17 Chemistry in Every Day Life

17.1 INTRODUCTION :

i) Among all the branches of science chemistry probably plays the most important role in our every day life. Following are some of the gifts of chemistry to man .

ii) Chemistry has given us the life saving medicines & drugs, beautiful dyes , synthetic fibres, synthetic detergents, cosmetics, preservatives for food , plastics etc.

Learning Objectives

- Introduction
- Analgesics : Aspirin
- Tranquilizers
  Barbiturates
- Antiseptic and
  disinfectants
- Antibiotics
  Definition
  Bactericidal and
  Bacteriostatic
- Antacids
- Chemicals in food
  preservation
  Physical methods &
  Chemical methods
- Artificial sweetening
  agents : Saccharin
- Antioxidants
- Enterprise education
  Preparation of phenyl

iii) Chemical science is the back bone of large number of industrial materials like glass, cement, fertilisers, pesticides, paper, polymers, oils and fats , fuels etc.

iv) There is hardly any aspect of life where chemistry is not in service of man. Hence we can say the main aim of chemist and chemistry is *to improve the quality of life.*

CHEMICALS IN MEDICINES & HEALTH CARE :

The chemical substances (natural or synthetic) used for treatment of diseases and for reducing the pains are called **medicines or drugs.**

The branch of science which deals with treatment of diseases by using suitable chemicals is called ***chemotherapy*** *and the chemicals (drugs) used for this purpose are called* ***chemotherapatic agents.***

These chemicals can destroy the invading organisms without injuring the cells of body.

Here we will discuss some specific types of drugs used in allopathy.

17.2 ANALGESICS : (Pain killers)

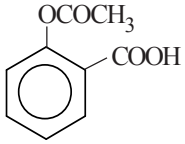
Analgesics are the drugs used for reliving pains in the body.

e.g. Aspirin, ibuprofen, naproxen, diclofenac sodium or potassium

ASPIRIN

(2- acetoxybenzoic acid or acetyl salicylic acid) Aspirin is a common **analgesic** with antipyretic properties i.e. it can lower temperature of body in fever.

Aspirin : (mol. formula $C_9H_8O_4$)



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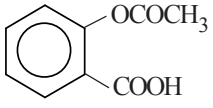
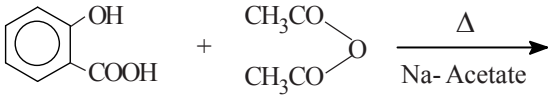
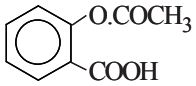


Preparation :

i) Aspirin is prepared by acetylation of salicylic acid.

ii) Salicylic acid is heated with acetic anhydride or acetyl chloride in presence of a catalyst like glacial acetic acid, sodium acetate, H_3PO_4 , H_2SO_4 or pyridine.
After the reaction, the reaction mixture is poured on crushed ice, when aspirin separates as a solid.





Aspirin + CH_3COOH Acetic acid

Medicinal properties :

i) Aspirin is a commonly used analgesic and antipyretic drug. It gives immediate relief in case of body ache, headache arthrites etc.

ii) Now a days aspirin is used in preventing heart attacks due to its anti-blood clotting action.

iii) Research work is carried out to study the applications of aspirin to treat many diseases e.g. to cure pregnancy related complications, viral inflammation in AIDS patients, Alzheimers disease (i.e. trembling of limbs), dementia (loss of memory and general mental weakness) and cancer.

Side efferts of Aspirin :

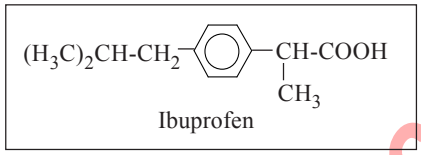
Dispite of its popularity aspirin has following harmful side - effects

i) It is toxic to the liver.

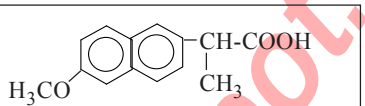
ii) It some times causes bleeding from stomach wall and leads to gastric irritation.

Substitutes for aspirin :

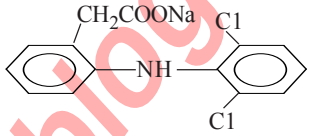
Due to many harmful side effects of aspirin, some analgesics are used as substitutes for aspirin e.g. ibuprofen , naproxen, and diclofenac sodium or potassium.

i)


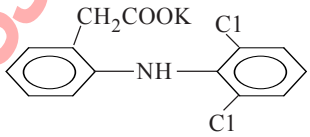
Ibuprofen

ii)


Naproxen

iii)


Diclofenac sodium

iv)


Diclofenac potassium

Read and Digest

i) Analgesic action of aspirin is due to its action on central and peripheral nervous system.

ii) Aspirin is non-narcotic and non-alkaloid analgesic. It does not induce sleep or unconsciousness.

iii) Inspite of severe side effects , aspirin still is a drug of choice for prevention of heart attack & to relieve the pain in angina.

ii) Actually aspirin gets hydrolysed to form salicylic acid which causes the harmful effects

iii) Hence it should not be taken empty stomach. (Actually sodium and calcium salts of aspirin are more soluble and less harmful) .

17.3 TRANQUILIZERS

(Psychotherapeutic drugs) :

The chemical compounds used for the treatment of stress and mental diseases due to their action on central nervous system (CNS) are called tranquilizers.

i) These drugs decrease the psychomotor activity of the patient.

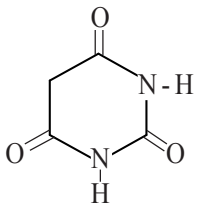
ii) They relieve fatigue and stress and improve the mood and behaviour of psychic patients. Hence they are called as *psychotherapeutic drugs*.

Traquilizers are of two types :

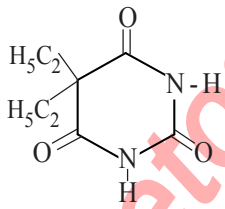
a) Hypnotic tranquilizers : *They relieve tension but inducing sleep*. They are essential components of sleeping pills.

e.g. the most common hypnotic tranquilizers are barbiturates, the derivatives of barbituric acid.

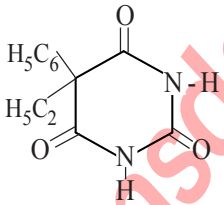
e.g. Veronal, luminal, seconal, amytal & nembutal.



Barbituric acid



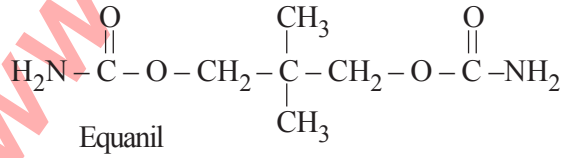
Veronal or barbital



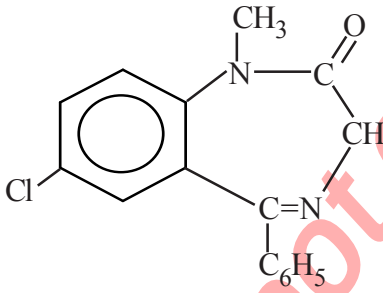
Luminal

b) Nonhypnotic tranquilizers or sedatives:

They relieve tension without inducing sleep. The mild drugs of this type are chlordiazepoxide, meprobamate. *Equanil and valium are used in controlling depression and hypertension.*



Equanil



Valium or Diazepam or compose

Side effects of tranquilizers : Drowsiness, fatigue, habit formation, visual disturbances, constipation, hypothermia (i.e low body temperature), anemia etc.

Note the following

i) **Hypnotics :** Tranquilizers which in normal dose induce sleep are called hypnotics.

ii) **Sedatives :** Tranquilizers which in normal dose act as antidepressant without inducing sleep are called sedatives. They are given to patients who are mentally agitated and violent.

iii) However a hypnotic in small dose acts as sedative and a sedative in higer dose acts as hypnotic.

17.4 ANTISEPTIC AND DISINFECTANTS :

Antiseptics are the chemicals which can either prevent the growth of micro-organism or can kill them but they are safe for the living tissues.

Uses :

i) They can be applied to living tissues, e.g. wounds, cuts, ulcers and diseased skin surfaces etc.

ii) Antiseptics are also used to reduce odours resulting from bacterial decompositition of the body or in the mouth. Hence antiseptics are mixed with deoderants, face powders and breath purifiers.

Common examples of antiseptics are :

Phenol, dettol, bithional, iodine, iodoform etc.

a) **Phenol :** A 0.2 % solution of phenol acts as good antiseptic.

b) **Dettol :** It is a mixture of chloroxylenol and terpeneol.

c) **Bithional :** It is added to soap to impart antiseptic properties. It eliminates the undesirable odours resulting from bacterial decomposition of organic matter on the skin.

d) **Iodine :** Its a powerful antiseptic. It is used in the form of tincture of iodine which is a 2-3 % solution of iodine in water alcohol mixture.

e) **Iodoform (CHI_3) :** It is used as antiseptic powder for wounds. This is because iodoform decomposes to liberate iodine, a powerful antiseptic.

f) **Boric acid (H_3BO_3) :** A dilute aqueous solution of boric acid is used as weak antiseptic for eyes. It is also used as antiseptic in baby talcum powder.

g) **Hydrogen peroxide (H_2O_2)**: It is a non-irritating strong antiseptic under the name *perhydrol* for washing wounds, teeth and ears.

Disinfectants :

Disinfectants are the chemicals which kill micro - organisams (similar to antiseptics) but are not safe for living tissues.

Uses :

i) Disinfectants are used to kill the micro-organisms in inanimate objects e.g. floors, drainage systems, instruments etc.

Some common examples of disinfectants are :

i) **Chlorine :** Chlorine in 0.2 - 0.4 ppm (parts per million) is used as a disinfectant for drinking water. It kills the micro - organisms and makes water fit for drinking.

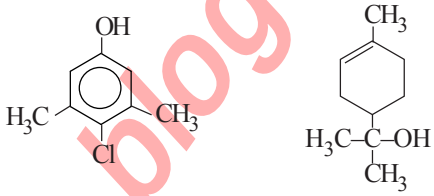
ii) **Sulphur dioxide :** Sulphur dioxide in low concentrations are used in sterlisation and preservation of squashes

iii) **Phenol :** 1% solution of phenol acts as disinfectant

Do You Know ?

i) It must be noted that the same substance can act as an antiseptic as well as disinfectant by varying its concentration.
For exmpale : A 0.2% solution of phenol is antiseptic but its 1% solution is a disinfectant.

ii) Dettol contains chloroxylenol antiseptic.



Chloroxylenol Terpeneol

17.5. ANTIBIOTICS :

Antibiotics are the chemical substances produced by micro-organisms (bacteria, fungi and moulds) that can inhibit the growth of other micro-organisms or even can destroy them.

However this definition has been modified since now antibiotics can be synthesised in laboratories also.

Antibiotics is a chemical substance prepared wholly or partly by chemical synthesis, and which in low concentration inhibits the growth of micro-organisms or destroys them by intervening in their metabolic processes.

Antibiotic therapy is similar to setting one thief against another because antibiotics themselves are produced by micro-organisms.

Alexander fleming discovered the first antibiotic penicillin in 1929. It was obtained from the mould *penicillium notatum.*

Antibiotics can be classified into two types:

i) **Bactericidal** (i.e. which can kill bacteria) : Eg.Penicillin, aminoglycosides, ofloxacin, cephalosporin, streptomycin.

ii) **Bacteriostatic** (which inhibits the growth of bacteria) : E.g. Erythromycin, Teracyclin Chloramphenicol.

Spectrum of antibiotics :

The full range of micro-organisms attacked by an antibiotic is called its spectrum.

On the basis of their spectrum antibiotics fall in two types :

a) Broad spectrum antibiotics : These antibiotics are effective against large no. of different types of harmful micro-organisms. e.g. tetracycline, chloramphenicol, ofloxacin etc.

b) Narrow spectrum antibiotics : These antibiotics are effective against only certain types of bacteria. Thus they are highly specific in their action e.g. penicillin, erythromycin.

Uses :

i) Penicillin, a short spectrum antibiotics can be used in treatment of sour throat, gonorrhoea (STD), rheumatic fever, local infections etc.

ii) Chloramphenicol (isolated in 1947) is a broad spectrum antibiotic. It is rapidly absorbed from gastro-intestinal tract hence it can be given orally. It is used in typhoid, dysentery, acute fever, certain forms of urinary infections , meningitis and pneumonia.

iii) Streptomycin is used in treatment of tuber culosis.

Side effects : Antibiotics may cause one or more of the side effects like, skin rashes, dryness of mouth, nausea, vomiting, abdominal pain, diarrhoea, insomnia (sleeplessness) headache, damage to hearing etc.

Note the following :

In India penicillin is manufactured at the Hindustan Antibiotics in Pimpri and at Indian drugs and pharmaceuticals limited Rishikesh and in private sector also.

17.6. ANTACIDS

Acidic stomach is necessary for good health, but excessive acidity in stomach can cause discomforts, such as acid indigestion , heart burn or gastric ulcers.

Acid gastritis is caused due to excess of hydrochloric acid in the gastric juice.

The chemical substances which neutralise the excess acid and raise the pH to appropriate level in stomach are called antacids.

Common examples of antacid are :

Magnesium hydroxide, magnesium carbonate magnesium trisilicate, aluminium hydroxide gel, aluminium phosphate and sodium bicarbonate.

In recent years, omeprazole and lansoprazole are used as antacids. They prevent acid formation in stomach.

Uses of antacids :

i) They neutralize excess of HCl acid and raise the pH to appropriate level in stomach.

ii) They can give relief from acid indigestion, hyper acidity, heart burns and gastric ulcers.

Side effects :

i) Chalky test in mouth, constipation, nausea or vomiting, headache, dizziness etc.

iii) Excess dose of sodium bicarbonate can cause *alkalosis.*

Do You Know ?

i) Empty stomach has pH about 1-2, while the full stomach has pH about 8.

ii) In normal adult person about 22 m Eq. HCl acid is screated per hour. When this scretion is increased upto 42 m Eq. per hour, it is called hyper acidity. It results in gastric or duodenal ulcers.

iii) Causes of peptic ulcer are emotional tension, smoking, alcohol and consumption of spicy food.

iv) Milk is a weak antacid and also possesses a protective action.

ii) Antacid preparations in market such as Gelusil, digene, siloxogene etc contain mainly $Al(OH)_3$, $Mg(OH)_2$ & methyl polysilox.

iii) Liquid antacids, are more effective than tablets since they afford greater surface area for action on acid.

17.7 FOOD PRESERVATION

During storage & distribution of food materials undesirable changes occur in flavour, colour, texture, etc and the food is spoiled.

The spoilage of food is due to three reasons

i) Microbial growth

ii) Enzyme activities and

iii) Oxidation

The process in which physical or chemical treatment is given to food materials to prevent their spoilage and to retain their nutritive value for long period, is called food preservation.

The chemicals which are added to the food materials to prevent their spoilage and to retain their nutritive value for long period are called *preservatives*.

The preservatives inhibit the growth of micro-organisms or kill them.

Necessity of food preservation :

i) To prevent the spoilage of food due to microbial growth.

ii) To retain the nutritive value of food for long period.

iii) To avoid the undersirable changes in the flavour, colour, texture and appetitic appeal of the food.

iv) To make the seasonal foods (like mangoes, oranges, grapes etc.) available through out the year.

Types : The food preservation methods are classified into two types

a) Physical methods : In this method chemicals reagents are not used.

b) Chemical methods : It involves use of suitable chemicals.

1) PHYSICAL METHODS :

a) By removal of heat or freezing : Freezing of food materials at about (273 - 269 K) slows down the growth of micro-organisms and the spoilage of food.

The food materials which can be preserved by refrigeration are mainly vegetables, milk, meat, fish, poultry, juices etc.

Vegetables are scalded (or blanched) i.e. dipped in hot water before refrigeration. This prevents enzymes from changing the flavours of vegetables.

b) By addition of heat : Heat treatment i.e. raising the temperature of food for a particular period can destroy the micro - organisms and inactivate the enzymes in the food. This prevents the spoilage of food.

Common methods of heat treatment :

i) Cooking : In addition to the usual advantages of heat treatment, cooking makes the food more palatable and digestible.

ii) Canning : Fruits, vegetables, meats , fish etc are preserved by heat treatment and sealing them into air tight containers ..... i.e. canning. The food is packed into cans and sterlised by using steam. The can is then sealed and heated in autoclave under pressure and then cooled rapidly.

iii) Pasteurization :

- Milk is preserved by this method (also some wines and other liquids).
- Milk is heated at 71.7^0 C for 15 seconds followed by rapid cooling.

- This causes little damage to nutrients but the micro -organism can't withstand this sudden change in temperature and they are either inactived or killed.

c) By removal of water (dehydration) :

- Dehydration of food is an effective method of food preservation.
- Dehydration of food kills the microbes and inactivates the enzymes.
- This is because microbes require ≈ 13-20 % moisture for their survival (dehydrated food contains only about 5 % moisture).
- e.g.i) Sun drying method is used for preservation of cereals (food gains), meat, fish etc.

  ii) Modern methods are (air drying, spray drying, freeze drying, drum drying etc.) used to prepare dry milk, instant coffee etc.

d) Irradiation :

- In this process food articles are exposed to radiations like γ- rays (from Co^{60}), β-rays from (linear accelerator), or X - rays.
- Low dose of radiations kills the microbes and inactivates the enzymes with little or no chemical change in food.

2) CHEMICAL METHODS

In this method food is preserved by using suitable chemicals called *food preservatives*. The nature of chemicals and their doses are strictly controlled by law. Some methods are

i) By addition of vinegar :

- Vinegar (6- 8 % acetic acid) is used as food preservative for pickles, ketchups, meat, onion, chinese food etc.
- Vinegar (acetic acid) lowers the pH of food, this prevents the growth of micro - organisms and blocks the enzyme activity.

ii) By addition of salt (salting) :

- Preservation of food by addition of common salt (NaCl) to it is called salting.
- Salt squeezes out water from the food material by osmosis and checks the bacterial growth. This avoids the spoilage of food.
- Salting is used for preservation of raw mango, amla, beans, tamarind, fish, meat and in pickle preparation.

iii) By addition of sugar :

- Sugar (sucrose) in the form of syrup is added to many fruits e.g. mango, apples, strawberry, carrot etc. as preservative.
- Sugar syrup (68 % sugar) retards the microbial and enzymatic action as it contains very little free water.

iv) By addition of chemicals :

a) Certain chemicals are used as food preservatives, the most common example is sodium benzoate (C_6H_5COONa). It is metabolised in the body to hippuric acid ($C_6H_5CONHCH_2COOH$) and excreted in urine . It is added to fruit juices, squashes, jams and jellies , acid food etc.

b) Sodium nitrate and sodium nitrite are used to maintain the pink colour of meat.

c) Salts of propionic acid and sorbic acid are also used as preservatives.

d) Potassium metabisulphite ($K_2S_2O_5$) is used in the preservation of colourless materials (raw mango chutney, lichies, apples, lemon squashes, fruit juices etc). It reacts with acids in these substances releasing SO_2 which kills the microbes.

17.8 ARTIFICIAL SWEETENING AGENTS

They are food additives which can be used as substitute for sugar and they are either low calorie or calorie free sweetners.

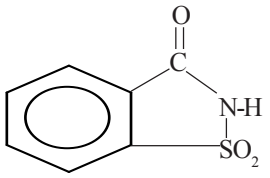
ii) They are of great value to diabetic persons and also to people who need to controll intake of calories (since they do not add to calorie intake of body).

iii) *Saccharine* (a white crystalline substance) is the first artificial sweetner.

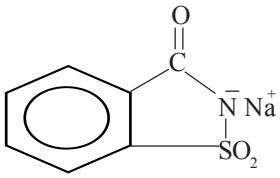
- It is marketed as its sodium or calcium salt which are water soluble.
- Saccharin is about 300 times more sweet than cane sugar

It is not biodegradable and is excerted as such in urine.

Other examples of artificial sweetners : are aspertame, sucralose and alitame.



Saccharine (o- sulphobenzoimide) or 1,2- benzisothiazolin-3-one-1,1-dioxide (insoluble in water)



Sodium salt of saccharine (soluble in water)

N.B. Artificial sweetners impart sweetness to food but they are not metabolised in the body and hence do not produce any calories.

17.9. ANTIOXIDANTS

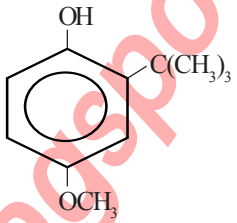
Antioxidants are compounds which retard the oxidation of food and help in its preservation.

Role of Antioxidants :

i) These compounds act as sacrificial material i.e. they undergo oxidation in preference to the food they are protecting (as they are more reactive towards oxygen) .

ii) They also reduce the rate of involment of free radicals in the aging process.

Common examples : The two most common antioxidants are butylated hydroxy toluene (BHT) and butylated hydroxy anisole (BHA)



Butylated hydroxy anisole (BHA)

i) These antioxidants protect the vegetable oils from rancidity (i.e. developing bad taste and odour due to oxidation.

ii) They are also used as protectives for breakfast cereals, potato chips etc.

iii) Some times BHA and BHT are added in combination with citric or ascrobic acids to produce a more active synergietic effect.

Other examples of antioxidants :

i) Sulphur dioxide and sulphites are used as antioxidants for wine and beers, sugar syrups and cut peeled or dried fruits and vegetables.

ii) Vitamin - C (ascorbic acid) and vitamin - E (tocopherols) are also used as antioxidants.

17.10 ENTERPRISE EDUCATION

Preparation of disinfectant phenyl :

Following steps are involved.

a) Brown phenyl

Raw materials : Turkey red oil, pine oil, perfume.

Procedure : Take 800 ml Turkey red oil and 600 ml pine oil in a plastic container. Shake and keep for half an hour, fill in the bottles and sell.

b) White phenyl

Procedure : To the above prepered brown

phenyl, add 11 to 13 litres of water, shake well and fill in the bottles to sell.

For hospital purpose take equal quantity of Turkey red oil and pine oil to prepare brown phenyl.

c) Perfumed phenyl :

Procedure : Water soluble perfumes of kewada, rose, jasmine, lavander or firdosh can be added to the above prepared white phenyl at the time of packing.

d) Mosquito repellent phenyl :

Procedure : To the above prepared one litre of brown phenyl, citronella oil (natural) 25 to 30 ml is added. The property of this oil is it repels the mosquitoes due to its strong smell

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Board Questions :

1) What is antibiotic? Give the name of the first antibiotic discovered.
2) List two major classes of anitbitotics with an example of each class.
3) What are antacids ? List some com pounds which are used as antacids.
4) Describe the following with suitable example: i) Tranquilizers ii) Analgesics
5) Describe the following with suitable examples.
   i) Preservatives ii) Artificial sweeteners
   iii) Antioxidants
6) What is chemotherpay? Name the compounds used for i) Tuberculosis ii) High fever.
7) What are tranquilizers? Name two tranquilizer give their structures used in depression and hypertension
8) What are broad specturn antibiotics? Give two examples.
9) How do antiseptics differ from disinfectants? How does an antibiotic differ from these two ?
10) To what class of medicines does chloroamphenicol belog ? For what disease can it be used ?
11) Describe the functions of antibiotics and antiseptics.
12) Define antiseptic and disinfectants. How do these differ ? Give one example of a substance which acts both as an antiseptic and disinfectant.
13) What is chemotherapy? Write the name of the medicine used for the treatment of each of the following diseases.
14) What are antibiotics ? Name any two antibiotics which are specific to certain diseases.
15) Write the chemical name of Aspirin & give its structure.
16) Give one example each of
    i) Tranquilizers ii) Wide spread antibiotics.
17) What type of medicines are Omeprazole and Lansoprazole ?
18) Give one important use of each of the following :
    i) Bithional ii) Chloramphenicol
    iii) Streptomycin iv) Aspirin
19) Pick out the odd one out from amongst the following on the basis of their medicinal properties mentioning the reason:
    Chloroxylenol, Phenol, Chloramphenicol, Bithional
20) Which chemical is responsible for the antispetic properties of dettol ?
21) Name the most common antacid.
22) Name one medicine which can act both as analgesic and antipyretic.
23) What type of drug is chloramphenicol? What are its uses
24) Name one artificial sweeting agent addes to foods.
25) Name two antioxidants used for food materials.
26) Define antacids. Give one example.
27) What is the role of bithional in toilet soaps. ?
28) Name a drug used in mental depression.
29) Write the structural formula of the following medicinal compounds :
    i) aspirin ii) paracetamol iii) antipyretics.

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Type	Function	Examples
1. Analgestic	Relieve pain	Aspirin, naproxen, ibuprofen, dichlofenac sodium or potassium ,
2. Tranquilisers	Treatment of stress, mental diseases	Hypnotic : Barbiturates (veronal, luminal, seconal, Sedatives,Chlordiazepoxide, meprobamate, equanil,valium .
3 . Antiseptics	Prevent the growth of micro- organisms or kill them (safe for living tissues)	0.2 % phenol , dettol (chloroxylenol and terpeneol), bithional, iodine, iodoform, boric acid, hydrogen peroxide, chlorine.
Disinfectants	Prevent the growth of micro- organisms or kill them (not safe for living tissues, used for inanimate systems).	1 % phenol , chlorine, sulphur dioxide etc.
5. Antibiotics	Produced by micro - organisms and can inhibit the growth of other micro - organisms. (may be wholly or partly synthetic)	Bactericidal : Penicillin, aminoglycosides , ofloxacine cephalosporin. Bacteriostatic : Erythromycin, teracycline, chloramphenicol Broad spectrum : Tetracyclin, chloramphenicol Narrow spectrum : penicillin, erythromycin,
6. Antacids	Remove excess acid in stomach and raise the pH to appropriate level.	$Mg(OH)_2$, $MgCO_3$, Magnesium trisilicate, $Al(OH)_3$ gel, $NaHCO_3$, omeprazole,lansoprazole
7.Chemicals in food preservation	Chemicals added to food to avoid the spoilage and to retain their nutritive value for long period.	Physical methods : removal of heat, addition of heat, removal of water, irradiation. Chemical methods : Addition of vinegar, salting, addition of sugar, addition of chemicals (sodium benzoate, sodium nitrite and nitrate, propionic and sorbic acid, potassium metabisulphite,
8. Artificial sweetening agents	Food additives, substitute of sugar, either low or no calorie	Saccharine, aspertame, sucralose, alitame
9.Antioxidants	Retard the oxidation of food and help its preservation.	BHT, BHA , sulphure dioxide and sulphites, Vitamine - C (ascorbic acid), Vitamine-E (tocopherols)