Chemicals in Medicines

- Drugs are the chemicals of low molecular masses and interact with macromolecular targets to produce biological response.
- The chemicals of therapeutic biological response which are used in diagnosis, prevention and treatment of diseases are known as medicines.
- Use of chemicals for therapeutic effect is known as chemotherapy.
- Therapeutic index (TI) : It is the ratio of maximum tolerated dose, MTD (*i.e.* amount of drug necessary to kill the microorganism) to maximum curative dose, MCD (*i.e.* amount of drug required to cure the disease).]

$$TI = \frac{\text{Maximum tolerated dose (MTD)}}{\text{Maximum curative dose (MCD)}}$$

Higher the therapeutic index, safer the drug will be.

Classification of Drugs

Drugs on the basis of

Drug action

- It is based on the action of a drug on a particular biochemical process *e.g.*, antihistamines (inhibit action of histamine), drugs related to gastro-intestinal motility are grouped together.

Chemical structure

- The drugs having similar chemical structures may have similar pharmacological activity.
- Sulphonamides (antibacterial properties)
- Alcohols (hypnotic, analgesic)

Pharmacological effect

- Analgesics (pain killer)
- Antiseptics (kill or arrest the growth of microorganisms)
- Antipyretics (reduce fever)

Molecular targets

- It is based on the interaction with biomolecules such as carbohydrates, lipids, proteins and nucleic acids which are known as target molecules.
- Drugs possessing same common structural features may have the same mechanism of action on specified drug target molecules.

Drug Target Interaction

Enzymes as Drug Target

Catalytic action of enzymes : Proteins which perform the role of biological catalysts in the body are called enzymes. Enzymes perform two major functions in their catalytic activity :

(i) To hold the substrate for a chemical reaction.

(ii) To provide functional groups that will attack the substrate and carry out chemical reactions.

Drug-enzyme interaction : Drugs that can inhibit the catalytic activity of the enzyme are called enzyme inhibitors.

- The drugs that compete with the natural substrate for their attachment on the active sites of enzymes are called competitive inhibitors.
- Some drugs bind to a different site of enzyme other than active site are called allosteric site which changes the shape of active site.

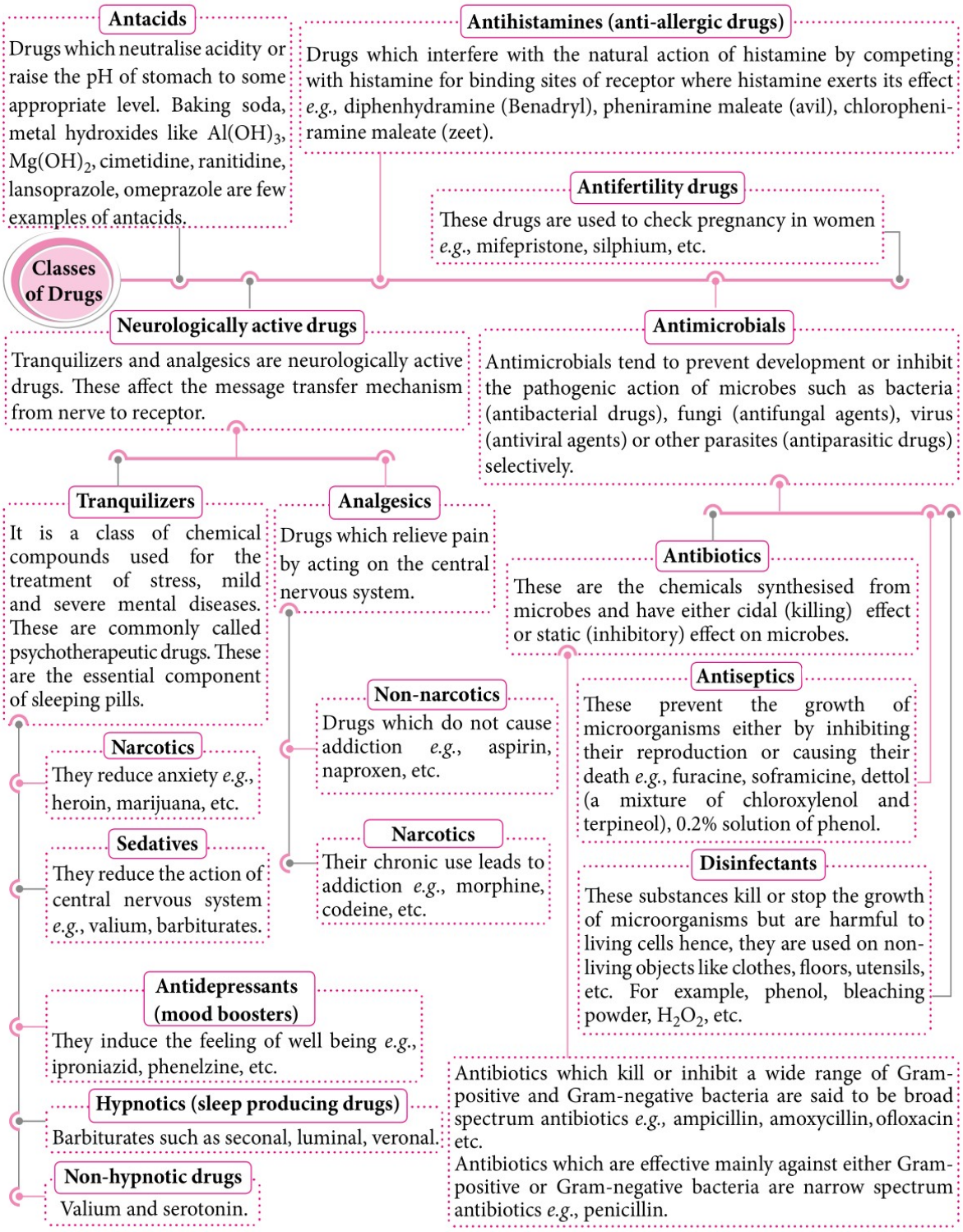
Receptors as Drug Target

- Proteins which transmit communication to the different parts of the body are called receptors. Receptor proteins are embedded in the cell membrane and receptor changes its shape to accommodate a chemical messenger which brings about transfer of message into the cell.

Drugs interact with receptors in two ways :

- Drugs bind to their receptor sites and inhibit its natural function **(antagonists)**. These are useful when blocking of message is required.
- Some drugs mimic the natural messenger by switching on the receptor **(agonists)**. These are useful when there is lack of natural chemical messenger.

Therapeutic Action of Different Classes of Drugs



Chemicals in Food

- Chemicals which are added to food for their preservation or enhancing their appeal, flavour or nutritive value in them, etc. are known as food additives.

Food Preservatives

- These are the chemical substances which are added to the food materials to prevent their spoilage due to microbial growth and to retain their nutritive value for long periods.
- The most common preservative used is sodium benzoate (C_6H_5COONa).
- Certain food preservatives such as BHA and BHT used for edible oils also act as antioxidants.

Artificial Sweetening Agents

- These are chemical compounds which give sweetening effect to the food and enhance its odour and flavour.

Artificial Sweetener	Sweetness Value in Comparison to Cane Sugar
Aspartame	100
Saccharin	550
Sucralose	600
Alitame	2000

Antioxidants

- These are the chemical substances which prevent oxidation and subsequent spoilage of the food by retarding the action of oxygen on food. They act as sacrificial materials as they are more reactive towards oxygen than the materials they are protecting.

Cleansing Agents

Soaps

- These are sodium or potassium salts of higher fatty acids (with 12-18 carbon atoms) *e.g.*, salts of $C_{15}H_{31}COOH$ (palmitic acid), $C_{17}H_{35}COOH$ (stearic acid), $C_{17}H_{33}COOH$ (oleic acid), $C_{17}H_{31}COOH$ (linoleic acid), etc.

Synthetic Detergents

- These are sodium salts of long chain alkyl hydrogen sulphates or the sodium salts of long chain benzene sulphonic acids.

Cationic detergents : Trimethylstearylammonium chloride, $CH_3(CH_2)_{17}N^+(CH_3)_3Cl^-$

Anionic detergents : Sodium lauryl sulphate, $C_{12}H_{25}OSO_3^-Na^+$

Non-ionic detergents : Polyethylene glycol stearate, $CH_3(CH_2)_{16}COO(CH_2CH_2O)_nCH_2CH_2OH$

Advantages of Synthetic Detergents over Soaps

- They can be used in hard water, in acidic medium while soaps get precipitated.
- They are more soluble in water and thus, form lather more easily.
- They are stronger cleansing agents than soaps as they decrease the surface tension to greater extent.

Cleansing Action of Soaps and Detergents

- The hydrophilic carboxylate group interact with water molecules while the hydrophobic long non-polar hydrocarbon chain does not interact.
- The hydrocarbon chains cluster together forming structure called micelles.
- In the micelles, the carboxylate groups form a negatively-charged spherical surface, with the hydrocarbon chains inside the sphere.
- Being negatively charged, soap micelles repel each other and remain dispersed in water.

INFO SHOTS

Polymers in Drug Delivery !

Polymer-based drug delivery systems have been extensively explored as promising nanoscale approaches in cancer nanotechnology research. Well-designed nanocarriers can improve the delivery of small drug therapeutics to targeted tumors in chemotherapy, thus minimizing undesired side effects and maximising drug efficacy common to small drugs. Despite these tremendous advances including several promising self-assembled nanocarriers in clinical studies, current and future research requires more precise control over the properties.