

Chapter- 16: Chemistry in Everyday life

1. Drugs: Drugs are chemical of low molecular masses, which interact with macromolecular targets and produce a biological response.

2. Medicines: Medicines are chemicals that are useful in diagnosis, prevention and treatment of diseases.

3. Chemotherapy: The use of chemicals for therapeutic effect is called chemotherapy.

4. Classification of Drugs:

1) On the basis of 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. For example, analgesics have pain killing effect, antiseptics kill or arrest the growth of microorganisms.

2) On the basis of drug action: It is based on the action of drug on a particular biochemical process. For example, all antihistamines inhibit the action of the compound, histamine which causes inflammation in the body.

3) On the basis of chemical structure: It helps us to design the synthesis of a number of structurally similar compounds having different substituents and then choosing the drug having the least toxicity. Example, sulpha drugs.

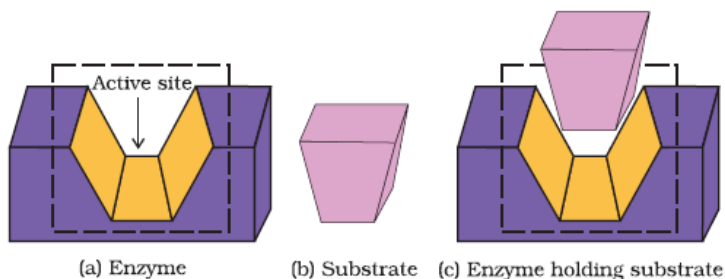
4) On the basis of molecular targets: Drugs usually interact with biomolecules such as carbohydrates, lipids, proteins and nucleic acids. These are called target molecules or drug targets. Drugs possessing some common structural features may have the same mechanism of action on targets. The classification based on molecular targets is the most useful classification for medicinal chemists.

5. Enzymes: Proteins which perform the role of biological catalyst in the body are called enzymes.

Functions of enzymes (Catalytic action of Enzymes): In their catalytic activity, enzymes perform two major functions:

(i) Enzymes have active sites which hold the substrate molecule. It can be attracted by reacting molecules.

(ii) Substrate is bonded to active sites through hydrogen bonds, ionic bonds, van der Waal or dipole-dipole interactions.

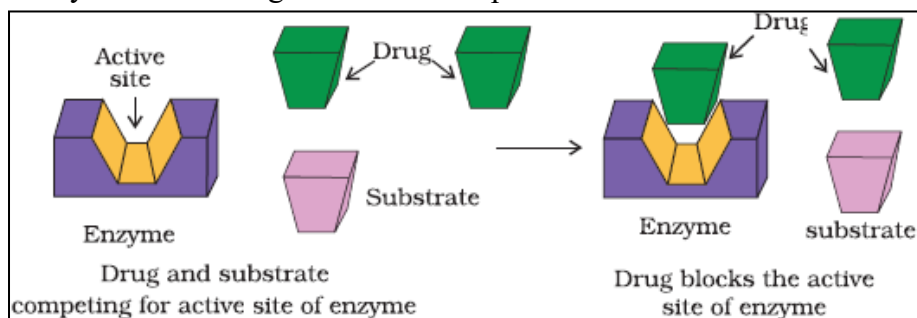


6. Role of Drugs: Main role of drugs is to either increase or decrease the role of enzyme catalyst reactions. Inhibition of enzymes is a common role of drug.

7. Enzyme Inhibitor: Enzyme inhibitor is drug which inhibits catalytic activity of enzymes or blocks the binding site of the enzyme and eventually prevents the binding of substrate with enzymes

Enzymes as drug target (Drug-enzyme interactions): Drugs (enzyme inhibitor) can block the binding site of the enzyme and prevent the binding of substrate, or can inhibit the catalytic activity of the enzyme in two different ways;

(i) Competitive Inhibition: Drugs compete with the natural substrate for their attachment on the active sites of enzymes. Such drugs are called competitive inhibitors.



(ii) Non-Competitive Inhibition: Some drugs binds to a different site of the enzyme called allosteric sites which changes the shape of active sites in such a way that substrate cannot recognize it.

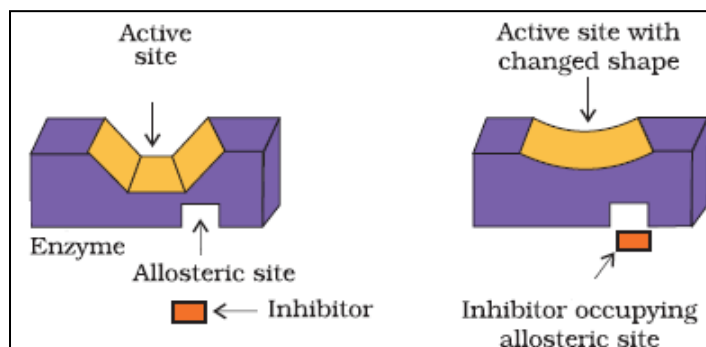
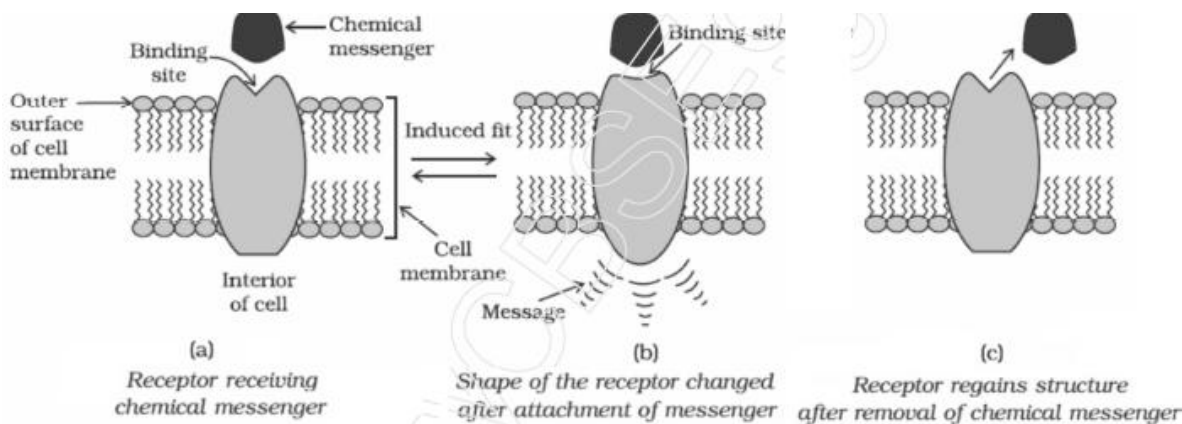


Figure: Non competitive inhibitor changes the active side of enzyme after binding at allosteric site

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

8. Receptors: Protein which is vital for communication system in the body is called receptors. Receptors show selectivity for one chemical messenger over the other b/c their binding sites have different shape, structure and different amino acid composition.

Receptors as drug targets (Drug-Receptors interactions): In the body, message between two neurons and that between neurons to muscles is communicated through certain chemicals. These chemicals, known as chemical messengers are received at the binding sites of receptor proteins. To accommodate a messenger, shape of the receptor site changes. This brings about the transfer of message into the cell. Thus, chemical messenger gives message to the cell without entering the cell.



- **Antagonists:** Drugs that bind to the receptor site and inhibit its natural function. These are useful when blocking of message is required.
- **Agonists:** Drugs that mimic the natural messenger by switching on the receptor are called agonists. These are useful when there is a lack of natural chemical messenger.

9. Therapeutic Action of Different Classes of Drugs:

1) **Antacids:** Chemical substances which neutralize the excess acid in the stomach and give relief from acid indigestion, acidity, hurt burn and gastric ulcers. Examples are Sodium hydrogencarbonate, A mixture of aluminium and magnesium hydroxide, Ranitidine (Zantac), Cimetidine, Digene, Gelucil, Eno etc.

- However, excessive hydrogencarbonate can make the stomach alkaline and trigger the production of even more acid. Metal hydroxides are better alternatives because of being insoluble; these do not increase the pH above neutrality.
- A chemical, histamine, stimulates the secretion of pepsin and hydrochloric acid in the stomach. The drug Cimetidine (Tegamet), was designed to prevent the interaction of histamine with the receptors present in the stomach wall. This resulted in release of lesser amount of acid.

2) **Antihistamine (Antiallergic):** The drugs which interfere with the natural action of histamines and prevent the allergic reactions. Example, Brompheniramine (Dimetapp), Terfenadine (Seladane), Pheniramine meleate (Avil), Cetrizine etc.

Antihistamines not affect the secretion of acid in stomach b/c antiallergic and antacid drugs work on different receptors.

3) Neurological Active Drugs:

(a) Tranquilizers (Sleeping pills): The chemical substances which acts on the central nervous system and has a calming effect. Since these are used for stress or mental diseases so are known as psychotherapeutic drugs.

They are of two types-

(i) Sedative: Reduce nervous system and promote relaxation. Examples, Reserpine, Barburic acid and its derivatives like Luminal, Seconal, Veronal, Amytal and Nembutal.

(ii) Mood elevators or antidepressants: A drug used for treatment of highly depressed patient, who has lost confidence. Examples, Benzedrine (amphetamine), Iproniazid and Phenelzine.

Chlorodiazepoxide and Meprobamate are relatively mild tranquilizers suitable for relieving tension.

(b) Analgesics: The substance which are used to get relief from pain. These are of two types-

(i) Narcotics or habit forming drugs: These are alkaloids and mostly opium products, causes sleep and unconsciousness when taken in higher doses. Examples are Morphine, Codeine, Heroin.

(ii) Non-narcotics or non-addictive: Analgesics belonging to this category are effective antipyretics also. Examples, Aspirin, Novalgin, Ibuprofen and Naproxen.

4) Antimicrobial Drugs:

(a) Antibiotics: Chemical substances produced by microorganisms that kill or prevent the growth of other microbes.

Classification of antibiotics based on control of diseases:

(i) Bactericidal antibiotics: Drugs that kills organisms in body. Examples are Penicillin, Amyloglycosides, Ofloxacin.

(ii) Bacteriostatic antibiotics: Drugs that inhibits growth of organism. Examples are Erythromycine, Tetracycline, Chloramphenicol.

Classification of antibiotics based on its spectrum of action:

(i) Broad spectrum antibiotics: Antibiotics which kill or inhibit a wide range of Gram-positive and Gram –negative bacteria are called broad spectrum antibiotics. Examples are Ofloxacin, Ampicillin and Amoxycillin.

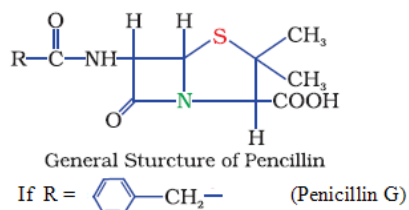
(ii) Narrow spectrum antibiotics: Antibiotics which are effective mainly against Gram-positive and Gram –negative bacteria are called Narrow spectrum antibiotics. Examples, Penicillin G.

(iii) Limited spectrum antibiotics: Antibiotics which are effective against a single organism or disease are called Limited spectrum antibiotics. Examples, Dysidazirine which toxic certain strain of cancer cell.

Note:

- Synthetic antibiotics are Streptomycin, Chloromycetin, Tetracyclins

- Ampicillin and Amoxycillin are synthetic penicillin.
- Penicillin is highly effective drug for pneumonia, bronchitis, abscesses, sore throat etc.



(b) Antiseptics: Chemical substances that either kill or inhibit the growth of micro-organisms and can be applied on living tissues such as wounds, cuts, ulcers etc are called antiseptics. Examples are Soframycine, Dettol, Savlon, Tincture of iodine, Methylene blue, Furacine, chloroxylenol terpinol and Bithionol.

- Dettol is a mixture of chloroxylenol and terpineol.
- A 2-3% solution of iodine in alcohol-water mixture is known as tincture of iodine.
- Bithionol is added to soap to impart antiseptic properties.
- Dilute aqueous solution of Boric acid is weak antiseptic for eyes.

(c) Disinfectants: Chemical substances that completely killing the micro-organisms on non – living objects like floor, drains, and toilets but cannot be applied on living tissues are called disinfectants. All antiseptic substances act as disinfectants by varying the concentration for example, 0.2% solution of phenol is an antiseptic while 1% solution is a disinfectant, 0.2 to 0.4 ppm aqueous chlorine solution, dilute SO₂.

5) Antifertility Drugs: These are the chemical substances used to control the pregnancy. They are also called oral contraceptives or birth control pills. Examples are Mifepristone, Norethindrone.

10. Chemical in food:

1) Artificial sweetening agents: These are the chemical compounds which give sweetening effect to the food without adding calorie. They are good for diabetic people. Some commonly artificial sweeteners and their relative sweetness value in comparison to cane sugar are show as

| Artificial Sweetner | Sweetness value in comarision to cane sugar |
|---------------------|---|
| Aspartame | 100 |
| Saccharin | 550 |
| Sucralose | 600 |
| Alitame | 2000 |

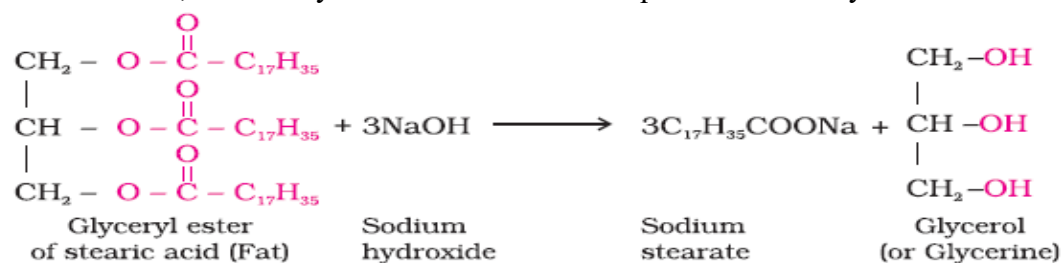
2) Food Preservatives: They prevent spoilage of food due to microbial growth. The most commonly used preservative include table salt, sugar, vegetable oil and sodium benzoate (C₆H₅COONa).

Sodium benzoate is used in limited quantities and is metabolized in the body. Salts of sorbic acid and propanoic acid are also used as preservatives.

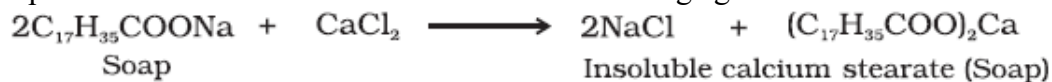
3) Antioxidants: Substances added to food to prevent oxidation of food materials. Examples, Butylated hydroxyl toluene (BHT), Butylated hydroxyl anisole (BHA).

11. Cleansing Agents: These are soaps and synthetic detergents. These improve cleansing properties of water. These help in removal of fats which bind other materials to the fabric or skin.

1) Soap: They are sodium or potassium salts of long chain fatty acids. They do not work well in hard water. Examples are stearic, oleic and palmitic acids. They are obtained by the saponification reaction, when fatty acids are heated with aqueous sodium hydroxide.



- Soap is good cleansing agent and is 100% biodegradable means microorganisms completely oxidize the soap therefore soap does not cause any pollution.
- Bathing soap are potassium salt of long chain fatty acids while washing soaps are sodium salt of long chain fatty acids.
- Soap does not work in hard water due to presence of calcium and magnesium ion in hard water. These ions form insoluble calcium and magnesium soap respectively. These insoluble soaps separate as scum in water and are useless as cleansing agent.



- Soap cannot be used in acidic solutions as acid present in the solution precipitate the insoluble free fatty acids which adhere to the fabrics and thus decrease the ability of soaps to remove the oil from fabrics.

Types of Soap:

(i) Toilet soaps: That are prepared by using better grade of fatty acids and excess of alkali needs to be removed. Colour and perfumes are added to make them attractive.

(ii) Medicated soaps: Soaps in which substance of medicinal value are added. E.g., Buthional, dettol.

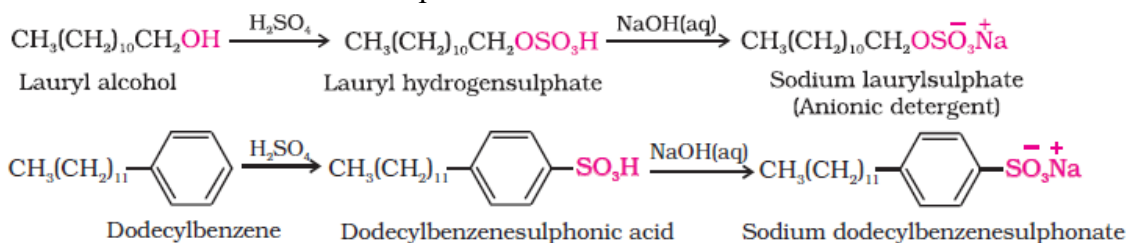
(iii) Transparent soaps: Those are made by dissolving the soap in ethanol and then evaporating the excess solvent.

(iv) **Laundry soaps:** It contains fillers like sodium rosinate, sodium silicate, borax and sodium carbonate.

(V) **Shaving Soap:** It contains glycerol to prevent rapid drying. A gum called rosin is added while making them. It forms sodium rosinate which lathers well.

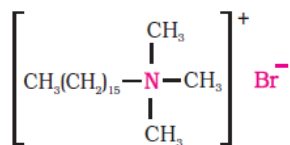
2) Synthetic Detergents: They are cleaning agents having properties of soaps, but actually contain no soap. They can be used in both soft and hard water. They are classified mainly in three categories:

(i) **Anionic detergents:** They are sodium salts of sulphonated long chain alcohols or hydrocarbons. Example, Sodium lauryl sulphate. They are effective in acidic solution. Mostly used for household work and in toothpaste.



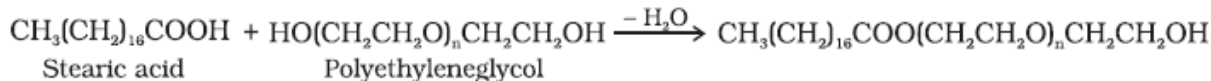
(ii) **Cationic Detergents:** They are quaternary ammonium salts of amines with acetates, chlorides or bromides. Cationic part possesses a long hydrocarbon chain and a positive charge on nitrogen atom. Hence, these are called cationic detergents.

Cationic detergents have germicidal properties so they are used as germicides. Cetyltrimethylammonium bromide is a popular cationic detergent and is used in hair conditioners. They are expensive so limited in use.

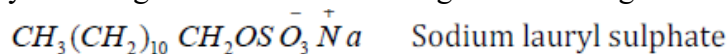


Cetyltrimethyl ammonium bromide

(iii) **Non-ionic detergents:** They do not contain any ions. These are esters of high molecular mass alcohols. Some liquid dishwashing detergents are of non-ionic type.



3) Biodegradable Detergents: Detergents which having straight hydrocarbon chain that are easily decomposed by microorganisms is called Biodegradable detergents. Examples,



4) Non-biodegradable Detergents: The detergents which are branched hydrocarbon and cannot be decomposed by micro-organisms are called non-biodegradable. It creates water pollution. Example, Sodium 4-(1, 3, 5, 7 tetramethyloctyl)-benzene sulphonate.

Summary of Therapeutic Action of Different Classes of Drugs

| Sr.No. | Drug | Application | Examples |
|--------|---------------------------------------|--|--|
| 1 | Antacid | Neutralize the excess acid in the stomach. | Cimetidine, Ranitidine |
| 2 | Antihistamine (Antiallergy) | They interfere with the natural action of histamines and prevent the allergic reactions. | Brompheniramine (Dimetapp), Terfenadine (Seldane), Pheniramine melete (Avil), Cetrizine |
| 3 | Tranquilizers (sleeping pills) | Acts on the central nervous system and used for stress or mental diseases. | ~ |
| | (a) Sedative | Reduce nervous system and promote relaxation. | Reserpine, Barburic acid and its derivatives like Luminal, Seconal, Veronal, Amytal and Nembutal. |
| | (b) Mood elevators or antidepressants | Used for highly depressed patient, who has lost confidence. | Benzedrine (amphetamine), Iproniazid and Phenelzine. Chlorodiazepoxide and Meprobamate are relatively mild tranquilizers |
| 4 | Analgesics | They used to get relief from pain. | ~ |
| | (a) Narcotics or habit forming drugs | Relief from pain. | Morphine, Codeine, Heroin. |
| | (b) Non-narcotics or non-addictive | Relief from pain and effective antipyretics also. | Asprin, Novalgin, Ibuprofen and Naproxen. |
| 5 | Antibiotics | They produced by microorganisms that kill or prevent the growth of other microbes. | ~ |
| | (a) Bactericidal antibiotics | Drugs that kills organisms in body. | Penicillin, Amyloglycosides, Ofloxacin. |
| | (b) Bacteriostatic antibiotics | Drugs that inhibits growth of organism. | Erythromycine, Tetracycline, Chloramphenicol. |
| | (a) Broad spectrum antibiotics | They kill or inhibit a wide range of Gram-positive and Gram –negative bacteria. | Ofloxacin, Ampicillin and Amoxycillin. Ofloxacin, Ampicillin and Amoxycillin. |
| | (b) Narrow spectrum antibiotics | Effective mainly against Gram-positive and Gram –negative bacteria. | Penicillin G |
| | (c) Limited spectrum antibiotics | Effective against a single organism or disease. | Dysidazine |
| 6 | Antiseptics | They either kill or inhibit the growth of micro-organisms and can be applied on living tissues such as wounds, cuts, ulcers etc. | Soframycine, Dettol, Savlon, Tincture of iodine, Methylene blue, Furacine, chloroxylenol terpinol and Bithionol. |
| 7 | Disinfectants | They completely killing the micro-organisms on non –living objects like floor, drains etc. | All antiseptic substances act as disinfectants, 0.2% solution of phenol is an antiseptic while 1% solution is a disinfectant, 0.2 to 0.4 ppm aqueous chlorine solution, dilute SO ₂ . |
| 8 | Antifertility Drugs | To control the pregnancy. | Mifepristone, Norethindrone. |
| 9 | Artificial sweetening agents | It give sweetening effect to the food without adding calorie. They are good for diabetic people. | Saccharine, Sucralose, Alitame, Aspartame |
| 10 | Food Preservatives | They prevent spoilage of food due to microbial growth. | Table salt, Sugar, Vegetable oil and Sodium Benzoate |
| 11 | Antioxidants | To prevent oxidation of food materials. | Butylated hydroxyl toluene (BHT), Butylated hydroxyl anisole (BHA). |

| | | | |
|----|--|--|--|
| 12 | Soap (Cleansing agent) | Soap is good cleansing agent and is 100% biodegradable. | sodium or potassium salts of long chain fatty acids, Sodium stearate |
| 13 | Synthetic Detergents (Cleansing agent) | They are cleaning agents having properties of soaps, but actually contain no soap. They can be used in both soft and hard water. | ~ |
| | (a) Anionic detergents | They are effective in acidic solution. Mostly used for household work and in toothpaste. | Sodium lauryl sulphate. |
| | (b) Cationic detergents | They are used as germicides | Cetyltrimethylammonium bromide. |
| | (c) Non-ionic detergents | These are esters of high molecular mass alcohols. | Some liquid dishwashing detergents |
| 14 | Biodegradable Detergents | Detergents which having straight hydrocarbon chain that are easily decomposed by microorganisms. | Sodium lauryl sulphate. |
| 15 | Non-biodegradable Detergents | Detergents which are branched hydrocarbon and cannot be decomposed by microorganisms. | Sodium 4-(1, 3, 5, 7 tetramethyloctyl)-benzene sulphionate. |

Important key points

Aspirin is used to prevent heart attacks besides being antipyretic and analgesic agents.

Derivatives of barbituric acid, viz. veronal, amytal, nembutal, luminal and seconal are hypnotic tranquillizer while meprohamate equanil, valium and serotonin are non-hypnotic tranquillizers.

Soaps, detergents and phospholipids are called surfactants since they lower the surface tension of water.

Sodium soaps are hard while potassium soaps are soft. Therefore, washing soaps are mostly sodium soaps while liquid soaps having creams and toilet soaps are potassium salts.

Unlike soaps, detergents can be used in hard water. The reason being that magnesium and calcium salts of detergents are soluble in water while those of soaps are insoluble in water.

Aspirin, phenacetin and paracetamol act both as antipyretics and analgesics.

The alkaloid morphine and its derivatives such as codeine (morphine methyl ether) and heroin (morphine diacetate) are important narcotic analgesic.

Aspirin is a non-narcotic analgesic but is toxic to liver. It also undergoes hydrolysis in the stomach producing salicylic acid which causes bleeding from the stomach wall. Therefore, other non-narcotic analgesics such as naproxen, ibuprofen and diclofenac sodium or potassium are preferred to aspirin.

Enovid E which is a mixture of norethindron (a progestogen) and ethynysestradiol (an estrogen) is the most commonly used oral contraceptive.

AZT (3'-Azido-3-deoxythymidine) is used against AIDS i.e. HIV-infections.

Sulpha drugs are effective against bacterial infections.

Ciprofloxacin and norfloxacin are quinolone based antibacterial drugs.

Artificial sweetners have no caloric value and hence are useful for diabetic persons.