intimately mixing wool fat with 30.0% water.

Description: Color: Whitish-yellow, Odor: Faint and characteristic Taste: Bland

Extra Features: It is found in the form of ointment like mass and on heating in water bath, it separates into two layers.

WOOL FAT: Lanolin, Adeps Lanae

Solubility: insoluble in water, soluble in $CHCl_3$ & solvent ether with separation of water.

Chemical Constituents: Complex mixture of esters and polyesters of 33 high molecular weight alcohols & 36 fatty acids. Hydrous wool fat contains mainly esters of cholesterol and isocholesterol with carnaubic, oleic, myristic, palmitic, lignoceric, and lanopalmitic acids. It also contains 50 % of water.

Identification Test: 0.5 g sample + $CHCl_3$ + 1 ml acetic anhydride + 2 drops of H_2SO_4 → green color → presence of cholesterol.

Uses: The lanolin is mainly used as water absorbable ointment base. It is a common ingredient and base for several water soluble creams and cosmetic preparations. It can be allergic also.

YELLOW BEESWAX/ CERA FLAVA

Biological Source: It is purified wax obtained by melting the walls of the honey comb of the bees *Apis mellifica* and other species of Apis, belonging to family Apidae.

Preparation: combs & capping of honeycomb are broken & boiled in soft water, then enclosed in porous bag weighted to keep under water, boiling causes oozing of the wax, gets collected outside the bag & forms a cake after cooling. The debris on outer surface, removed by scraping. Purified by heating in boiling H_2O/ dilute H_2SO_4 & settling, process repeated & finally wax is skimmed off. bleach the wax by treating with H_2O_2, chromic acid, ozone, charcoal, chlorine or $KMnO_4$, natural bleaching exposing the wax to sunlight.

Description: Color: Yellow to yellowish-brown Odor: Agreeable and honey-like

YELLOW BEESWAX/ CERA FLAVA

Solubility: insoluble in H_2O, soluble in hot alcohol, ether, $CHCl_3$, CCl_4, fixed & volatile oils.

Chemical Constituents: consists of esters of straight chain monohydric alcohols with straight chain acids. Chief constituent of the bees wax is myricin i.e. myricyl palmitate (about 80 %). Free cerotic acid (about 15%), small quantities of melissic acid and aromatic substance cerolein are the other constituents. Indian bees wax is characterised by its low acid value, while European bees wax has the acid value of 17 to 22.

Chemical Test: Saponification claud test: 0.5 gm+ 20 ml aq. caustic soda solution+ boil for 10 minutes. Cool, No turbidity

YELLOW BEESWAX/ CERA FLAVA

Uses: used in preparation of ointments, plasters and polishes, in ointment for hardening purposes & manufacture of candles, moulds & dental & electronic industries, in lipsticks & face creams. It is an ingredient of paraffin ointment IP.

Adulterants: colophony, hard paraffin, stearic acid, Japan wax, spermaceti, carnauba wax & other substances.

Adulteration can be detected on the basis of solubility and melting point.

The genuine wax should not give turbidity when 0.5 g of wax is boiled with 20 ml of aqueous caustic soda for 10 minutes and cooled.

White beeswax: Obtained by bleaching yellow bees wax, should not be used for ophthalmic purposes.

MARINE
Novel medicinal agents from marine sources

Marine drugs

- Oceans cover more than 70% of the earth's surface with over 200,000 invertebrates and algal species.
- Commonly used Drugs obtained from marine organisms which are being used are shark & cod-liver oils, sodium alginate, agar-agar, and chitin etc.
- Classification

Class	Examples
Antibiotic compunds	Cycloeudesmol, variabilin, Ircinin-1
Anti inflammatory & anti spasmodic	Manoalide, Tetrado toxin
Antimicrobial compd	Holotoxin ABC, Tholepin, eunicin acanthelin
Cardiovascular active compd	Anthopleurins, Laminine, Eptatretin, saxitoxin, spongosine, eledosin, ATX-II, Autonomium
Anti cancer (cytotoxic)	Ara-c, crassin acetate simularin.
Marine toxins compds	Ciguatoxin, Palytoxin, Saxitoxin, Brevetoxin
Miscellaneous compd	Kainic acid, Domoic acid, Aplysinopsin.

ANTIBIOTICS COMPOUNDS

Organism	Antibiotic Substance
Marine bacterium, Pseudomonas bromutilis	2, 4 - Dibromo - 6 - (3, 4, 5 tribromopyrrole - 2 - yl) phenol
Red algae, Chondria oppositiclada	Cycloeudesmol
Sponge, Ircinia strobilina and Ircinia oros	Variabilin, Ircinin – 1
Sponge, Verongia archery	3, 5 - dibromo - 4 - hydroxy benzene-1 acetamide

ANTI INFLAMMATORY COMPOUNDS

Organism	Anti inflammatory Substance	MOA/ uses
Luffariella variabilis (sponge)	Manoalide (analgesic also)	it acts by direct inactivation of phospholipase A2enzyme present in some neurotoxins and also has a role in synthesis of prostaglandins
Phyllospongia dendyi; sponge	dendalone 3hydroxy butyrate	Antiinflammatroy
soft coral, Sinularia flexibilis	flexibilide	
Brown algae, Caulocystis cephalornithos.	6-n-tridecyl salicylic acid	
Flustra foliaceae, a Swedish marine moss.	Flustramine A& B	Muscle relaxant
liver and ovaries of puffer fishes	Tetradotoxin	strong antispasmodic.

ANTI MICROBIAL COMPOUNDS

Organism	ANTIMICROBIAL
Sea cucumber, Stichopus japonicus	Holotoxin A, B and C (steroida glycoside) antifungal in nature Zonarol and iso-zonarol
Brown algae, Dictyopteris zonaroides	Tetrabromoheptanone
Red algae, Bonnemaisonia hemifera	Four isomers of polyhalo 3 butene - 2 - one and seven isomers of polythaloacetones.
Red algae, Asparogopsis taxiformis.	Aeroplysinin-1 (+)
Sponge, Verongia aerophoba	Aeroplysinin-1 (-)
Sponge, Agelas oroides	2 - cyano - 4, 5 – dibromo pyrrole
Red algae, Laurencia pacifica and L. filformis.	Prepacifenol
Annelida, Thelepsus setosus	Tholpin
Sea hare, Aplysia californica	Debromolaurenterol
Gorgonian corals, Eunicia mammosa	Eunicin
Acanthella acuta	Acanthelin -1 (active against Mycobacterium)

CARDIOVASCULAR ACTIVE SUBSTANCES

Organism	Compounds
peptides obtained from coelenterates Anthropleura xanthogrammica A. elegantissima	Anthopleurins: (AP - A and AP - B); type C (AP – C)
aneural bronchial hearts of pacific hogfish viz. Eptatretus stoutii.	Eptatretin
marine algae, Laminaria angustata	Laminine
Octopus macropus, O. vulgaris and Eledone moschata	D (–) Octopamine
Saxidomus giganteus, and California mussel, Mytilus californianus.	Saxitoxin
sea anemones	ATX – II (POLYPEPTIDE)
Sea cucumbers, Holothuroidae family	Holothurins (triterpenoids moiety)
star fishes of family Asteroidae	asterosaponins (steroidal aglycone)
Caribbean sponge Crypotethia crypta.	Spongosine (nucleoside)
posterior salivary glands of cephalopod Eledone moschata.	Eledosin

ANTICANCER SUBSTANCES

Organism	Compounds
Caribbean sponges: spongosine and spongouridine.	Ara –C: 1 - α - D - arabinofuranosyl cytosine or cytosine arabinoside. Used in acute myelogenous leukemia and human acute leukemia,
Caribbean gorgonian, Pseudoplexaura porosa (soft corals)	Crassin acetate cyclic diterpene human leukemic and HeLa cells in-vitro.
Soft coral Sinularia flexibilis	simularin, dihydrosimularin and simulariolide.
Gorgonian coral	Asperdiol
Aplidium species	geranyl hydroquinone (cytotoxic to leukemia and mammary carcinoma)
Sea hare Aplysia angasi	aplysistatin (antileukemic)
Sponge Haliclona viridis;	halitoxin (antitumour)
Algae Lyngbya majuscula; Sea sqirt Ecteinascidia turbinata.	majusculamine - C (inhibitor of X - 5563 myeloma)

MARINE TOXINS

Organism	Compounds	Effects
Gonyaulax catenella G. tamarensis	saxitoxin	depolarises membranes, permeability alteration to Na+
Haliclona rubens	holotoxin	potent neuromuscular blocker
Gambier discus toxicus	maitotoxin	stimulates calcium channels in insect skeletal muscles
Palythoa species	palytoxin	most potent coronary vasoconstrictor
Lophogorgia rigida	lophotoxin	neuromuscular blocker
Ptychodiscus brews	brevetoxin	positive inotropic and arrhythmogenic
Gambier discus toxicus	ciguatoxin	respiratory depression and bradycardia
Babylonia japonica	neosurugatoxin	potent blocker of sympathetic ganglia and a specific blocker of nicotinic Ach receptors

MISCELLLANEOUS COMPOUNDS

Organism	Compounds	Effects
red algae: Digenea simplex	Kainic acid	potent convulsant, antiascariatic activity.
red algae Chondria armata	domoic acid	activity against ascaris and pinworm.
marine annelid, Lumbriconeris heteropoda	nereistoxin	insecticide due to its ganglion blocking effects
Sponge	Didemnins A, B and C	against Herpes simplex type-2 virus in mice
Sponge	Ara - Aadenine arabinoside	Herpes encephalitis.
yellow sponge, Verongia spengeli	aplysinopsin	antidepressant action in animals, cytotoxic activity.
Eucheuma, Chondrus and Gigartina	carrageenan	anticoagulant agent.

THANK YOU