Chapter 15

Chemistry in Everyday Life

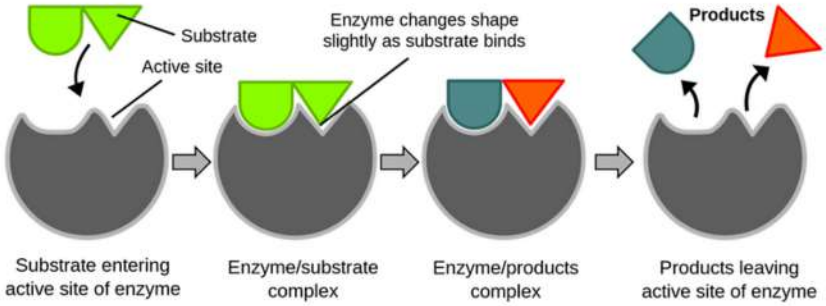
Detailed Overview: Chemistry in Everyday Life

Drugs are any chemical substances that affect/alter physiology when taken into a living system. When a drug is therapeutically active and is used for the diagnosis, treatment or prevention of a disease, it is called medicine. It is the drug interactions with macromolecules inside the body that generate a biological response.

Drugs and Drug Target

- Molecular targets are one of the criteria for the classification of drugs. Here the drugs are classified based on their target molecule.
- In the body, macromolecules are the primary targets of drugs. Once a drug is ingested, it will bind to some macromolecules to generate a biological response. Such macromolecules are called target molecules or drug targets.
- We know enzymes as a biological catalyst that hastens the biochemical reaction within a living system.
- Enzymes are protein molecules that are also drug target. Another drug target is the receptors that help with the communication of cells of the body.
- The drug interactions with these molecules explain the drug action. Here we will discuss enzymes and receptors as drug targets.

Enzymes as Drug Targets



- The catalytic function of an enzyme can be explained with the help of its properties. Enzymes have active sites which provide a binding site for the substrates where it is attacked by the reagent.
- Additionally, enzymes offer functional groups that will attack the substrate necessary for the chemical reactions.
- A drug-enzyme interaction will interrupt this catalytic action and such drugs are called enzyme inhibitors. An enzyme inhibitor drug can accomplish this by interfering with the active site of the enzyme. There are two types of inhibitor drugs- competitive inhibitors and noncompetitive inhibitors.

Drug-Enzyme Interaction

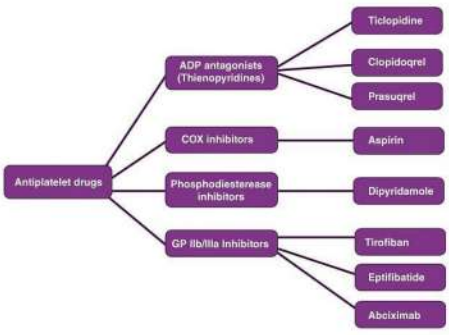
At certain times the actions of enzymes need to be controlled and we do this with the help of drugs known as enzyme inhibitors. Here the enzyme will be the drug target, i.e. the drug will try to impede with the functioning of the enzyme. This can be done in one of two ways,

- Some drugs will rival the substrate by attaching themselves to the active site of the enzyme. They are known as competitive inhibitors.
- This will not allow the substrate to attach itself to the enzyme, and so the reaction will not occur. But if the concentration of the substrate is far greater than that of the drug, such a method will not work successfully.
- Then the inhibitors known as allosteric inhibitors will attach itself to the allosteric site of the enzymes. This is any other site than the active site.
- By doing so they will change the shape and structure of the enzyme. Now the substrate cannot recognize the enzyme, and won't attach itself to the active site, thus inhibiting the catalytic reaction.

Receptors as Drug Targets

- Receptors are also a protein in our bodies. Their main function is to facilitate communication, between two neurons and between neurons and muscles.
- These biomolecules help us communicate via certain specific chemicals, known as chemical messengers Receptors are usually found in the membrane of cells. They are embedded in the cell membrane in a very peculiar way.
- Most of their body is contained within the membrane. Only a small portion of the molecule projects out of the membrane in the region outside the cell. This region that projects out, contains the active site of the receptor.
- So when a chemical messenger approaches the receptor, it binds to the active site of the receptor, and the shape of the molecule will change. This will transmit the message to the cell, inside the membrane.
- So the message will be relayed to the cell, without the chemical messenger even entering the cell.
- There are numerous types of receptors in the human body. These receptors interact with many chemical messengers.
- The receptors are able to identify their particular messenger, because of the difference in the shape, structure and the chemical composition of the active sites. This allows the receptors and the messengers to interact with selectivity.
- The drugs that target these receptors do so by impeding its natural functioning. They attach to their active site and inhibit their actions, and block the communication of the message.
- These are known as antagonists, examples include naltrexone and naloxone. Another way a drug targets receptors is by mimicking the natural messengers. This activates the receptors and will produce some kind of biological response. Such drugs that elicit a response from receptors are known as agonists.

Classification of Drugs



(i) On the basis of pharmacological effect:
This classification provides doctors with the whole range of drugs available for the treatment of a particular type of problem. Hence, such a classification is very useful to doctors.
(ii) On the basis of drug action:
This classification is based on the action of a drug on a particular biochemical process. Thus, this classification is important.
(iii) On the basis of chemical structure:
This classification provides the range of drugs sharing common structural features and often having similar pharmacological activity.
(iv) On the basis of molecular targets:
This classification provides medicinal chemists with the drugs having the same

Therapeutic Action of Different Classes of Drugs

Antacid

The chemical substances which neutralize the excess acid in gastric juice and raise the pH to an appropriate level in the stomach are based antacids.
The most commonly used antacids are weak bases such as sodium bicarbonate sodium hydrogen carbonate, [$NaHCO_3$], magnesium hydroxide [$Mg(OH)_2$] and aluminium hydroxide [$Al(OH)_3$].
Generally, liquid antacids are more effective than tablets because they have more surface area available for interaction and neutralisation acid.
Milk is a weak antacid.
Histamine stimulates the secretion of pepsin and hydrochloric acid. The drug cimetidine [Tegamet] was designed to prevent the interaction of histamine with the receptors present in the stomach. Cimetidine binds to the receptors that triggers the release of acid the stomach. This results in release of lesser amount of acid. Now ranitidine (zantac), omeprazole and lansoprazole are used for hyperacidity.

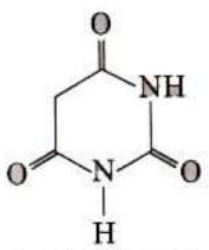
Tranquilizers (Psychotherapeutic Drugs)

Chemical substances used for the treatment of stress, anxiety, irritability and mild or even severe mental diseases, are known as tranquilizers. These affect the central nervous system and induce sleep for the patients as well as eliminate the symptoms of emotional distress. They are the common constituents of sleeping pills.

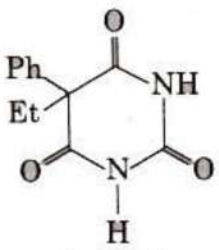
Noradrenaline is one of the neurotransmitter that plays a role in mood change. If the level of noradrenaline is low, the signal sending activity becomes low, and the person suffers from depression. In such situations antidepressant drugs are required. These drugs inhibit the enzymes which catalyse the degradation of

noradrenaline. If the enzyme is inhibited, this important neurotransmitter is slowly metabolized and can activate its receptor for longer periods of time, thus counteracting the effect of depression. Iproniazid and phenelzine are two such drugs.

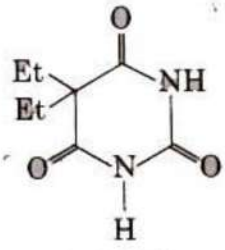
Barbituric acid and its derivatives viz. veronal, amytal, nembutal, luminal, seconal are known as barbiturates. Barbiturates are hypnotic, i.e., sleep producing agents.



barbituric acid



luminal



veronal

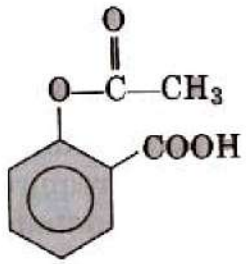
Equanil is used to control depression and hypertension.
Non-hypnotic chlorodiazepoxide and meprobamate are relatively mild tranquilizers suitable for relieving tension.

Analgesics:

Medicines used for getting relief from pain are called analgesics. These are of two types

1. Narcotics
Drugs which produce sleep and unconsciousness are called narcotics. These are habit forming drugs. For example, morphine and codeine. Morphine diacetate is commonly known as heroin.

2.Non-narcotics
These are non-habit forming chemicals which reduce mild to moderate inflammation such as headache, toothache, muscle and joint pain, etc. These are also termed as non-addictive. These drugs do not produce sleep unconsciousness. Aspirin (2-acetoxybenzoic acid) is most commonly used analgesic with antipyretic properties. Now these days because of its anti-blood clotting action, aspirin is widely used in heart-attacks.

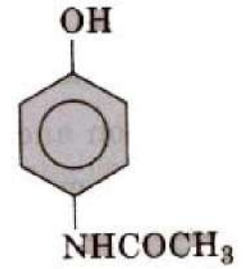


aspirin

Aspirin is toxic for liver and sometimes also causes bleeding from- stomach. So, naproxen, ibuprofen, paracetamol dichlorofenac sodium are other widely used analgesics.

Antipyretics

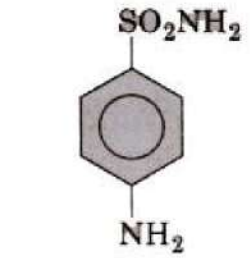
These are the chemical substance which reduce body temperature during high fever. Paracetamol, aspirin, phenacetin (4-hydroxy acetanilide), analgin and novalgin, etc., are common antipyretics. Out of these, paracetamol (4-acetamidophenol) is most common.



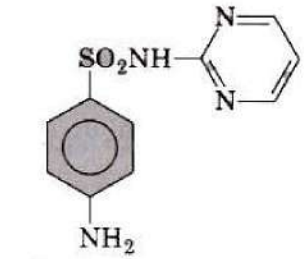
paracetamol

Antimicrobials

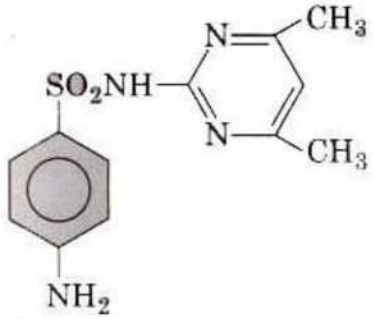
An antimicrobial tends to kill or prevent development of microbes CII inhibit the pathogenic action of microbes such as bacteria, fungi and virus selectively. [Sulpha drugs constitute a group of drugs which are derivatives of sulphanilamide and have great antimicrobial capacity. Thus, these are widely used against diseases such as dyptheria, dysentry, tuberculosis, etc.]



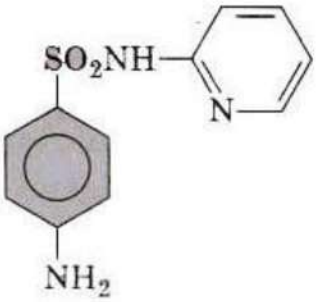
sulphanilamide



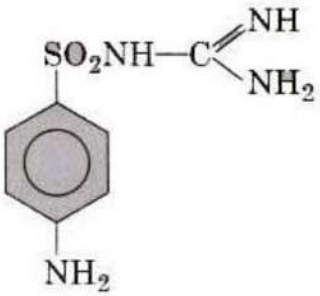
sulphadiazine



sulphadimidine



sulphapyridine



sulphaguanidine

In structure, these drugs are analogues of p-amino benzoic acid. Different types of antimicrobial drugs are as follows:

Antibiotics

These are the substances (produced wholly or partially by chemical synthesis) which in low concentrations inhibit the growth of microorganisms or destroy them by intervening in their metabolic processes.

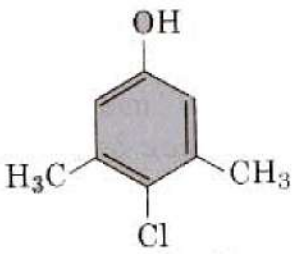
Antibiotics are products of microbial growth and thus, antibiotic therapy has been linked to 'setting one thief against another'.
Antibiotics are of two types :

1. Bactericidal antibiotics have cidal (killing) effect on microbes. For example, penicillin, ofloxacin, amino glycosides, etc.
2. Bacteriostatic antibiotics have a static (inhibitory) effect on microbes. For example, erythromycin, tetracycline, chloramphenicol, etc.

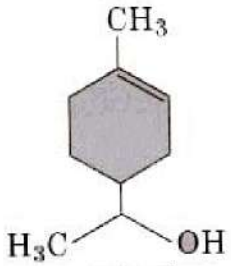
Penicillin was the first antibiotic discovered (by Alexander Fleming) in 1929. It is a narrow-spectrum antibiotic. Ampicillin and amoxicillin are semi-synthetic modifications of penicillin. Penicillin is not suitable to all persons and some persons are allergic to it. Consequently, it is essential to test the patients for sensitivity (or allergy) to penicillin, before it is administered.
In India, penicillin is manufactured at Pimpri and Rishikesh (Uttarakhand).
Broad-spectrum antibiotics also called antibiotics, are antibiotics which are effective against different types of harmful micro-organisms. e.g., Tetracycline, chloramphenicoltgiven in case of typhoid, dysentery, fever ofloxacin, etc.

Antiseptics

These are the chemicals which either kill or prevent the growth microorganisms. Antiseptics are applied to the living tissues such as wounds, cuts, ulcers and skin diseases in the form of antiseptic creams like furacin and soframycin. e.g., Some important examples of antiseptics are:
(i) **Dettol** is a mixture of chloroxylenol and terpineol.

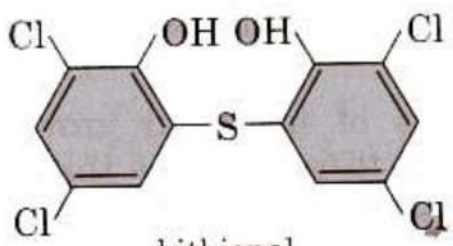


chloroxylenol



terpineol

(ii) **Bithional** is added to soaps to impart antiseptic properties to reduce the odour produced by bacterial organic matter on the skin.



bithional

(iii) **Tincture of iodine** is a 2-3% solution of iodine in alcohol, which is a powerful antiseptic for wounds.
(iv) **Iodoform** (CHI_3) is also used as an antiseptic for wounds.
(v) **Boric acid** in dilute aqueous solution is weak. Its formula is H_3BO_3.

Disinfectants

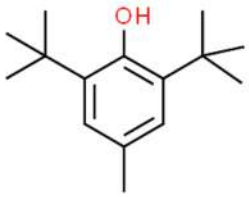
These are the chemical substances which kill micro-organisms not safe to be applied to the living tissues. They generally kill the micro-organisms present on inanimate objects such as drainage systems, instruments, etc.
Some common examples of disinfectants are as follows
(i) 1% phenol solution is disinfectant while in lower concentration i.e., 0.2% solution of phenol is antiseptic.
(ii) 0.2-0.4 ppm aqueous solution of chlorine is used for sterilisation of water to make it fit for drinking purpose.
(iii) SO_2 at very low concentration behaves like disinfectant.
(iv) Formaldehyde (HCHO) in the disinfecting rooms and operation gaseous theatres forms is used in hospitals.

Antifertility Drugs

These are the chemical substances used to control the pregnancy. These are also called oral contraceptives. They belong to the class of natural products, known as steroids.
Birth control pills essentially contain a mixture of synthetic estrogen and progesterone derivatives. Norethisterone is widely used as an antifertility drug.

Food Preservatives

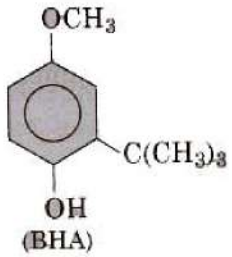
These are the chemical substances added to food to prevent their spoilage due to microbial growth (bacteria, yeasts and moulds) and to retain their nutritive value for longer periods.



BHT

The most commonly used preservatives include table salt, sugar, vegetable oil, vinegar, citric acid, spices and sodium benzonate (C_6H_5COONA). Salts of sorbic acid and propanoic acid are also used" preservatives for cheese, baked food, pickles, meat and fish products.

1. Sodium benzoate is metabolised by conversion into hioppuric acid ($C_6H_5CONHCH_2COOH$), which is ultimately urine. It is used in soft drinks and acidic foods.
2. Antioxidants like BHT (butylated hydroxytoluene) and BRA butylated hydroxyanisole) retard the action of oxygen on the food and help in the preservation of food materials.



(BHA)

Cleansing Agents: Soaps & Detergents

Cleansing Agents

The word detergent means cleansing agent. Actually detergent word is derived from Latin word 'detergere' means "to wipe off", Cleansing agents are the substance which remove dirt and have cleansing action in water. These are also called surfactants.

Detergents can be classified into two types.

1. Soapy detergents or soaps, and
2. Non-soapy detergents or soapless soap.

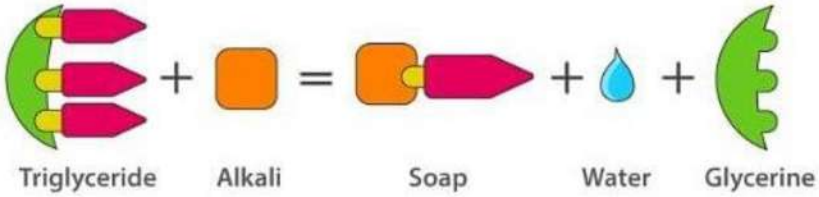
Soaps

Soaps are sodium or potassium salts of higher fatty acids (containing 15-18 carbon atoms) e.g., stearic acid, oleic acid and palmitic acid. Sodium salts of fatty acids are

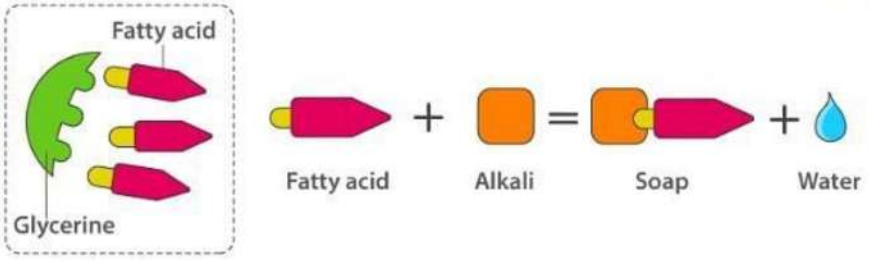
known as hard soaps while the potassium salts of fatty acids are known as soft soaps.
Hard soaps are prepared by cheaper oil and NaOH while soft soaps are Jlrepared by oil of good quality and KOH. The soft soaps do not contain freealkali, produce more lather and are used as toilet soaps, shaving soaps and shampoos.

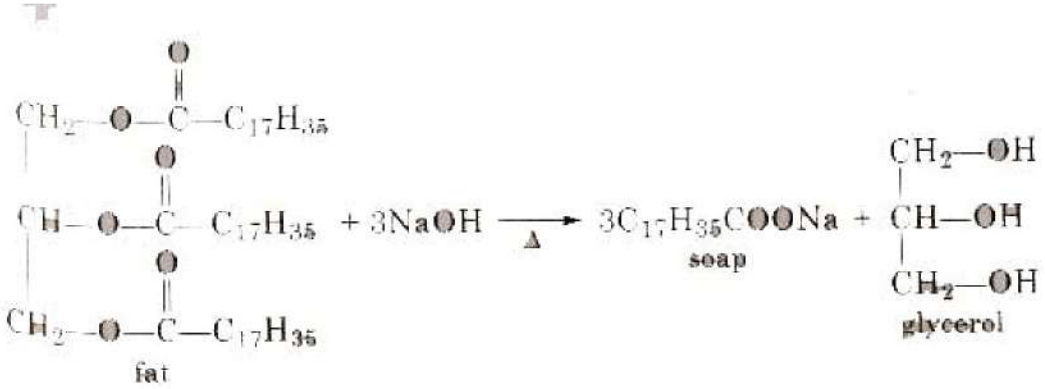
Preparation of soaps

Soaps containing 'Sodium salts are formed by heating fat (glyceryl ester ~fatty acid) with an aqueous sodium hydroxide solution. This reaction is known as saponification.



The fatty acids are later purified by the method of distillation and neutralized with an alkali to produce water and soap.





$$\text{Oil/Fat} + \text{NaOH} \xrightarrow[\Delta]{} \text{Soap} + \text{Glycerol}$$

The solution left after removing the soap contains glycerol, which can be recovered by fractional distillation. To improve the quality of soaps desired colours, perfumes and medicinal chemical substances, added.

Types of Soaps

Different kind of soaps are made by using different raw materials.

1. **Toilet soaps** These are prepared by using better grade of fat or oil and care is taken to remove excess alkali. Colour and perfumes are added to make these more attractive.
2. **Floating soaps** These can be prepared by beating tiny bubbles into the product before it hardens.
3. **Transparent soaps** These are made by dissolving the in ethanol and then evaporating the excess solvent.
4. **Medicated soaps** Medicated soaps are prepared by some antiseptics like dettol or bithional.
5. **Shaving soaps** These contain glycerol to prevent drying. A gum called rosin is added while making them. It forms sodium rosinate which lather well.
6. **Laundry soaps** These sodium silicate, borax and contain sodium fillers like carbonate. sodium rosins
7. **Soap Chips** These are made by running a thin sheet of melted soap on a cool cylinder and scraping off the soaps in small broken pieces.
8. **Soap grannules** These are dried miniature soap bubbles.
9. **Soap powder and scouring soaps** These contain a scouring agent (abrasive) such as powdered pumice or finely divided sand and builders like sodium carbonate and trisodium phosphate. Builders make the soaps act more quickly.

Disadvantages of Soaps

Soap is good cleansing agent and is 100% biodegradable microorganisms present in sewage water can completely oxidise soap to CO_2 As a result, it does not create any pollution problem. However soaps have two disadvantages:
(i) Soaps cannot be used in hard water since calcium magnesium ions present in hard water produce curdy precipitates of calcium and magnesium soaps.

$$2C_{17}H_{35}COONa + CaCl_2 \longrightarrow \underset{\text{insoluble}}{(C_{17}H_{35}COO)_2Ca} + 2NaCl$$

$$2C_{17}H_{35}COONa + MgSO_4 \longrightarrow \underset{\text{insoluble}}{(C_{17}H_{35}COO)_2Mg} + Na_2SO_4$$

These insoluble soaps separate as scum in water and causes hinderance to washing because the precipitate adheres onto the fibre of the cloth as gummy mass. Thus, a lot of soap is wasted if water. is hard.
(ii) Soaps cannot be used in acidic solutions since acids precipitate the insoluble free fatty acids which adhere to the fabrics and thus, reduce the ability of soaps to remove oil and grease from fabrics.

$$\underset{\text{soap}}{RCOONa} + H^+ \longrightarrow \underset{\substack{\text{free fatty acid}\\ \text{precipitate out}}}{RCOOH} + Na^+$$

Detergents

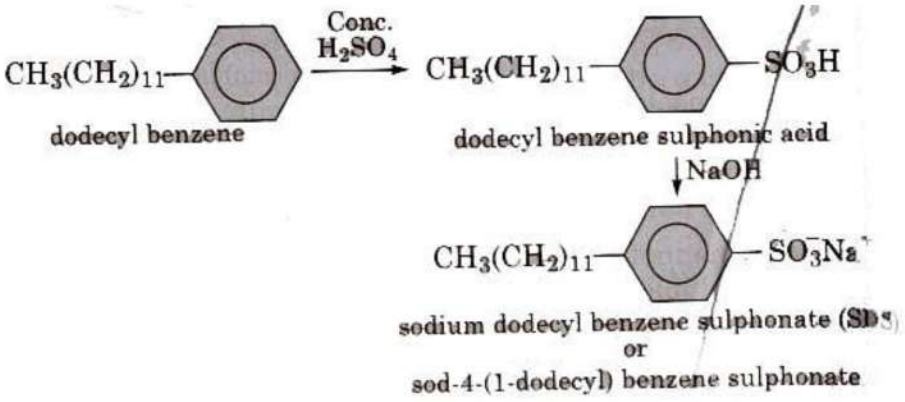
Synthetic detergents have all the properties of soaps but actually does not contain any soap, so they are known as 'soapless soaps'.
Straight chain alkyl group containing detergents are biodegradable whereas branched chain alkyl group containing detergents are non-biodegradable.
Unlike soaps, synthetic detergents can be used in both soft and hard water. This is due to the reason that calcium and magnesium salts of detergents like their sodium salts are also soluble in water. Synthetic detergents are mainly classified into three categories:

Anionic Detergents

These are sodium salts of sulphonated long chain alcohols or hydrocarbons.
(i) Alkyl hydrogen sulphates formed by treating long chain alcohols with concentrated sulphuric acids are neutralised with alkali to form anionic detergents.

$$\underset{\text{lauryl alcohol}}{CH_3(CH_2)_{10}CH_2{-}OH} \xrightarrow[H_2SO_4]{\text{Conc.}} \underset{\text{lauryl hydrogen sulphate}}{CH_3(CH_2)_{10}CH_2{-}OSO_3H} \xrightarrow{NaOH} \underset{\substack{\text{sodium lauryl sulphate}\\ \text{(anionic detergents)}}}{CH_3(CH_2)_{10}CH_2OSO_3^-Na^+}$$

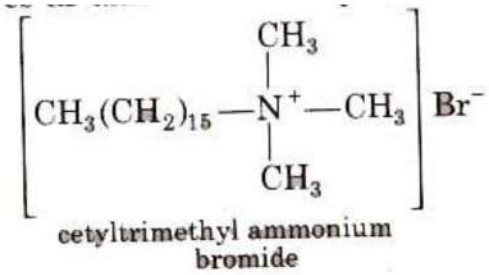
(ii) Alkyl benzene sulphonates are obtained by neutralising alkyl benzene sulphonic acids with alkali.



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

Cationic Detergents

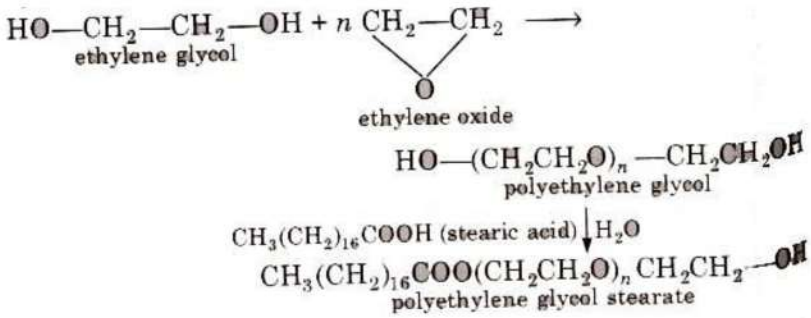
These are quaternary ammonium salts of arnines with acetates, chlorides or bromides as an anion. For example,



Cationic detergents are used in hair conditioner. They have germicidal properties but are expensive therefore, these are of limited use.

Non-ionic Detergents

Such detergents does not contain any ion in their constitution. One such detergent can be obtained by reaction of stearic acid and polyethylene glycol.



Liquid dish washing detergents are non-ionic type, Mechanism of cleansing action of this type of detergents is the same as that of soaps.

Advantages of synthetic detergents over soaps

1. Synthetic detergents can be used even in case of hard water whereas soaps fail to do so.
2. Synthetic detergents can be used in the acidic medium while soaps cannot because of their hydrolysis to free acids.
3. Synthetic detergents are more soluble in water and hence, form better lather than soaps.
4. Synthetic detergents have a stronger cleansing action than soaps.

Chemistry in Colouring Matter

The natural or synthetic colouring matter which are used in solution to stain materials especially fabrics are called dyes.
All colouring substances are not dyes, e.g., azobenzene, a coloured substance does 'not act as dye.
A dye have following characteristics:

1. It must have a suitable colour.
2. It can be fixed on the fabric either directly or with the help of mordant.
3. It must be resistant to the action of water, acid and alkalies. The groups, responsible for colour, are called chromophore, e.g.,

The substance wheih do not given colour itself but intensify the colour of chromophore, are called **auxochrome**.
e.g., —OH, —SO_3H, —COOH, —NH_2, —NH*R*—, —NR_2.

Classification of Dyes on the Basis of Constitution

(i) Nitro or nitroso dye Chromophore NO_2 or NO group, Auxochrome = -OH group, e.g., picric acid, martius yellow, Gambine, naphthol yellow-S.
(ii) Azo dye, e.g., bismark brown, methyl orange, methyl red, congo red, etc.
(iii) Anthraquinone dye e.g., alizarin
(iv) Indigo is the oldest known dye. Other examples are tyrian purple, indigosol.
(v) Phthalein dye e.g., phenolphthalein, fluorescein, eosin, mercurochrome.
(vi) Triarybnethane dye, e.g., malachite green, rosaniline.

Classification of Dyes on the Basis of Application

(i) Direct dyes These dyes applied directly to fibre and are more useful to the fabrics containing H-bonding like cotton, rayon, wool, silk and nylon, e.g., martius yellow, congo reu/etc.
(ii) Acid dyes These are water soluble and contain porar/acidic groups which interact with the basic group of e.g., Orange-I, congo red, methyl orange, etc. These dyes does not have affinity for cotton but are used for silk, wool, etc.
(iii) Basic dyes These dyes contain basic group (like NHz group) and react with anionic sites present on the fabric. These are used to dye nylons and polyester, e.g., butter yellow, magenta (rosaniline), aniline yellow, etc.
(iv) Vat dyes Being water insoluble, these cannot be applied directly. These are first reduced to a colourless soluble form by a reducing agent in large vats and then, applied to fabrics. After applying, these are oxidised to insoluble coloured form by exposure. to air or some oxidising agents, e.g., Indigo, tyrian purple, etc.
(v) Mordant dyes These are applied with the help of a binding material (e.g., metal ion, tannic acid or metal hydroxide) called mordant. Depending upon the metal ion used, the same dye can give different colours. Alizarin is an important example of such dyes.
(vi) Ingrain dye These dyes are synthesised directly on the fabric. These are water insoluble and particularly suitable for cotton fibres. Azo dyes belong to this group of dye.

Chemistry in Cosmetics

Cosmetics are used for decorating, beautifying or improving complexion of skin. Some of the cosmetics of daily use are as

1. Creams

These are stable emulsions of oils or fats in water and contain emmollients (to prevent water loss) and humectants (to attract water) as two fundamental components.

2. Perfumes
These solutions have pleasent odour and invariably consist of three ingredients: a vehicle (ethanol + H20), fixative e.g., sandalwood oil, benzoin, glyceryl diacetate etc.) and odour producing substance (e.g., terpenoids like linalool, anisaldehyde (p-methoxy- benzaldehyde etc.)

3. Talcum Powder
It is used to reduce irritation of skin. Talc ($Mg_3(OH)_2Si_4O_{10}$), chalk, Zno, zinc sterate and a suitable perfume are the constituents of talcum powder.

4. Deodorants
These are applied to mask the body odour. These possess antibacterial properties. Aluminium salts, ZnO, $Zn0_2$, $(C_{17}H_{35}COO)_2Zn$ can be used in deodorant preparation.

Rocket Propellants
Substances used for launching rockets are called rocket propellants. These are the combination of an oxidiser and a fuel.
Depending upon the physical states of oxidiser and fuels, rocket propellants are classified as

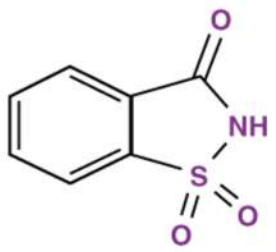
1. Solid Propellants
These are further divided into two classes
(i) Composite propellants In these propellants, fuel is polymeric binder such as polyurethane or polybutadiene and oxidiser is ammonium per chlorate or potassium perchlorate.

Chemicals in Food

Artificial Sweetening Agents

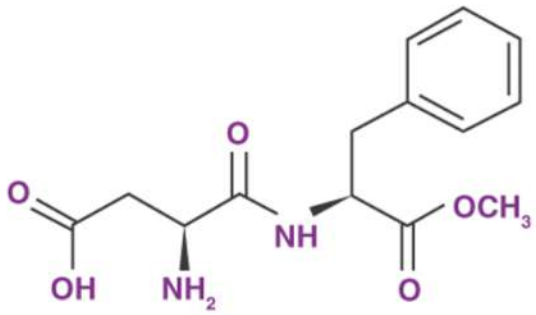
Sucrose (table sugar) and fructose are the most widely used natural sweeteners. But they add to our calorie intake and promote tooth decay. To avoid these problems many people take artificial sweeteners.
Organic substances which have been synthesized in lab are known to be many times sweeter than cane sugar. Such compounds are known as artificial sweetening agents or artificial sweeteners.
Some important artificial sweeteners are given below:

Saccharin (o-sulphobenzimide)
Discovered by Johns- Hopkins in 1879 (University of USA).



It is the most popular artificial sweetener. It is 550 times as sweet as cane Sugar, since it is insoluble in water, so it is sold in the market as its soluble or calcium salt. It is non-biodegradable so excreted from the body in urine (unchanged). Its use is of great value for diabetic persons and people who need to control intake of calories.

Aspartame



Aspartame

It is the methyl ester of the dipeptide derived from phenylalanine aspartic acid. It is also known as 'Nutra sweet'.
It decomposes at baking or cooking temperatures and hence, can be used only in cold food and soft drinks.
Aspartame has the same amount of calories as sugar (4 cal per gram).
Aspartame should not be used by people suffering from the genetic disease known as PKU (phenyl ketone urea). Because in such people decomposition of aspartame gives phenylpyruvic acid. Accumulation of phenylpyruvic acid is harmful especially to infants due to brain damage and mental retardation.

Alitame

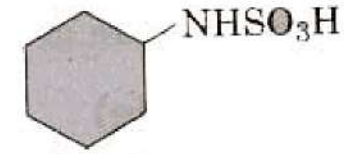
It is quite similar to aspartame but more stable than aspartame. It is 2000 times as sweet as sucrose. The main problem for such sweetener is the control of sweetness of the substance to which it is added because it is high potency sweetener.

Sucralose

It is a trichloro derivative of sucrose. It's appearance and taste are like sugar. It is stable at cooking temperature. It is almost 600 times as sweet as sucrose. However, it neither provides calories nor causes tooth decay.

Cyclamate

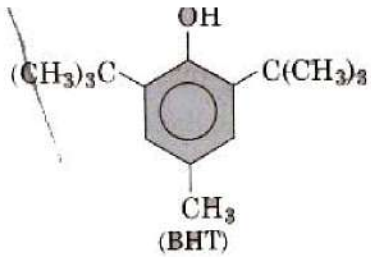
It is N-cyclohexylsulphamate. It is only 20 times sweeter than cane sugar.



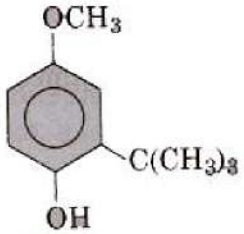
cyclamate

Food Preservatives

- These prevent spoilage of food by stopping the growth of microorganism. For example, Sodium benzoate, sodium meta bisulphate.
- These are the chemical substances added to food to prevent their spoilage due to microbial growth (bacteria, yeasts and moulds) and to retain their nutritive value for longer periods.
- The most commonly used preservatives include table salt, sugar, vegetable oil, vinegar, citric acid, spices and sodium benzoate (C_6H_5COONA).
- Salts of sorbic acid and propanoic acid are also used as" preservatives for cheese, baked food, pickles, meat and fish products.
- Sodium benzoate is metabolised by conversion into hippuric acid ($C_6H_5CONHCH_2COOH$), which is ultimately urine. It is used in soft drinks and acidic foods.
- Antioxidants like BHT (butylated hydroxytoluene) and BRA butylated hydroxyanisole) retard the action of oxygen on food and help in the preservation of food materials.



(BHT)



(BHA)

Anti-Oxidants in Food

These prevent the spoilage of food by preventing the oxidation of food. For example,

1. Butylated hydroxyl tolerance (BHT)
2. Butylated hydroxyl anisole (BHA)