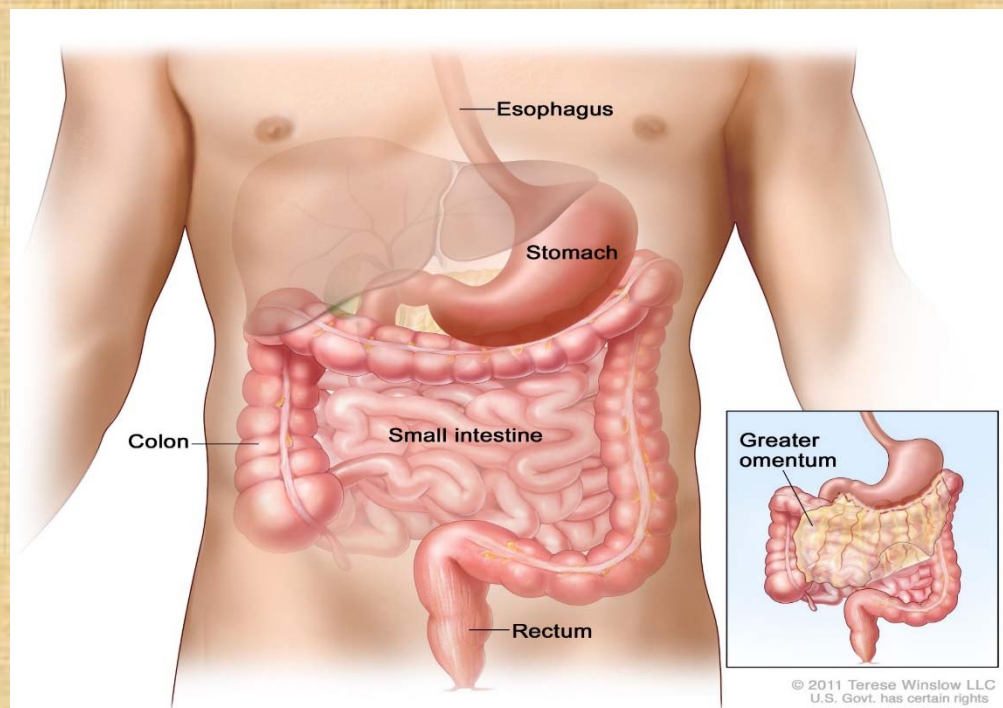


# GASTROINTESTINAL AGENTS



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## **Classify Gastrointestinal agents:**

# **Acidifying agents/acidifiers**

**Antacids**

**Protective**

**Adsorbents**

**Laxative, Cathartics,  
purgative**

## **Classification of inorganic gastrointestinal agents :**

1. Products for altering gastric pH
2. Protectives for intestinal inflammation
3. Adsorbents for intestinal toxins
4. Cathartics or laxatives for inflammation

Acidifiers	Antacids	Cathartics	Antimicrobials
1. Ammonium Chloride(*) 2. Dil HCl	1. Sodium bicarbonate (*) 2. Aluminium hydroxide gel 3. Magnesium hydroxide mixture	1. Magnesium sulphate 2. Sodium orthophosphate 3. Kaolin 4. Bentonite	1. Potassium permanganate 2. Boric acid 3. Hydrogen peroxide (*) 4. Chlorinated lime (*) 5. Iodine and its preparations

## **Hyperchlorhydria/ hyperacidity**

Whenever excess secretion of acid takes place in the stomach, this causes the imbalance in acid enzyme ratio, thereby finally leading to hyperacidity and ulcers.

Antacids are used in treatment of **Hyperchlorhydria**.

## **Hypochlorhydria**

Whenever inadequate secretion of acid takes place in the stomach, this causes achlorhydria or hypochlorhydria.

**Acidifying agents/acidifiers** are used in treatment of **Hypochlorhydria**



### Acidifying agents/acidifiers:

The drugs or agents which are used to increase metabolic acidosis and gastric hydrochloric acid. They are also known as acidifying reagents or acidifiers.

e.g. **Dilute HCl**

### Antacids:

These are drugs or substances which are alkaline substances and used for neutralizing excess acid in the stomach of the patients suffering from hyperacidity.

e.g **Sodium bicarbonate, aluminium hydroxide gel, Magnesium carbonate, milk of magnesia, Tribasic Calcium Phosphate, Magnesium hydroxide**

## Protective and adsorbents:

These are chemically inert substances which are used in the treatment of mild diarrhoea or dysentery of GIT because of their ability to adsorb gases, toxins and bacteria.

e.g **Bismuth subcarbonate, Bismuth subnitrate**  
**milk of Bismuth.**

## Cathartics:

Cathartics may be defined as the drugs which bring about defecation. They are beneficial in constipation and for expulsion of intestinal parasites.

e.g **magnesium hydroxide**  
**sodium potassium tartrate**

## Purgatives:

Purgatives are also cathartics which act similarly but are generally mild in their nature of action.

**Potassium bitartrate**

## Laxatives

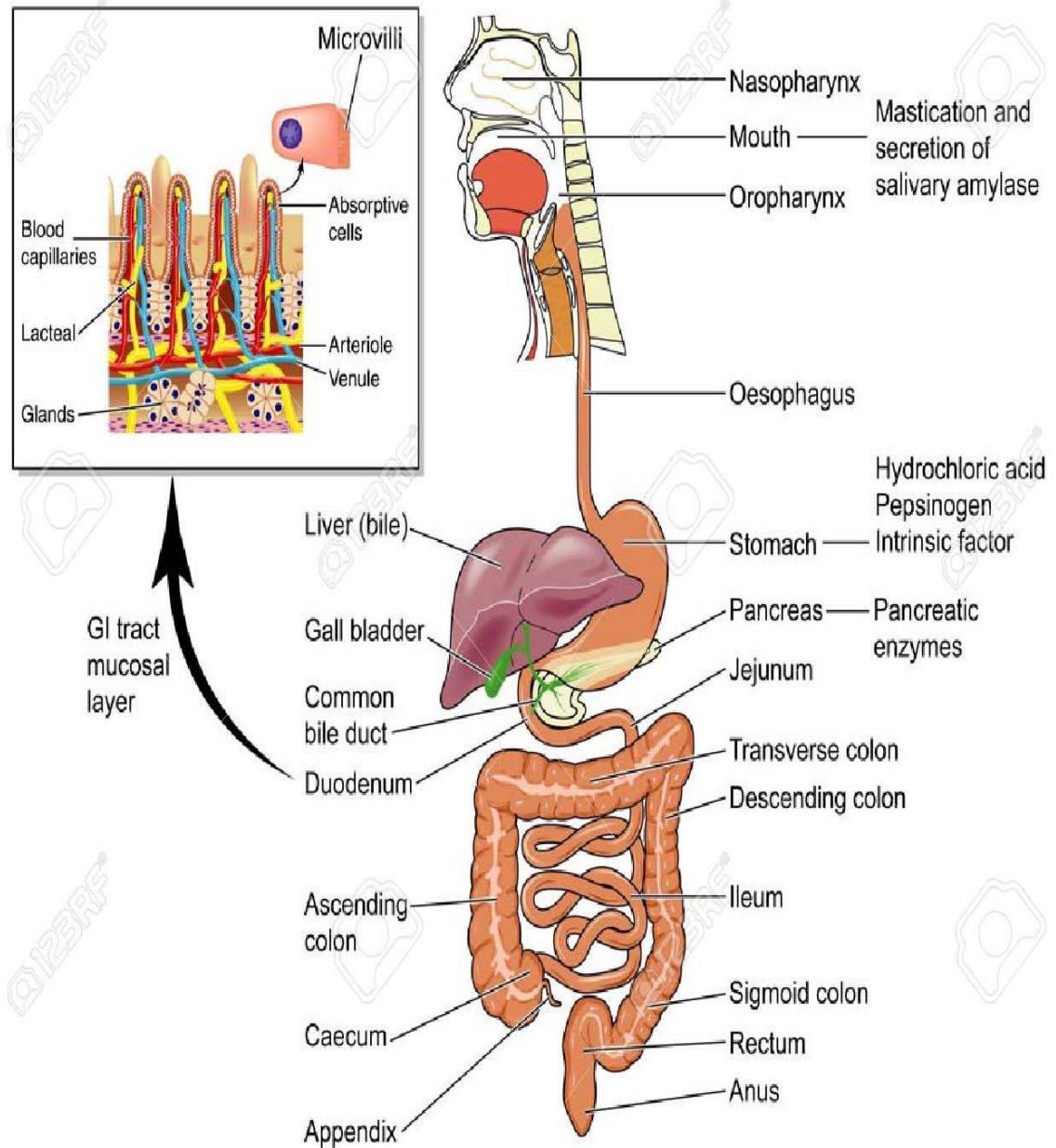
Laxatives are mild type of purgatives. They give rise to same effect but vary in nature and mechanism of action.

e.g **Magnesium sulphate and sodium phosphate**



## Introduction:

- ❖ The digestive system is the gastrointestinal tract (GIT)
- ❖ It starts from the oesophagus to the anus.
- ❖ The main portion of GIT includes the stomach, small intestine, large intestine and the rectum with the exit anus.
- ❖ Whenever the functions of GIT go wrong, disease occurs.



### Disease of GIT:

- ❖ *Inadequate secretion of acid in the stomach causes **achlorhydria or hypochlorhydria**.*
- ❖ *When excess of acid secretion takes place in stomach, this causes imbalance of acid – enzyme ratio, which causes **hyperacidity or ulcer**.*
- ❖ *There may occur accumulation of toxic substances or gases.*
- ❖ *There may occur inadequate absorption of fluids and minerals from large intestine, which causes **diarrhoea**.*
- ❖ *There may occur insufficient peristaltic movement of large intestine, thereby causing **constipation**.*
- ❖ *There may occur inadequate secretion of saliva, thereby making the food to swallow with difficulty.*
- ❖ *There may occur ingestion of poisonous substance accidentally or intentionally by some person.*
- ❖ *It is possible to correct the above conditions by administration of suitable drugs, which are called the **GASTROINTESTINAL AGENTS**.*

## **Detail Classification:**

### **A. Acidifying Reagent or Acidifiers**

- 1) Gastric acidifiers Eg. Dilute HCl
- 2) Urinary acidifier
- 3) Systemic acidifier
- 4) Acids

### **B. Antacids**

- 1) Systemic (absorbable) antacids eg. Sodium bicarbonate
- 2) Non-Systemic (non-absorbable) antacids
  - a) Aluminium containing antacids e.g Aluminium hydroxide, Aluminium phosphate
  - b) Calcium containing antacids e.g Calcium carbonate, Tri basic calcium phosphate
  - c) Magnesium containing antacids e.g Magnesium carbonate, magnesium hydroxide.
  - d) Combination antacid preparations e.g. Aluminium hydroxide gel and magnesium hydroxide  
Aluminium hydroxide gel and magnesium trisilicate



## **C. Protective and Adsorbents**

1. **Bismuth compounds– Bismuth subcarbonate , Bismuth subnitrate**

## **D. Laxatives, Cathartics and Purgatives**

1. **Stimulant-----→ Senna, Rhubarb**

1. **Bulk purgative-----→ Methyl cellulose, sodium CMC**

2. **Lubricants-----→ Liquid paraffin, glycerin**

3. **Saline cathartics-----→ Magnesium hydroxide, Magnesium sulphate.**



## **Acidifying reagents/acidifiers:**

These are drugs or agents which are able to increase acidity in GIT. Some of the drugs are used to increase metabolic acidosis whereas some of these are used to increase the gastric hydrochloric acid. They are also known as acidifying reagents or acidifiers.

- ❖ **Gastric acidifiers:** These are drugs which are used to restore temporarily the acidity of stomach in patients suffering from achlorhydria or hypochlorhydria.
- ❖ **Urinary acidifiers:** These are the drugs which are used to render acidic urine to enable treatment of some type of urinary tract disorders.
- ❖ **Systemic acidifiers:** These are the drugs which are able to neutralize the alkaline body fluids, particularly blood, in patients who are suffering from systemic alkalosis.
- ❖ **Acids:** Acids are used as pharmaceutical aids in the preparation, laboratory quality control etc.

**Properties:**

- ❖ White, fine, coarse crystalline powder.
- ❖ Odourless
- ❖ Cool saline taste.
- ❖ A solution of 0.8% of ammonium chloride is isotonic with serum.
- ❖ Freshly prepared aqueous solutions are neutral to litmus but becomes quickly acidic on standing because of hydrolysis.

**Assay:**

- ✓ It was previously assayed by precipitation titration using Volhard's method.
- ✓ Now it is assayed by acid base titration technique

## Dilute Hydrochloric acid:

Formula : HCl (10%w/w)

Mol. Wt: 36.46

### Ingredients: Hydrochloric acid and purified water.

❖ Hydrochloric acid is commonly known as **spirit of salt** because it was first of all prepared by distilling sea salt with Sulphuric acid. It is an aqueous solution of hydrogen chloride in water and is having not less than 35% w/w and not more than 38 % of HCl.

### ❖ Preparation:

1. It is manufactured by the action of **sulphuric acid on sodium chloride**. Calculated quantities of concentrated sulphuric acid and sodium chloride are heated in the cast iron pans of a salt cake furnace. The hydrochloric acid gas is formed which is passed in a tower, which is sprayed with water. The dilute hydrochloric acid is collected at the bottom. It is again circulated to the tower to absorb more hydrogen chloride so that it gets concentrated. The acid so produced is then purified.  $\text{NaHSO}_4$  formed in the process is mixed with some more quantity of sodium chloride, and heated strongly in the muffle furnace to get more hydrogen chloride gas.





- ❖ During the manufacture of caustic soda by electrolysis of sodium chloride solution, large quantities of hydrogen and chlorine are obtained as **by-products**. These gases are combined to yield hydrogen chloride.



### Properties:

1. It is a colourless liquid , strongly acidic.
2. It is miscible with water, alcohol having a specific gravity of 1.18
3. It is a strong acid and attacks metals, forming their hydrochlorides with the evolution of hydrogen gas.
4. Even in high diluted form, it is very strongly acidic to litmus.

### Identification:

- ✓ After neutralization, it gives reactions which are characteristic of chloride.
- ✓ When it is added to  $\text{KMnO}_4$  solution, chlorine gas is liberated.

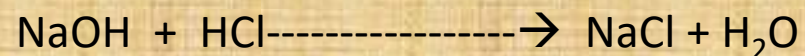
### Test for purity:

- ✓ It has to be tested for As, Heavy metals, sulphate, sulphite, free chlorine, bromide and iodide and residue on ignition.



**Assay:**

4 g of HCl is transferred into a stoppered flask which is having 40 mL of water. Now the solution is titrated with 1 N NaOH, using Methyl orange as an indicator.



**Simple acid-base  
neutralization reaction.**

**Storage:**

It should be stored in well closed container of glass or other material at a temperature not exceeding 30 °C.

**Uses:**

- ☐ It is mainly used as a **pharmaceutical aid** or as an **acidifying agent**.
- ☐ Used as **gastric acidifier** when levels of hydrochloric acid in gastric juice are low.
- ☐ Externally used as a solvent, catalyst in basic pharmaceutical and as acidifier.

## ANTACIDS:

- ✓ These are drugs which are usually alkaline substances and are used to neutralize the excess acid in the stomach of patients suffering from hyperacidity.(a condition in which the level of acid in the gastric juices is excessive, causing discomfort.)
- ✓ Production of gastric HCl is a continuous process. It means use of antacids is also a continuous process.
- ✓ Strong alkaline bases will damage the mucosal layer.
- ✓ The action of antacids should be gradual without evoking rebound acidity. Also antacids should not have any side effects.
- ✓ Antacids give symptomatic relief from pain by neutralizing excess of hydrochloric acid. So they find use in treatment of ulcers by reducing pain.



## **Antacids are classified as follows:**

### **1) Systemic (absorbable) antacids**

**These are soluble, readily absorbable and capable of producing systemic electrolytic alteration and alkalosis. eg. Sodium bicarbonate**

### **2) Non-Systemic (non-absorbable) antacids**

**These are not absorbed to a significant extent and thus do not alter an appreciable systemic effect. This group is further divided into following:**

- a) Aluminium containing antacids e.g Aluminium hydroxide, Aluminium phosphate, Basic aluminium carbonate, Dihydroxyaluminium aminoacetate**
- b) Calcium containing antacids e.g Calcium carbonate, Tri basic calcium phosphate**
- c) Magnesium containing antacids e.g Magnesium carbonate, magnesium hydroxide, magnesium citrate, magnesium oxide, magnesium peroxide, magnesium trisilicate, magnesium phosphate.**
- d) Combination antacid preparations e.g. Aluminium hydroxide gel and magnesium hydroxide  
Aluminium hydroxide gel and magnesium trisilicate  
Semithicone containing antacids  
Calcium carbonate containing antacids**



## **Ideal requirements of Antacids:**

- ☐ It should be insoluble in water and has fine particle form.
- ☐ It should not be absorbable or cause systemic alkalosis.
- ☐ It should be able to exert its effect gradually and over a long period of time.
- ☐ It should not be a laxative or cause constipation.
- ☐ It should not cause any side effect.
- ☐ It should be stable and readily available.
- ☐ The reaction between antacid and gastric hydrochloric acid should not produce large volume of gas.
- ☐ The antacid should buffer in the pH range 4-6.
- ☐ Antacid should probably inhibit pepsin, the proteolytic enzyme.

**Antacid preparations are administered as oral suspension, mixtures, tablets, chewable tablets, capsules, and oral products.**

**Evaluation of antacid activity is done by acid neutralizing test.**



## Aluminium hydroxide gel

- ❖ It is an aqueous **white viscous suspension** of **hydrated aluminium oxide** having varying amounts of **basic aluminium carbonate**.
- ❖ The preparation may sometimes have **methyl oil, peppermint oil, glycerine, sucrose or saccharin as flavouring and sweetening agents** and upto **0.05% sodium benzoate** as preservative.

### ❖ **Preparation:**

- ✓ It is prepared by adding hot solution of potash alum slowly with constant stirring to a hot solution of sodium carbonate. After complete removal of  $\text{CO}_2$ , the precipitated aluminium hydroxide is filtered.
- ✓ It is washed properly with hot water until it gets free from sulphate ion and the precipitate is suspended in distilled water to the required strength.



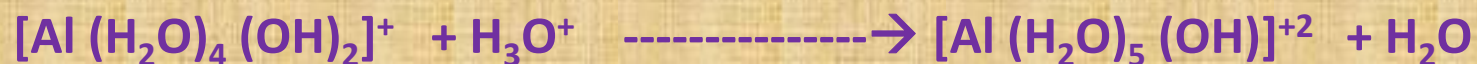
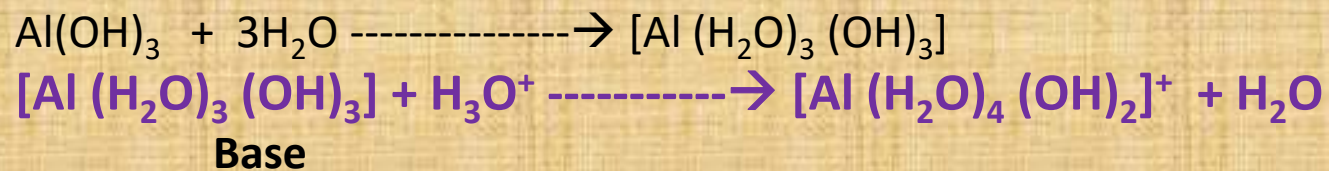
**Precaution:** Alum solution is added to solution of sodium carbonate and not vice versa.

## Properties:

- ❖ It is a white viscous suspension.
- ❖ Aluminium hydroxide gel gives astringent aluminium chloride when it reacts with gastric hydrochloric acid. This results in nausea, vomiting and constipation.



- ❖ Aluminium hydroxide gel is a popular antacid and brings about neutralization of gastric acid by following mechanism.



## Mechanism:

- ❖ Aluminium hydroxide gel is **non-absorbable** and exert very little systemic effect.
- ❖ If the gel is formed by precipitation in a carbonate or bicarbonate reaction mixture, there may be some evolution of  $\text{CO}_2$  when the carbonate or bicarbonate anions react with gastric acid. But this reaction is very slow , so patient will not feel discomfort.
- ❖ Other drugs should not be taken with antacid, simultaneously, as there is loss of antacid property.
- ❖ End product of neutralization of aluminium hydroxide gel with hydrochloric acid is Aluminium chloride, which is water soluble astringent salt. This may cause constipation, nausea, vomiting.

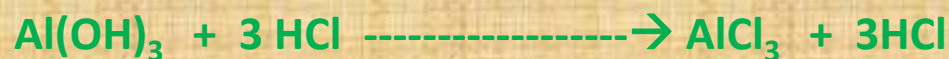


## Assay:

- ✓ An accurately weighed amount of sample is dissolved in a mixture of **hydrochloric acid** and water by warming on a water bath.
- ✓ 20 mL solution is taken in a conical flask and 40 mL of 0.05 N **disodium edetate** is added to it, followed by water and few drops of **methyl red**.
- ✓ To this solution, **1 N NaOH** solution is added to neutralize this solution. This can be identified by color change red to yellow.
- ✓ Now flask is warmed on a water bath for 30 minutes.
- ✓ To this 3 g of **hexamine** is added.
- ✓ Also 0.5 ml **xylene orange solution** is added as an indicator.
- ✓ This mixture is titrated with standard 0.05 M **Lead nitrate** solution until a violet color appears at the end point due to formation of **lead xylene orange complex**.

## ❖ Uses

- ✓ It is a very effective slow acting antacid.



Base

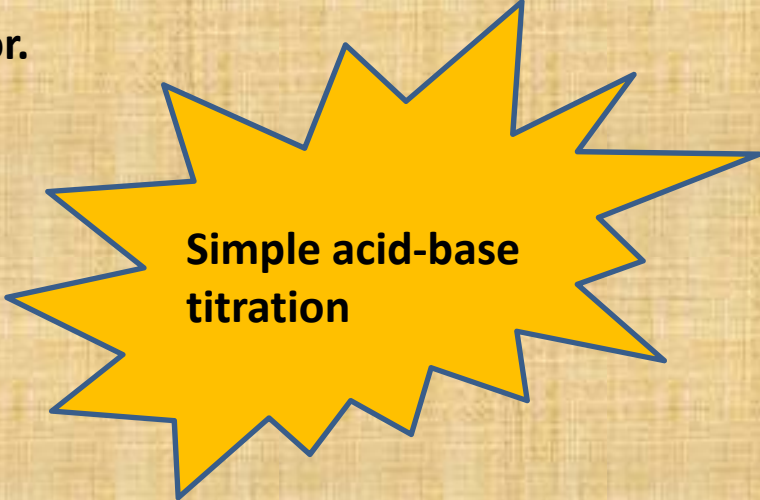
Acid

- ✓ It does not get absorbed in alimentary canal and does not produce carbondioxide.
- ✓ Used in treatment of intestinal toxemia and hyperchlorhydria.
- ✓ It does not cause systemic alkalosis.



## Test for acid consuming capacity:

1. An accurately weighed quantity of **gel** (1.5 ml) is taken in a flask.
2. To it 50 ml of 0.1 N HCl is added.
3. The contents are shaken at 37 °C for 1 hour.
4. The solution is titrated for excess HCl with 0.1 N NaOH using **bromophenol blue** as an indicator.

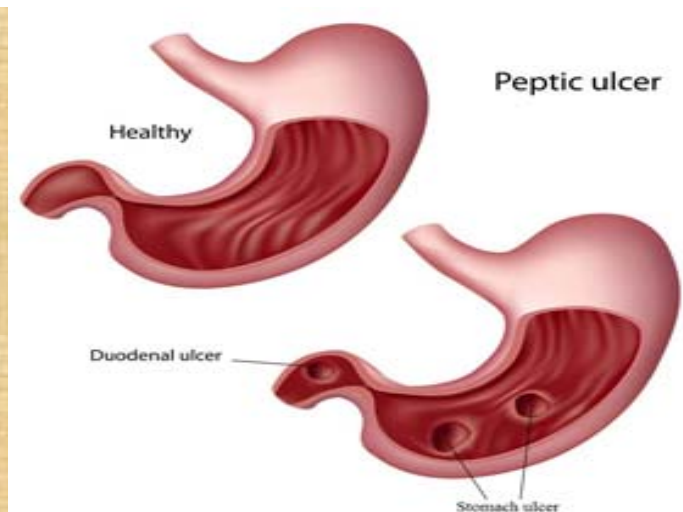


Simple acid-base  
titration

### Storage:

- It is stored in well closed containers and should not be allowed to freeze.
- For attractiveness it is usually dispensed in blue or amber colour bottles.

## Dried Aluminium Hydroxide Gel



Each 5 ml Contains:

Activated Dimethicone	I.P. 50 mg
Magnesium Hydroxide	I.P. 250 mg
(Added as Magnesium Hydroxide Paste)	
Dried Aluminium Hydroxide Gel	I.P. 250 mg
(Added as Aluminium Hydroxide paste)	
Sorbitol solution (70%)	I.P. 1.25 g
(non-crystallising)	

**Indications:** Hyperacidity, Peptic Ulcers, Reflux/Erosive Esophagitis, Dyspepsia

**Synonym:** Aluminium hydroxide powder

**Properties:**

- ❖ It is a white amorphous powder
- ❖ Colourless and tasteless
- ❖ Insoluble in water

❖ **Assay** : Same as Aluminium Hydroxide Gel

❖ **Uses:**

1. Used as an antacid.
2. Dried aluminium hydroxide gel is used externally as a desiccant.
3. It is a constituent of some foot powders.
4. Used in the treatment of diarrhoea as protective.

## **Magnesium containing antacids**

- ☐ **Magnesium carbonate (Heavy and Light)**  
**(MgCO<sub>3</sub>)**
- ☐ **Magnesium hydroxide (Milk of Magnesia)**  
**(Mg(OH)<sub>2</sub>)**
- ☐ **magnesium citrate,**
- ☐ **magnesium oxide (MgO)**
- ☐ **magnesium peroxide,**
- ☐ **magnesium trisilicate,**
- ☐ **magnesium phosphate.**



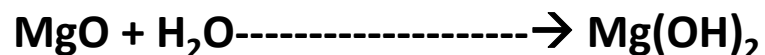
# Magnesium hydroxide (Milk of Magnesia)



Suspension having not less than 7% and not more than 8.5 % w/w of **Mg(OH)<sub>2</sub>** in **purified water**. It may contain suitable preservatives.

It is also called **cream of magnesium hydroxide mixture**.

- ❖ Although the preparation is having magnesium hydroxide, it is not obtained by suspending magnesium hydroxide, but by reacting **sodium hydroxide with Magnesium sulphate**.



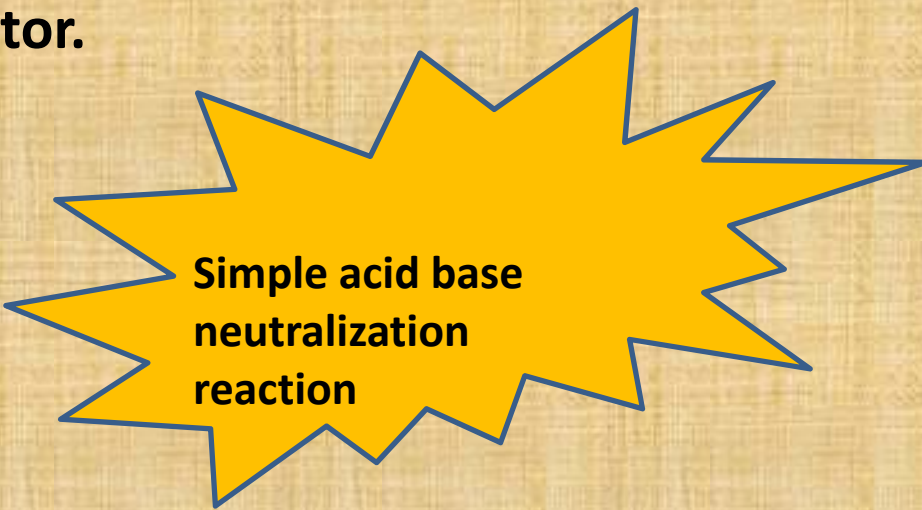
- ❖ Light Magnesium oxide (MgO) is mixed with a solution of sodium hydroxide to get a smooth cream. It is now diluted with water and the suspension is poured in thin stream into a solution of magnesium sulphate stirring continuously.
- ❖ The precipitate is allowed to settle.
- ❖ Now clear upper liquid is removed by decantation; the residue is transferred on a calico filter.
- ❖ Now the residue is washed with water until it becomes free from sulphate ions.
- ❖ The precipitate is mixed with required water to get sufficient volume.

## Properties:

- ❖ White uniform suspension
- ❖ Varying proportions of water may separate out on standing.

## ❖ Assay

1. An accurately weighed amount of sample is taken in a flask.
2. To it 25 mL of 1 N Sulphuric acid is added.
3. Excess of acid is back titrated with 1 N NaOH using methyl red as indicator.



Simple acid base  
neutralization  
reaction

**Storage :**

**Store in a tightly closed container.**

**It should not be kept in a cold place.**

**USES:**

❖ **Milk of magnesia is a popular antacid and has laxative action.**

❖ **Used as “Alkaline mouth wash”**

**a) Calcium containing antacids :**  
**Calcium carbonate,**  
**Tri basic calcium phosphate**



## Combination antacid preparations:

Aluminium hydroxide magnesium carbonate co- dried gel	It is a co-precipitate of Aluminium hydroxide and magnesium carbonate
Magaldrate	Combination of Aluminium hydroxide and magnesium hydroxide.
Calcium carbonate containing antacid mixture	Calcium carbonate with Aluminium hydroxide gel  Rapid onset of action with prolonged action
Simeco tablet	<b>Chewable tablet</b> Aluminium hydroxide magnesium carbonate co- dried gel, magnesium hydroxide and activated dimethicone
Alginic acid sodium bicarbonate antacid mixture.	

Calcium and aluminium-----→ Constipating  
Magnesium-----→ Laxative

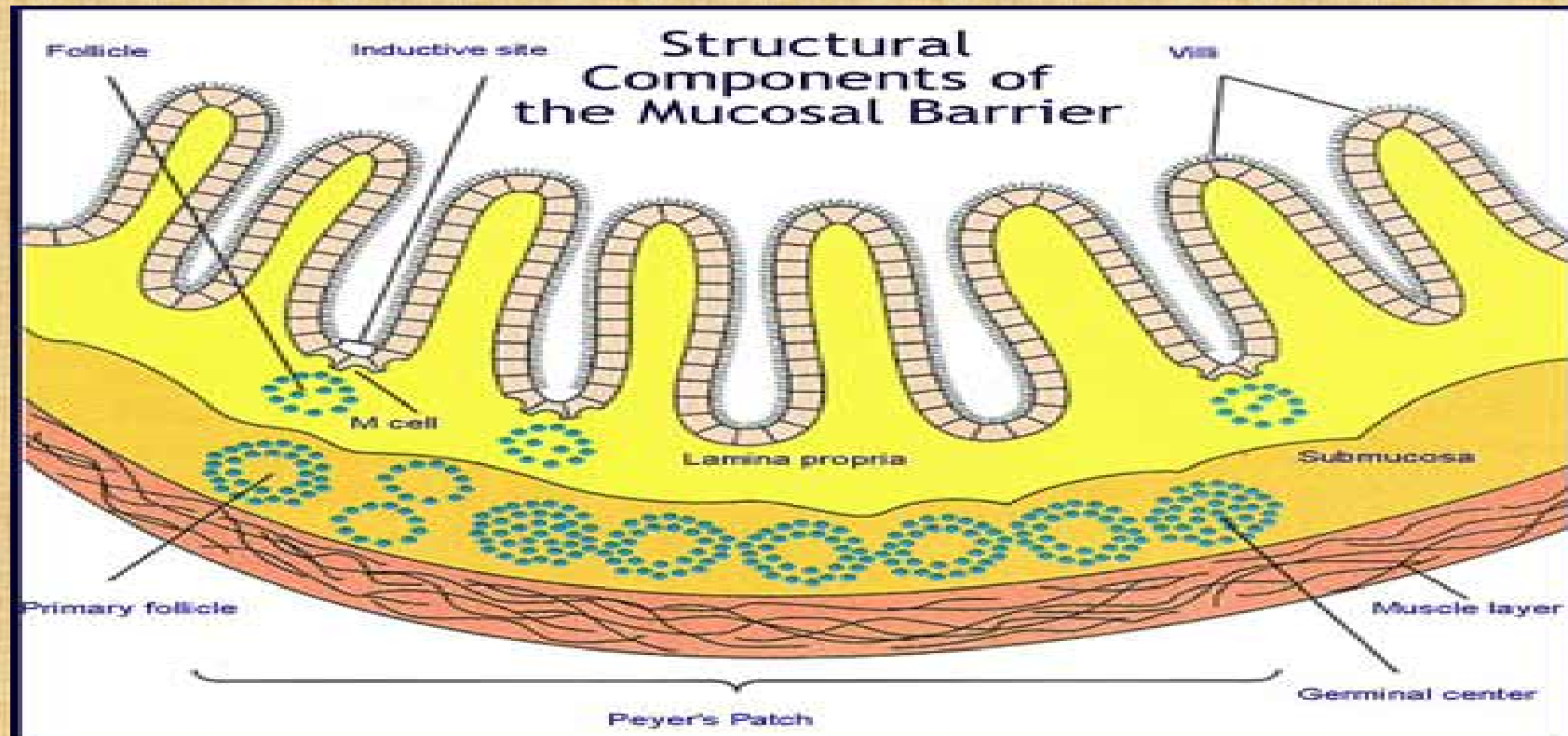
So, more magnesium containing antacid will  
cause diarrhoea.

Because of these, combinations of calcium-  
magnesium or aluminium magnesium salts  
are given as antacids. (GTU important)

## Protective and Adsorbents:

- ❖ These are chemically inert substances which are used in treatment of mild diarrhoea or dysentery and other disturbances of gastrointestinal tract because of their ability to absorb toxins and bacteria.
- ❖ *Dysentery is a type of gastroenteritis that results in diarrhoea with blood.*
- ❖ *Dysentery is a disease which is marked by frequent elimination of watery fluid with or without mucus or blood and it is caused mainly due to infection of small protozoa like amoeba.*
- ❖ Diarrhoea occurs mainly because of improper digestion or absorption of food or by bacterial infection.
- ❖ Many chemical agents are used to treat diarrhoea. Their main action is of protective and adsorbent in nature.
- ❖ Substances like bismuth subcarbonate, kaoline etc. are insoluble salt and they form a protective coat on the mucosal membrane and provide mechanical protection.
- ❖ They absorb bacterial toxins which are able to stimulate flow of electrolytes into intestine causing watery stool.

- ❖ Protectants or protective are used to form a protective layer on painful ulcers in the GIT. Some of them may help in reducing ulcers.



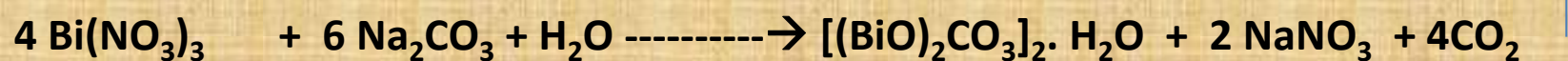


## Bismuth subcarbonate:

Bismuth subcarbonate is a basic salt having variable composition.

### Preparation:

1. It is prepared by adding an acid solution of **bismuth salt** to a hot solution of **sodium carbonate** and stirring constantly.
2. The precipitate is filtered and washed with an equal volume of cold water and dried at a temperature not above 60 °C. Repeated washing has to be avoided it tends to decompose sub carbonate into hydroxide.



bismuth salt    sodium carbonate

Bismuth subcarbonate

### Properties:

- ☐ White or pale yellowish white.
- ☐ Odourless and tasteless powder.
- ☐ Stable in air but it is slowly affected by light
- ☐ Insoluble in alcohol and water; dissolves with **effervescence in HCl**.
- ☐ When ignited, it gets decomposed into yellow bismuth trioxide, carbondioxide and water.



### Assay:

- **It is assayed by gravimetric method.**
  - Accurately weighed substance of bismuth subcarbonate is ignited in a tarred crucible to a constant weight.
  - The  $\text{Bi}_2\text{O}_3$  so obtained is cooled and weighed.
- 
- **Uses:**
  - **Used as an astringent and absorbent.**
  - **Used topically as a protective.**
  - **As an antacid, it is very mild.**

# Laxatives, Cathartics and Purgatives

**(Side effect : diarrhoea)**

## Cathartics:

Cathartics may be defined as the drugs which bring about defecation. They are beneficial in constipation and for expulsion of intestinal parasites. They may be given for clearing bowels before surgery.

## Purgatives:

Purgatives are also cathartics which act similarly but are generally mild in their nature of action.

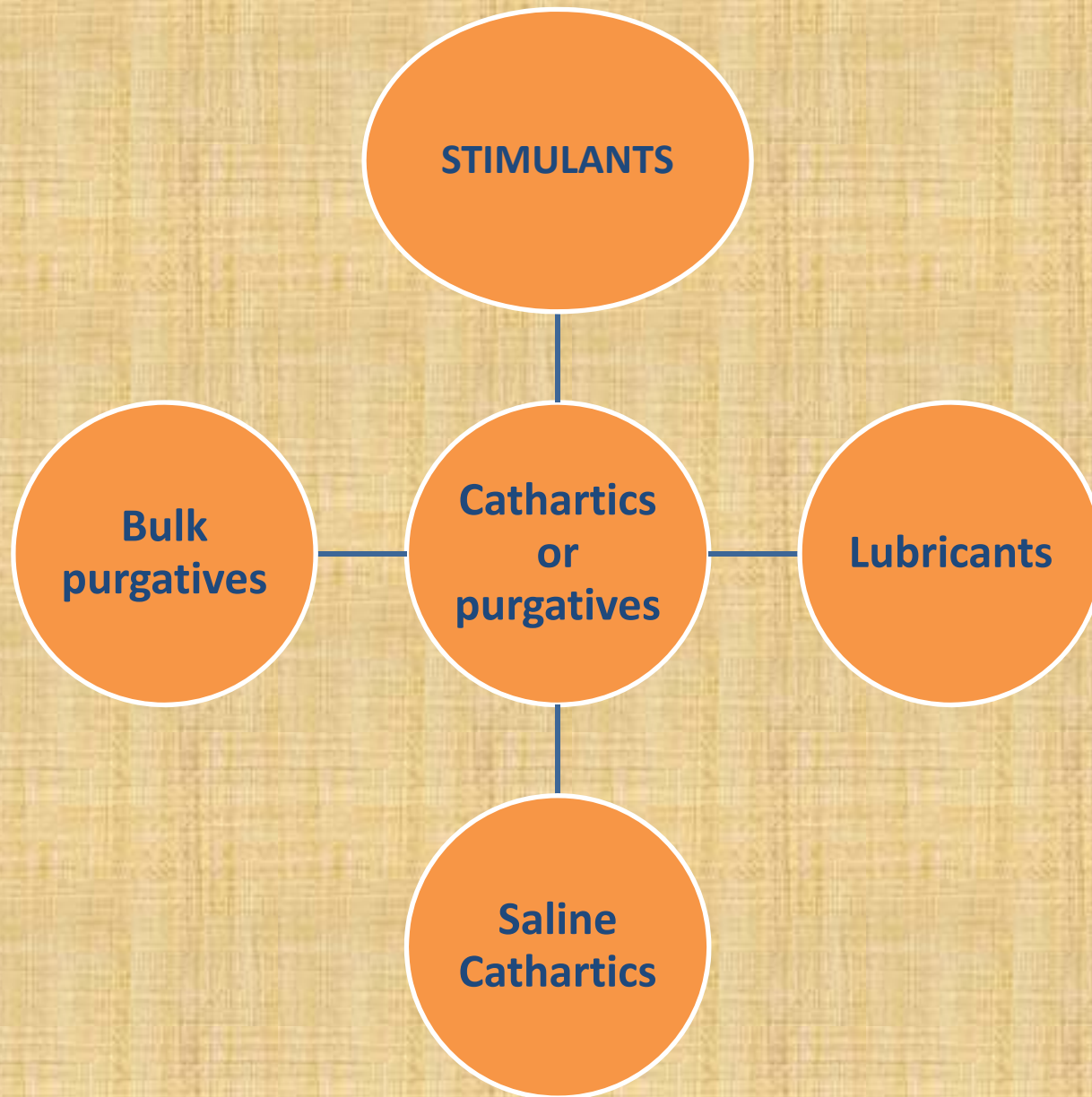
**Potassium bitartrate**

## Laxatives

Laxatives are mild type of purgatives. They give rise to same effect but vary in nature and mechanism of action.

**Laxatives, cathartics and purgatives act by retaining fluid in the bowel. These may be administered by oral route. (suspension/powder) or by rectal route (enema or suppository)**

**Cathartics or purgatives act by 4 different mechanisms:**





### **Stimulants:**

These drugs cause **local irritation** on the intestinal tract and bring about stimulation of peristaltic activity.

As they act directly on intestine and stimulate peristalsis, they are termed as stimulants.

E.g Senna, Castor oil.

### **Bulk purgatives:**

These are agents which are able to **increase the bulk** of intestinal contents. These are cellulose or non-digestible type of materials which swell considerably when wet and because of increase bulk stimulate peristalsis.

### **Lubricants:**

In constipation, contents of intestine become hard because of absorption of water by body. This results in difficulty in clearing bowels.

**Lubricants cause smooth clearance of faecal material.**

### **Saline Cathartics:**

They act by **increasing the osmotic load** of intestine by absorbing large quantity of water and thus stimulate peristalsis. Poorly absorbable cations like calcium, magnesium and anions like phosphate, sulphate and tartrate are contributing to this effect.

Saline cathartics are water soluble mainly inorganic chemicals and they are taken with plenty of water. This is helpful in restricting excessive loss of body fluid and reduces nausea and vomiting. They are administered by oral or rectal route.

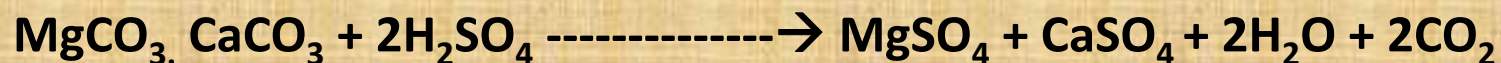
# Magnesium sulphate:

Preparation :

- ❖ It is obtained by action of dilute sulphuric acid on magnesium carbonate or magnesium oxide or from native carbonate.



- ❖ It is manufactured by the action of sulphuric acid on the native carbonate or on previously calcined dolomite. When dolomite is used, magnesium sulphate passes into solution, and the sparingly soluble calcium sulphate gets deposited.



Uses:

Used as a cathartic

### Properties:

- ❖ Colorless crystals having a cool, saline and bitter taste.
- ❖ Effloresces in warm dry air.
- ❖ Soluble in water and sparingly soluble in alcohol.
- ❖ When gently heated, it loses some of its water of hydration and gets converted into monohydrate white powder.

# Antimicrobial agents



- **Antimicrobial Agents: (Short note)**

*GTU Important*

- These are chemicals and their preparations which help in reducing or preventing infection due to microbes. Specific terms describes their exact mode of action.

**Antiseptics**

**Disinfectants**

**Germicides**

**Bacteriostatic**

**Sanitizers**

- **Antiseptics:**

- These are substances that are able to kill or prevent the growth of microorganisms.
- This term is specific for preparations which are to be applied to living tissues. An ideal antiseptic should destroy bacteria, spores, fungi, viruses or any other infective agent without causing any harm to the tissue of the host.



- **Disinfectant:**

- These are substances which are used for premises, atmosphere in a hospital environment, toilets, utensils and linen used in a hospital to free them from living organisms.
- Widely used in home and hospital cleaning.
- e.g Sulphur dioxide

- **Germicides:**

- These are substances which kill microorganisms.
- Bactericide (against bacteria)
- Fungicide (against fungi)
- Virucide (against virus)



- **Bacteriostatic:**
  - Substances which primarily function by inhibiting the growth of bacteria.
  - *They do not kill bacteria but stop the growth of bacteria.*
- 
- **Sanitizer:**
  - Disinfectants that are used to maintain the general public health standards are called as sanitizers.
  - Sanitation is concerned with cleaning and washing away organic matter. (saliva, mucous etc.)
  - Sanitizers have power to kill microorganisms.
  - Sanitizer should not cause local cell damage.



# Mechanism of action

- **Mechanism of anti-microbial action:**
- The mechanism of antimicrobial action ranges from mild astringent to powerful oxidative process.
- Inorganic compounds generally exhibit antimicrobial action by following 3 mechanisms:
  - ☐ **Oxidation**
  - ☐ **Halogenation**
  - ☐ **Protein binding or precipitation**
- **Oxidation:**
  - ❖ **Examples of compounds acting by this mechanism are peroxides of peroxy acids, oxygen liberating compounds like potassium permanganate.**
  - ❖ **They bring about oxidation of active functional groups present in proteins and enzymes vital to the growth and survival of microbes.**



# Mechanism of action

- **Halogenation:**

- ❖ **Examples of compounds acting by this mechanism are the compounds which are able to liberate chlorine or hypochlorite or iodine**
- ❖ **This category of agents acts on peptide linkage and alter its potential and property.**
- ❖ **The destruction of specific function of protein causes death of the microorganism.**

- **Protein precipitation:**

- ❖ **Examples of compounds acting by this mechanism are metal ions.(e.g Astringents)**
- ❖ **Polar group of protein binds with metal ions to form complex.**
- ❖ **The complex formed may be strong chelate leading to inactivation of protein.**

# Examples

Silver Nitrate $\text{AgNO}_3$	Lunar Caustic	As an astringent and germicide. Used as a mild antiseptic
Weak Iodine Solution	Tincture of iodine	Good source of iodine. Used as antiseptic
Aqueous Iodine solution	Lugol's solution	Good source of Iodine as germicide and fungicide
Sublimed sulphur	Flower of sulphur	Used as an ingredient of Sulphur ointment, used as scabicide
Borax $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$	Sodium borate	Used for eye washes, used as emulsifying agent, as astringent.
Hydrated potassium aluminium sulfate $\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$	Alum	Used as an astringent, Antiseptic and pharmaceutical aid

# Characteristics of Anti microbial agent:

- ❖ It should possess antiseptic / germicide activity and not bacteriostatic activity.
- ❖ It should have rapid onset of action and sustained activity.
- ❖ It must have good therapeutic index in the concentrations used.
- ❖ It should not cause local cell damage.
- ❖ It should not interfere with body defence.
- ❖ It should show no systemic toxicity from topical applications.
- ❖ It should have broad spectrum of activity against bacteria, fungi, protozoa, virus etc.
- ❖ It should have favourable lipid water distribution coefficient.

Formula :  $I_2$

# Iodine



- **Preparation:**

- ❖ It is manufactured by extracting kelp (seaweed's ash) with water.
- ❖ The solution is concentrated when the sulphate and chloride of sodium and potassium get crystallized out, leaving freely soluble sodium and potassium iodide in the mother liquor.
- ❖ Sulphuric acid is added to mother liquor and sulphur and small amounts of thiosulphate and sulphide are allowed to settle down.
- ❖ Mother liquor is decanted and to this  $MnO_2$  is added and iodine distills over.



### Assay:

- ☐ Assay is based on redox titration.
- ☐ 0.5 g iodine is dissolved in solution of KI in water in iodine flask.
- ☐ This is diluted to 50 ml with water and acidified with 1 ml acetic acid.
- ☐ This is titration against 0.1 M Sodium thiosulphate using starch solution as indicator.

### Properties:

- ☐ Bluish, black rhombic prisms.
- ☐ Have metallic luster.
- ☐ It volatilizes at ordinary temperature.
- ☐ Insoluble in water but soluble in alcohol.
- ☐ Potassium iodide is able to dissolve large quantities of iodine due to formation of  $I_3^-$

### Uses:

- ☐ Iodine is used as a counter irritant and disinfectant.
- ☐ Used as local germicide.
- ☐ For proper functioning of thyroid gland, elemental iodine is used.

# **Various Iodine preparations:**

1. **Aqueous iodine solution**
2. **Weak iodine solution**
3. **Strong iodine solution**
4. **Povidone iodine solution**
5. **Tincture of Iodine**

## **Note on composition of various iodine preparations:**

### **1) Aqueous iodine preparation:**

**Synonym: Lugol's solution**

**It is having 5% w/v of iodine and 10% w/v of potassium iodide in purified water.**

**Composition:**

<b>Iodine</b>	<b>50 g</b>
<b>Potassium iodide</b>	<b>100 g</b>
<b>Purified water</b>	<b>1000 ml</b>

### **2) Weak iodine preparation:**

**Synonym: Tincture of iodine**

**It is having 2% w/v of iodine and 2.5% w/v of potassium iodide.**

**Composition:**

<b>Iodine</b>	<b>20 g</b>
<b>Potassium iodide</b>	<b>25 g</b>
<b>Alcohol (50 %)</b>	<b>1000 mL</b>

## Povidone iodine:

Povidone iodine is an aqueous solution of povidone iodine. It is a complex produced by the interaction between iodine and povidone (polyvinyl pyrrolidone). The complex has 10 percent available iodine.

### Description:

- ❑ Complex occurs as yellowish brown, amorphous powder and has characteristic colour.
- ❑ Soluble in water and alcohol.
- ❑ The solution is transparent in nature, has reddish brown colour and faint smell of iodine.

### ❑ Action and uses:

1. It is a powerful bactericidal.
2. Used as disinfectant for skin, wounds, mouth.
3. Effective in management of burns and cuts.
4. Important advantage of these preparations over usual iodine preparations are its water solubility, non irritation, less toxic and non staining nature. It could be easily removed from skin and cuts by washing.





- The definitions of “bacteriostatic” and “**bactericidal**” appear to be straightforward: “bacteriostatic” means that the agent prevents the growth of bacteria (i.e., it keeps them in the stationary phase of growth), and “**bactericidal**” means that it kills bacteria.

# Monographs

# Hydrogen peroxide: (GTU IMPORTANT)

Chemical formula:  $\text{H}_2\text{O}_2$

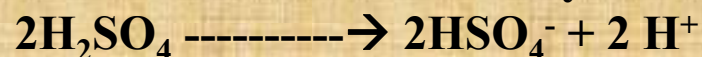
It is an aqueous solution (LIQUID) of hydrogen peroxide. It is having not less than 6% w/w of  $\text{H}_2\text{O}_2$  which is corresponding to about 20 times its volume of available oxygen.

## Preparation:

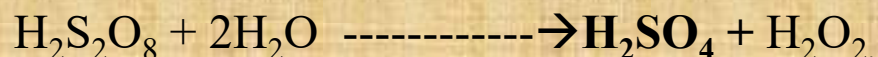
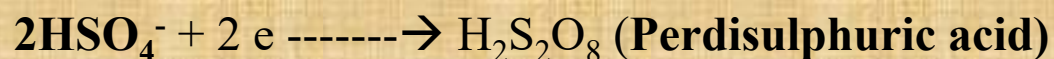
1. It is obtained by adding a thick paste of Barium peroxide ( $\text{BaO}_2$ ) in ice cold water to a calculated quantity of ice cold dilute sulphuric acid. The insoluble Barium sulphate is filtered off.



2. It is also manufactured by electrolysis of ice cold 50% sulphuric acid.



Perdisulphuric acid is formed, which on distillation under reduced pressure gives  $\text{H}_2\text{O}_2$ .

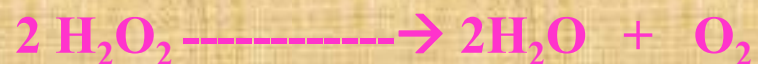


3) Prepared by passing  $\text{CO}_2$  through a suspension of **Barium peroxide** ( $\text{BaO}_2$ ) in water.



### Properties:

- ☐ It is colourless and odourless liquid having slightly acidic taste.
- ☐ It is a strong oxidizing agent.
- ☐ The solution decomposes in contact with oxidizable matter or when made alkaline.



- ☐ The decomposition is promoted by catalyst like Cu, Fe, Mn etc.

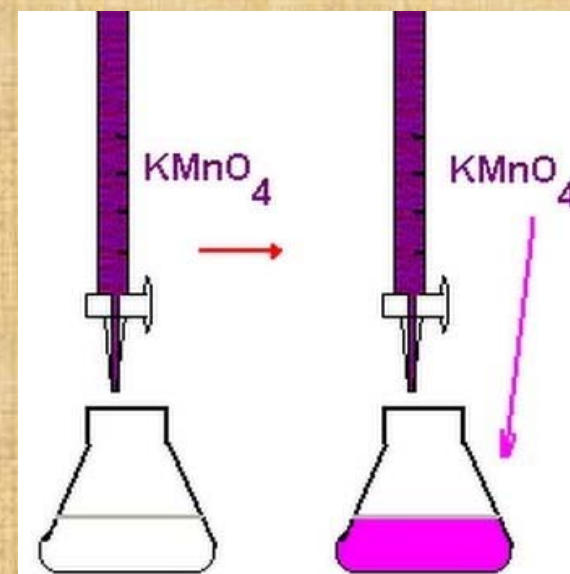


## Assay:

$\text{H}_2\text{O}_2$  -----  $\rightarrow$  Oxidizing agent

Acidified  $\text{KMnO}_4$  ---  $\rightarrow$  Oxidizing agent

- ❖ These 2 oxidizing agents reduce one another with evolution of gaseous oxygen.
- ❖ Hydrogen peroxide reduces  $\text{KMnO}_4$  solution and causes its discoloration.
- ❖ At end point, excess drop of  $\text{KMnO}_4$  gives pink colour.
- ❖  $\text{KMnO}_4$  acts as self indicator.



### Uses:

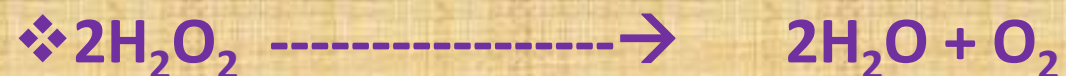
1. It is a strong oxidizing agent and it gives nascent oxygen.
2. It is used in cleaning cuts and wounds as it is antiseptic and germicide.
3. It is used as deodorant.
4. Used in bleaching the hair.
5. Effective antidote in phosphorous and cyanide poisoning.

### Storage:

- a) It is stored in a light resistant container with a stopper made of glass or plastic resistant to hydrogen peroxide.
- b) It is kept in a cool and dark place.

## What is volume strength of $\text{H}_2\text{O}_2$ ???

- ❖ Volume or percentage strength of hydrogen peroxide is the term to express the concentration of  $\text{H}_2\text{O}_2$  in terms of volumes of oxygen gas based on its decomposition to form water and oxygen.



- ❖ The volume of oxygen released at STP (standard temperature and pressure) is used to quantify the volume of  $\text{H}_2\text{O}_2$  in the solution and it is called **volume strength or percentage strength**.

❑ Volume strength is the volume of oxygen at STP liberated from one volume sample of  $\text{H}_2\text{O}_2$  on heating.

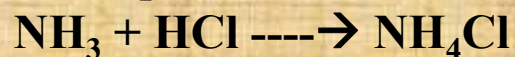
❑ One volume of  $\text{H}_2\text{O}_2$  gives 20 volumes of  $\text{O}_2$  at STP.

# Ammonium Chloride

Formula:  $\text{NH}_4\text{Cl}$  Mol. Wt: 53.49

## Preparation:

1. Commercially it is prepared by neutralizing ammonia with HCl. The solution is evaporated till crude, crystalline mass of ammonium chloride is obtained.



The crude salt is purified by crystallization.

2. Ammonium chloride is produced by heating **ammonium sulphate** with **sodium chloride**.





### **Properties:**

- ❖ White, fine, coarse crystalline powder.
- ❖ Odourless
- ❖ Cool saline taste.
- ❖ A solution of 0.8% of ammonium chloride is isotonic with serum.
- ❖ Freshly prepared aqueous solutions are neutral to litmus but becomes quickly acidic on standing because of hydrolysis.



### **Assay:**

- ✓ It was previously assayed by precipitation titration using Volhard's method.
- ✓ Now it is assayed by acid base titration technique.

**(Learn as given in notes)**

### Uses:

- ❖ Ammonium chloride acts as a mild expectorant in small doses. Due to local irritation, it produces increasing secretions of respiratory tract and makes the mucous less viscous.
- ❖ It acts in maintaining acid base equilibrium of body fluids.
- ❖ Ammonium chloride acts as systemic acidifier.
- ❖ Used for its diuretic action.
- ❖ Ammonium chloride and ammonium carbonate are used in cough preparations.

### **3 principal pharmacological actions:**

**A. It acts in maintaining acid base equilibrium pf body fluids.**

**B. Diuretic effect**

**C. Ammonium chloride acts as a mild expectorant and diaphoretic when taken in small doses. Used in cough preparations.**

### Storage:

**Stored in highly closed containers.**

# Thank You