CHAPTER 16

Chemistry in Everyday Life

Chemistry influences our daily life and is used in following ways to benefit the human life:

- Production of cleanliness products such as soaps, detergents, toothpaste etc.
- Use of chemicals in food as preservatives, artificial sweetening agents etc.
- Use of chemicals in medicines as antiseptics, antacids, antibiotics etc.

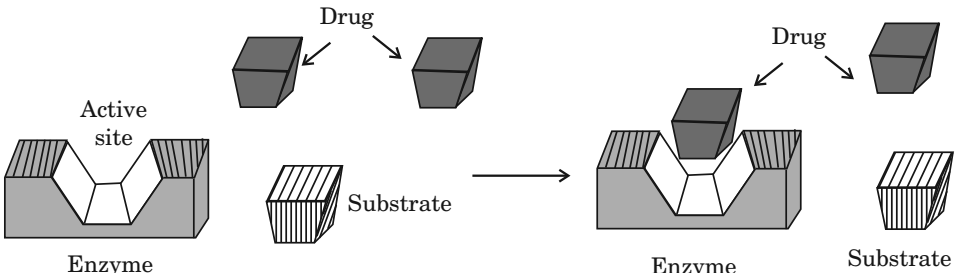
Drugs and their classification

- Chemical substances of low molecular masses which produce biological responses are called drugs. When the effects of these drugs are therapeutic and useful, they are called medicines.
- **Classification of Drugs**
  - *On the basis of pharmacological effects*: These are the types of drugs that are prescribed for the treatment of particular problem or sickness. For example, antacids bring relief from acidity.
  - *On the basis of drug action*: These are the types of drugs that have a particular biochemical process for targeted effects. For example, antihistamines that inhibits the actions of histamines that cause inflammation in the body.
  - *On the basis of chemical structure*: These are the types of drugs that have a particular chemical structure. For example, sulphonamides have common chemical structural feature.
  - *On the basis of molecular targets*: These are the types of drugs that interact with different biomolecules such as proteins and carbohydrates and directly affect the targets.
- **Drug-target interaction**
  - Enzymes are the proteins that act as biological catalysts
  - Catalytic action of enzymes: For this action of enzymes interactions such as hydrogen bonding or dipole-dipole interactions are required. The substrate molecule is held by the active site of enzyme by using the strong interactions which is attacked by the reagent and then the chemical reaction is carried out.

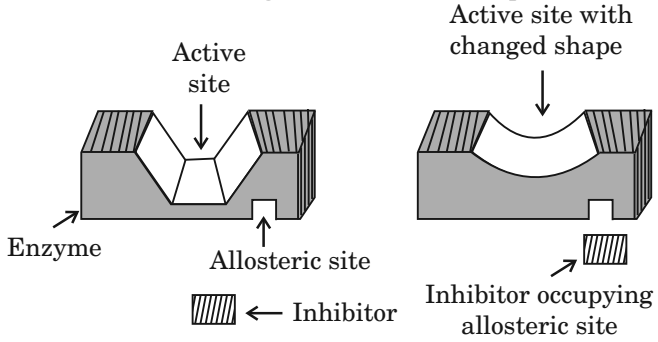
(a) Enzyme (b) Substrate (c) Enzyme holding substrate

  - Drug-enzyme interaction: Enzyme inhibitors are the drugs that block the binding site of the enzyme and the substrate. There are two ways in which this action takes place:

(*i*) Some drugs called as competitive inhibitors compete for the active site of the enzyme attachment as shown in the diagram.



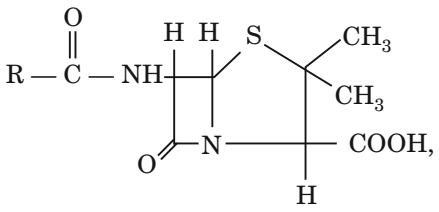
(*ii*) There are some drugs that do not bind with the active site of the enzyme but different site called allosteric site. In this interaction, a strong covalent bond is required which cannot be broken easily.



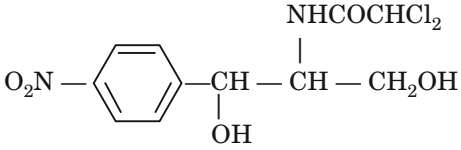
- Receptors are proteins that are important for communication in the body. For communication between neurons to muscles, chemical messengers are required which forwards the message to the cell without entering the cell. Different receptors have different binding shapes, structures and composition.
- Antagonists are those drugs that bind to the receptor site and inhibit its natural function whereas agonists are the drugs that act as natural messengers by swapping on the receptors.

Different classes of drugs on basis of therapeutic action

- **Antacids:** These are the drugs that stop the excess production of acids in the stomach that causes pain and irritation. The most common antacids are sodium hydrogencarbonate or mixture of magnesium hydroxide and aluminium.
- **Antihistamines:** These are the drugs that have a particular biochemical process and have targeted effects. For example, histamine is a chemical that activates the secretion of pepsin and hydrochloric acid in the stomach. Antihistamines react with the receptors and helps lessen the amount of such acids released in the stomach. For example, common antihistamines are brompheniramine (Dimetapp) and terfenadine (Seldane).
- **Tranquilizers:** These are the types of drugs that act on neurological issues such as stress, anxiety, severe or mild mental diseases and affect the transfer mechanism from nerve to receptors. For example, sleeping pills and nonadrenaline that act on mood changes. Iproniazid and phenelzine are the two drugs that act as antidepressants, which activate receptors for a person suffering from depression.
  - There are some mild tranquilizers that are suitable for relieving tension such as chlordiazepoxide and meprobamate. The drug that helps in controlling hypertension and depression is Equanil.
  - There are some strong tranquilizers called Barbiturates which are hypnotic such as veronal, amytal, nembutal, luminal, valium and serotonin.
- **Analgesics:** These are the types of drugs that minimize or stop pain without actually causing any imbalance to nervous system. There are two types:
  - **Non-narcotic(non-addictive) analgesics:** These are the drugs that have a relieving effect on skeletal pain(joints pain), helps in reducing fever and platelet coagulation and also prevention of heart attacks as these drugs have anti blood clotting action.
  - **Narcotic analgesics:** These are the types of drugs that also have relieving properties but then taken in excess amount can have severe side effects such as coma, stupor and untimely death. This is the reason they are mainly used in child birth, cardiac pain and terminal cancer pain. For example, Morphine, also referred to as opiates.
- **Antibiotics:** These are the types of drugs that stop the growth of microorganisms and kill them eventually these are drugs that are synthesized from chemicals that are low in concentration and they act on metabolic processes.
  - A German bacteriologist, Paul Ehrlich produced arsphenamine, known as salvarsan, for the treatment of syphilis. He was awarded the Nobel Prize in medicine in 1980. In 1932, he succeeded in preparing the first effective antibacterial agent, prontosil, which later was converted to sulphanilamide.
  - H.W. Florey and Alexander Fleming shared the Nobel prize for Medicine in 1945 for their independent contributions to the development of penicillin.



General Structure of Penicillin



Chloramphenicol

- There are two types of antibiotics, Bactericidal and Bacteriostatic. Bactericidal have killing effects and examples are Penicillin, Aminoglycosides and Ofloxacin. Bacteriostatic have inhibitory effects on microbes and examples are Erythromycin, Tetracycline and Chloramphenicol.
- Chloramphenicol can be given orally in case of typhoid, meningitis, acute fever, some form of urinary infections, dysentery and pneumonia.

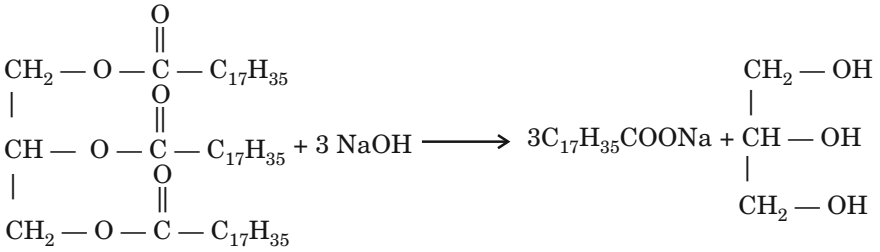
- **Antiseptics and Disinfectants:** These are used to kill or stop the growth of microorganisms.
  - Antiseptics are used on outer wounds on skin surface. For example, soframicine, furacine, Iodoform and Iodine tincture etc. Dettol is a mixture of chloroxylenol and terpineol.
  - Disinfectants are the chemicals or drugs that are used in cleaning objects. For example, Phenol is an antiseptic while its one percent solution is disinfectant.
- **Anti-fertility drugs:** These are the drugs that help in the prevention of unwanted pregnancy. For example, Birth control pills contain a mixture of synthetic estrogen and progesterone derivatives. both of which are hormones and known to suppresses ovulation.The commonly used anti-fertility drug is Norethindrone is an example of synthetic progesterone derivative.

Chemicals in Food

- **Artificial sweetening agents:** These are the chemicals added in food to enhance their appeal such as food colouring, flavours and sweeteners. Sucrose is a natural sweetener, whereas Saccharin is the first popular artificial sweetening agent. This is useful for diabetic people. Some artificial sweeteners are Aspartame, Sucrolose and Alitame.
- Food preservatives:They are added to increase the nutritive value of the food since they prevent spoilage of food that happens due to microbial growth. For example, table salt, sugar, vegetable oils and sodium benzoate, C_6H_5COONa are commonly used preservatives.

Cleansing agents

- **Soaps:** These are used for cleaning purposes and are mainly made of sodium or potassium salts of long chain fatty acids.



Gylceryl ester of stearic acid (Fat)	Sodium hydroxide	Sodium stearate	Glycerol (or Glycerine

- The process of obtaining sodium salts soaps by heating fat with aqueous sodium hydroxide solution is called Saponification.
- There are different types of soaps such as toilet soaps, transparent soaps, medicated soaps, shaving soaps, laundry soaps, soap powders or granules.

- Soaps don't work in hard water because hard water contains calcium and magnesium ions which are insoluble in water and separate out as scum in water and become useless. This is the reason why hairs and clothes are not washed in hard water.

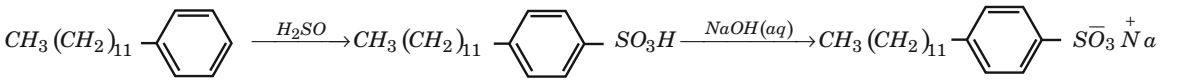
$$2C_{17}H_{36}COONa + CaCl_2 \longrightarrow 2NaCl + (C_{17}H_{35}COO)_2 Ca$$

Soap — Insoluble calcium stearate (Soap)

- Synthetic detergents:These have the same property as those of soaps but they work in hard water as well. They have 3 main categories.
  - **Anionic detergents:** These are the sodium salts of sulphonated long chain alcohols or hydrocarbons. The anionic part of the molecule is involved in the cleansing action in anionic detergents. They are used in toothpastes.

$$CH_3(CH_2)_{10}CH_2OH \xrightarrow{H_2SO_4} CH_3(CH_2)_{10}CH_2OSO_3H \xrightarrow{NaOH(aq)} CH_3(CH_2)_{10}CH_2OS\overline{O}_3\overset{+}{N}a$$

Lauryl alcohol — Lauryl hydrogensulphate — Sodium laurylsulphate (Anionic detergent)



Dodecylbenzene — Dodecylbenzenesulphonic acid — Sodium dodecylbenzenesulphonate

  - **Cationic detergents:** They are quarternary ammonium salts of amines with acetates, chlorides or bromides as anions. These detergents have germicidal properties. For example, Cetyltrimethylammoniumbromide is used in hair conditioners.
  - **Non-ionic detergents:** They do not contain any ion in their constitution. The grease and oil are removed by micelle formation. For example, liquid dishwashing detergents.

EXERCISE

1. Soaps are
(*a*) Sodium salts of long chain fatty acids
(*b*) Potassium salts of long chain fatty acids
(*c*) Potassium salts of short chain fatty acids
(*d*) Both (*a*) and (*b*)

2. Which of the following is the correct set of food preservatives?
(*a*) Alitame, bithionol and terpineol
(*b*) Sodium benzoate, sugar and table salt
(*c*) lodme, sugar and of loxain
(*d*) Table salt, seldane and sugar

3. Receptors help in
(*a*) Communication of the cells
(*b*) Killing of the cells
(*c*) degradation of the cells
(*d*) None of the above.

4. Substances used in bringing down the body temperature in the high fever are called
(*a*) antiseptics (*b*) pyretics
(*c*) antibiotics (*d*) antipyretics

5. Arsenic drugs are mainly used in the treatment of
(*a*) Jaundice (*b*) typhoid
(*c*) syphilis (*d*) cholera

6. Which of the following can possibly be used as analgesic without causing addiction and modification?
(*a*) Morphine
(*b*) N-acetyl-para-aminophenol
(*c*) Diazepam
(*d*) Tetrahydro catenol

7. Asprin is an acetylation product of
(*a*) p-dihydroxy benzene
(*b*) p-hydroxybenzoic acid
(*c*) o-dihydroxybenzene
(*d*) m-hydroxybenzoic acid

8. Which of the following is an antidiabetic drug?
(*a*) Insulin (*b*) Penicillin
(*c*) Chloroquine (*d*) Asprin

9. Which of the following is used for inducing sleep?
(*a*) Paracetamol
(*b*) Chloroquine
(*c*) Bithional
(*d*) Barbituric acid derivatives

10. A broad spectrum antibiotic is
(*a*) Paracetamol (*b*) Penicillin
(*c*) aspirin (*d*) Chloramphenicol

11. Which of the following is used as a " morning after pill"
(*a*) Mifepristone (*b*) Ethynylestradiol
(*c*) Northindrone (*d*) Bithional

12. An ester used as medicine is
(*a*) ethyl acetate (*b*) methyl acetate
(*c*) methyl salicylate (*d*) ethyl benzoate

13. A drug that is antipyretic as well as analgesic is
(*a*) Chloropromazine hydrochloride
(*b*) Para-acetamidophenol
(*c*) Chloroquine
(*d*) Penicillin

14. Barbituric acid and its derivatives are will known as.
(*a*) tranquilizers (*b*) antiseptices
(*c*) analgesics (*d*) antipyretics

15. The drug given during hypertension is
(*a*) streptomycin (*b*) Chloroxylenol
(*c*) equanil (*d*) aspirin

16. Which of the following is used as an antiseptic?
(*a*) Phenol (*b*) Benzaldehyde
(*c*) Benzalamine (*d*) Maleic anhydride

17. Betadine is
(*a*) antiseptic (*b*) tranquilizer
(*c*) antibiotic (*d*) disinfectant

18. Which of the following will not enhance nutritional value of food?
(*a*) Minerals
(*b*) Artificial sweetners
(*c*) Vitamins
(*d*) Amino acids

19. The safest and most common alternative of sugar is
(*a*) glucose (*b*) dulcin
(*c*) cyclodextrine (*d*) aspartame

20. One of the mst widely used drug in medicine iodex is
(*a*) methyl salicylate
(b) ethyl salicylate
(c) acetyl salicylic acid
(d) O-hydroxy benzoic acid

Answer Keys

1. (*d*)	**2.** (*b*)	**3.** (*a*)	**4.** (*d*)	**5.** (*c*)	**6.** (*c*)	**7.** (*b*)	**8.** (*a*)	**9.** (*d*)	**10.** (*d*)
11. (*a*)	**12.** (*c*)	**13.** (*b*)	**14.** (*a*)	**15.** (*c*)	**16.** (*a*)	**17.** (*a*)	**18.** (*c*)	**19.** (*d*)	**20.** (*a*)