Chapter-16

Chemistry In Everyday Life

LECTURE 01

Drugs and their classification.

Drugs: These are chemicals that interact with macromolecular targets and produce a biological response. When the biological response is therapeutic and useful, these chemicals are called medicines and are used in diagnosis, prevention, and treatment of disease.

Classification:

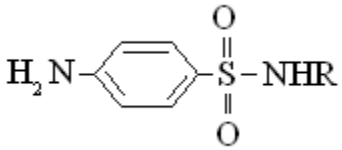
- Based on the pharmacological effect
- Based on drug action.
- Based on chemical structure.
- Based on the molecular target.

Based on the pharmacological effect: It is useful for doctors because it provides them the whole range of drugs available for the treatment of a particular type of problem.

e.g., analgesics have a painkilling effect; antiseptics kill or arrest the growth of microorganisms.

Based on drug action: It is based on the action of a drug on a particular biochemical process. e.g., histamines inhibit the action of the compound, histamine which causes inflammation in the body.

Based on Chemical structure: It is based on the chemical structure of the drug having similar pharmacological activity. e.g., sulphonamides.



Based on molecular target: These are the drugs that usually interact with biomolecules, such as carbohydrates, lipids, proteins, nucleic acids, etc. These are called target molecules or drug targets.

Drug-Target Interaction:

Enzymes as drug targets:

(a)The catalytic action of enzymes: Enzymes perform two major functions in their catalytic activity.

First Function: Enzymes hold the substrate for a chemical reaction. Active sites of enzymes hold so that it can be attacked by the reagent effectively. The active sites of the enzyme are bonded by the substrate through ionic bonding, hydrogen bonding, Vander Waals interaction, or dipole-dipole interaction.

The second function: Enzymes provide functional groups that will attack the substrate and carry out chemical reactions.

(b)**Drug-enzyme Interaction:** Drugs can block the binding site of the enzyme and prevent the binding of substrate, or can inhibit the catalytic activity of the enzyme. Such drugs are called enzyme inhibitors. These are of two types:

(i) Competitive inhibitors

(ii) Non-competitive inhibitors

Competitive inhibitors: These are the drugs that compete with the natural substrate for their attachment to the active sites of enzymes.

Non-competitive inhibitors: These are the drugs which do not bind to the active site of the enzyme. These bind to a different site of enzymes called allosteric sites which change the shape of the active site.

If the bond formed between an enzyme and an inhibitor is a strong covalent bond and cannot be taken easily, then the enzymes are blocked permanently. The body then degrades the enzyme-inhibitor complex and a new enzyme is synthesized.

Receptors as drug targets: Receptors are proteins that are crucial to the communication process of the body. These are embedded in the cell membrane in such a way that their small part possessing active site projects out of the surface of the membrane and opens on the outside region of the cell membrane. Certain chemicals known as chemical

messengers are received at the binding sites of receptor proteins as a result shape of the receptor site changes. This brings about the transfer of messages into the cell. Receptor regains structures after the removal of a chemical messenger.

Drugs that bind to the receptor site and inhibit its natural function are called antagonists, which are useful when blocking a message is required.

Drugs that mimic the natural messenger by switching on the receptor are called agonists which are useful when there is a lack of natural chemical messenger.

LECTURE 02

Antacids: These are the chemicals used for the treatment of acidity in the stomach.

Example: Sodium hydrogen carbonate or a mixture of aluminum and magnesium hydroxide.

However, in advanced stages, acidity leads to ulcers in the stomach which become life-threatening and its only treatment is the removal of the affected part of the stomach.

Other examples of drugs used as antacids are cimetidine, ranitidine.

Antihistamines: These are the synthetic drugs that interfere with the natural action of histamines by competing with histamine for binding sites of receptor where histamine exerts its effects.

Example: Brompheniramine (Dimetapp), terfenadine (Seldane)

Neurologically active drugs: Example - Tranquilizers, analysis.

(a) **Tranquilizers:** These drugs are used for the treatment of stress and mental diseases.

Example: Chlordiazepoxide, meprobamate, Equanil, Valium, Serotonin, iproniazid.

Chlordiazepoxide and propagate are used for relieving tension. Equanil is used for controlling depression and hypertension.

(b) **Analgesics:** These are the drugs that reduce pain without causing impairment of mental confusion or some other disturbances of the nervous system. These are of two types :

- Non-narcotic analgesic
- Narcotic analgesics

Non- narcotic analgesics: These drugs are effective in relieving skeletal pain such as that due to arthritis. These also reduce fever and preventing platelet coagulation.

Example: Aspirin, Paracetamol

Aspirin inhibits the synthesis of chemicals known as prostaglandins which stimulate inflammation in the tissue and cause pain. Aspirins due to their anti-blood clotting action find use in the prevention of heart attacks.

Narcotic analgesics: These analgesics are chiefly used for the relief of post-operative pain, cardiac pain, pains of terminal cancer, and childbirth.

Example: Morphine, Heroin, codeine

Antimicrobials: These are the drugs which inhibit the pathogenic action of microbes such as bacteria, fungi, virus, and other parasites.

Example: Antibiotics, antiseptics, disinfectants.

Antibiotics: These are substances produced wholly or partly by chemical synthesis which in low concentrations inhibit the growth or destroy microorganisms by intervening in their metabolic processes. These have either a civil (killing) effect or static (inhibitory) effect on microbes.

Example: Bactericidal antibiotics: Penicillin, aminoglycosides, ofloxacin.

Bacteriostatic antibiotics: Erythromycin, tetracycline chloramphenicol.

Based on the spectrum of action, antibiotics are classified into two types, broad-spectrum antibiotics, and narrow-spectrum antibiotics.

Broad-spectrum antibiotics: These are the antibiotics that kill or inhibit a wide range of Gram-negative bacteria.

Example: Ampicillin, Amoxicillin, chloramphenicol, vancomycin, ofloxacin.

Narrow spectrum antibiotics: These are the antibiotics that inhibit Gram-positive or Gram-Negative bacteria.

Example: Penicillin G

Antiseptics: These are the chemicals that either kill or prevent the growth of microorganisms. These are applied to the living tissues such as wounds, cuts, ulcers, and diseased skin surfaces.

Example: Francine, saframicine, Chloroxylenol, Terpineol, Bithionol, iodine, iodoform.

Bithionol is added to soaps to impart antiseptics properties.

Tincture of iodine: 2-3 percent of iodine solution in an alcohol-water mixture is called the tincture of iodine.

Disinfectants: These are the chemicals that either kill or prevent the growth of microorganisms. These are applied to inanimate objects such as floors, drainage systems, instruments, etc.

Example: 1% solution of phenol, 0.2 to 0.4 ppm of chlorine, low concentration of SO2.

Antifertility drugs: These are the drugs used to control the population. Birth control pills mainly contain a mixture of synthetic estrogens and progesterone derivatives. Both of these compounds are hormones. Progesterone. Suppresses ovulation. An example of progesterone is norethindrone which is widely used as an ant fertility drug. Another example is the novel stroll.

LECTURE 03

Chemicals in food:

Chemicals are added to food for their preservation and adding nutritive value to them.

Main categories of food additives are

a) Food colors

b) Flavors and sweet enters

c) Flat emulsifiers and stabilizing agents

d) Antioxidants

e) Preservatives

f) A nutritional supplement such as minerals, vitamins, and amino acids.

Artificial Sweetening Agents: These are the drugs helpful for diabetic patients and people who need to control the intake of calories.

Example: Saccharin, sucralose, Alitame, Aspartame.

Aspartame is roughly 100 times as sweet as cane sugar. It is limited to cold foods and soft drinks because it is unstable at cooking temperatures.

Sucralose is a trichloro derivative of sucrose. Its appearance and taste are like sugar. It is stable at cooking temperature. It does not provide calories.

Food Preservatives: These prevent spoilage of food due to microbial growth.

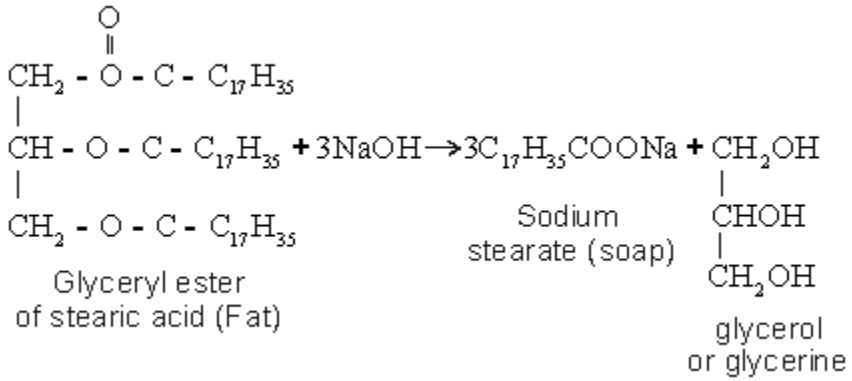
Example: Table salt, sugar, vegetable oils, sodium benzoate, salts of sorbic acid, and propanoic acid.

Cleansing Agents: Two types of detergents are used as cleansing agents. These are soaps and synthetic detergents, which improve the cleaning properties of water and help in the removal of fats that bind other materials to the fabric or skin.

Soaps: Soaps are sodium and potassium salts of long-chain fatty acids e.g., stearic, oleic, and palmitic acids.

Preparation: Saponification:

Soaps containing sodium salts are formed by heating fat (I.e, glycerol ester of fatty acid) with aqueous sodium hydroxide solution.



In the above reaction, ester of fatty acids is hydrolyzed and the soap obtained remains in colloidal form. It is precipitated from the solution by adding sodium chloride. The solution left after removing the soap contains glycerol, which can be recovered by fractional distillation. Only sodium and potassium soaps are soluble in water and are used for cleaning purposes.

Types of Soaps: These are different types of soaps like toilet soaps, transparent soaps, medicated soaps, shaving soaps, laundry soaps.

Toilet soaps: These are prepared by using better grades of fats and oils containing less amount of alkali. Colour and perfumes are added to make these more attractive.

Transparent soaps: These are made by dissolving the soap in ethanol and then evaporating the excess solvent.

Medicated soaps: These are made by adding substances of medicinal value to the soap.

Shaving Soaps: These contain glycerol to prevent rapid drying.

Laundry Soaps: These contain fillers like sodium resinate, sodium silicate, borax, and sodium carbonate.

Why do soaps not work in hard water?

Answer: Hard water contains calcium and magnesium ions. These ions form insoluble calcium and magnesium soaps respectively when sodium or potassium soaps are dissolved in hard water.

$$\underset{\text{Soap}}{2C_{17}H_{35}COONa} + CaCl_2 \rightarrow 2NaCl + \underset{\text{Insoluble calcium strerate(soap)}}{(C_{17}H_{35}COO)_2Ca}$$

These insoluble soaps separate as scum in water which adheres to the fiber of the cloth as gummy mass. Hair washed with hard water looks dull because of this sticky precipitate.

Synthetic detergents: These are cleansing agents that have all the properties of soaps, but which do not contain any soap. These can be used both in soft and hard water as they give foam even in hard water. Some detergents also give foam in ice-cold water.

These are mainly of three types.

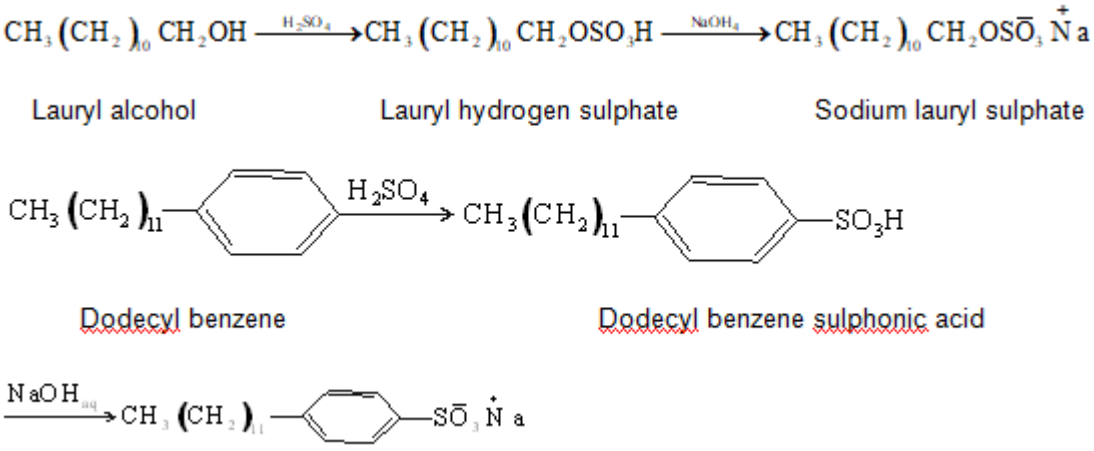
(a) Anionic detergents

(b) Cationic detergents

(c) Non-ionic detergents

Anionic detergents: These are sodium salts of sulfonated long-chain alcohols and hydrocarbons.

Example: Sodium Lauryn sulphate, sodium dodecylbenzene sulphonate.



(Sodium dodecylbenzene sulphonate)

In anionic detergents, the anionic part of the molecule is involved in the cleansing action. These are used in household work and toothpaste.

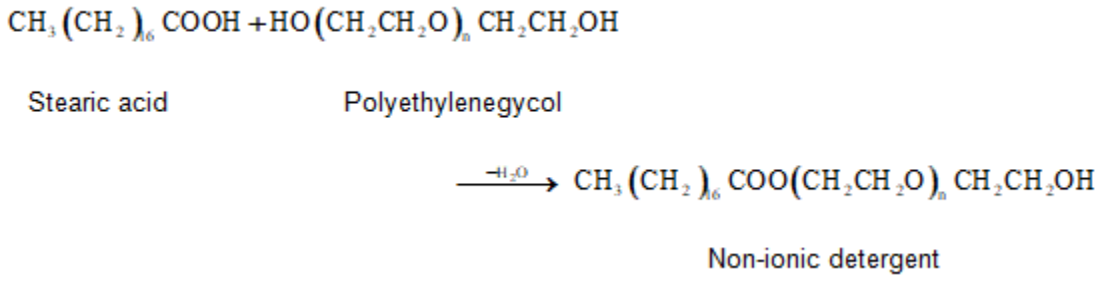
Cationic detergents: These are quaternary ammonium salts of amines with acetates, chlorides, and bromides as anions. The cationic part possesses a long hydrocarbon chain and a positive charge on the nitrogen atom. Hence these are called cationic detergents.

Example: Cetyl trimethyl ammonium bromide used in hair conditioners.

These have germicidal properties but expensive, so these are of limited use.

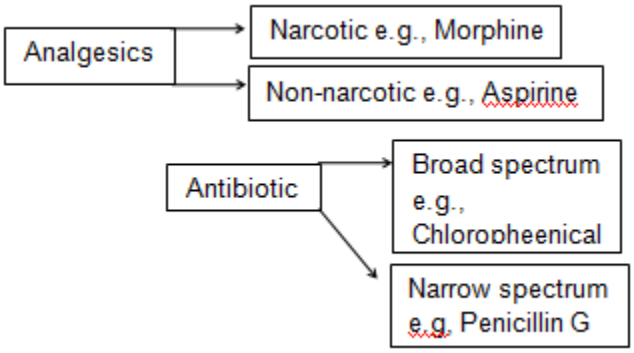
Non-ionic detergents: These do not contain any iron in their constitution.

One such detergent is formed when stearic acid reacts with polyethylene glycol.



These remove grease and oil by micelle formation. Liquid dishwashing detergents are of this type.

Disadvantage: If the hydrocarbon in non-ionic detergents is highly branched, then bacteria cannot degrade this easily. Slow degradation leads to accumulation. Effluents containing such detergents cause farming in rivers, ponds, streams leading to water pollution.



Questions.(Lect-1)

- Explain the term target molecules or drug targets as used in medicinal chemistry.
- Name the macromolecules that are chosen as drug targets.
- Why should not medicines be taken without consulting doctors?
- Define the term chemotherapy.
- Which forces are involved in holding the drugs to the active sites of enzymes?

Questions: (Lect-2)

- What is meant by the term 'broad spectrum? Antibiotics? Explain.
- How do antiseptics differ from disinfectants? Give one example of each.
- Why are cimetidine and ranitidine better antacids than sodium hydrogen carbonate or magnesium or aluminum hydroxide?
- Name a substance which can be used as an antiseptic as well as a disinfectant.

- What is the tincture of iodine? What is its use?

Questions: (Lect-3)

- What are food preservatives?
- What are artificial sweetening agents ? Give two examples.
- Why is the use of aspartame limited to cold foods and drinks?
- Name the sweetening agent used in the preparation of sweets for a diabetic patient.
- How are synthetic detergents better than soaps?
- Explain the following terms with suitable examples.

  a) Cationic detergents

  b) Anionic detergents

  c) Non-ionic detergents
- Why do soaps not work in hard water?
- Explain the cleansing action of soaps.
- What are biodegradable and non-biodegradable detergents ? Give one example of each.