



**SNS COLLEGE OF PHARMACY AND HEALTH SCIENCES**

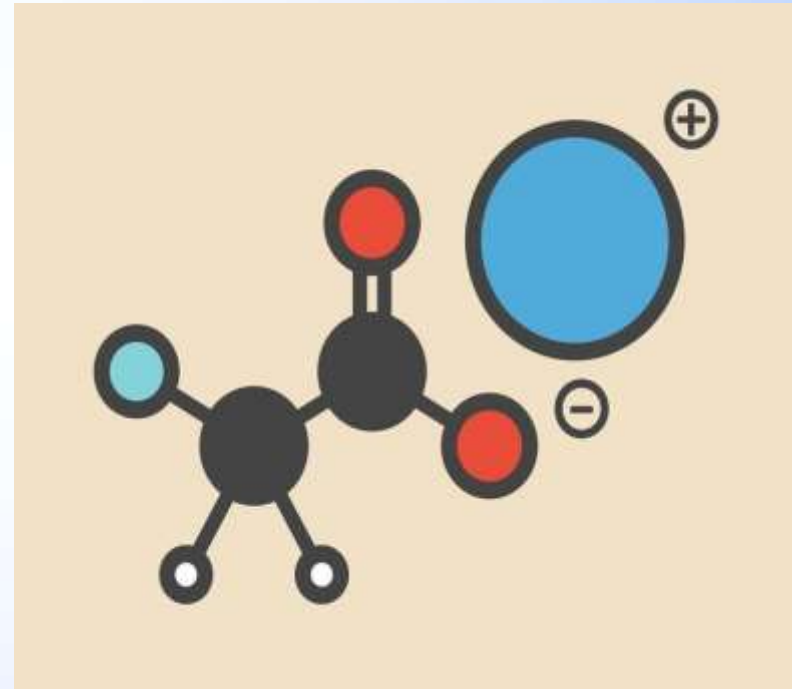
Sathy Main Road, SNS Kalvi Nagar,  
Saravanampatti Post, Coimbatore - 641 035,  
Tamil Nadu.




# ***PHYSIOLOGICAL ACID – BASE BALANCE***

# What is electrolyte?

*An electrolyte is a substance that produces an electrically conducting solution; when dissolved in a polar solvent.*






# *Importance of electrolytes in human body*

- × Maintain water balance.*
- × Helping muscles (including heart) contract and relax.*
- × Help in transmit nerve impulses.*
- × Maintain acid-base balance.*
- × Maintain a constant environment in the whole body tissue.*

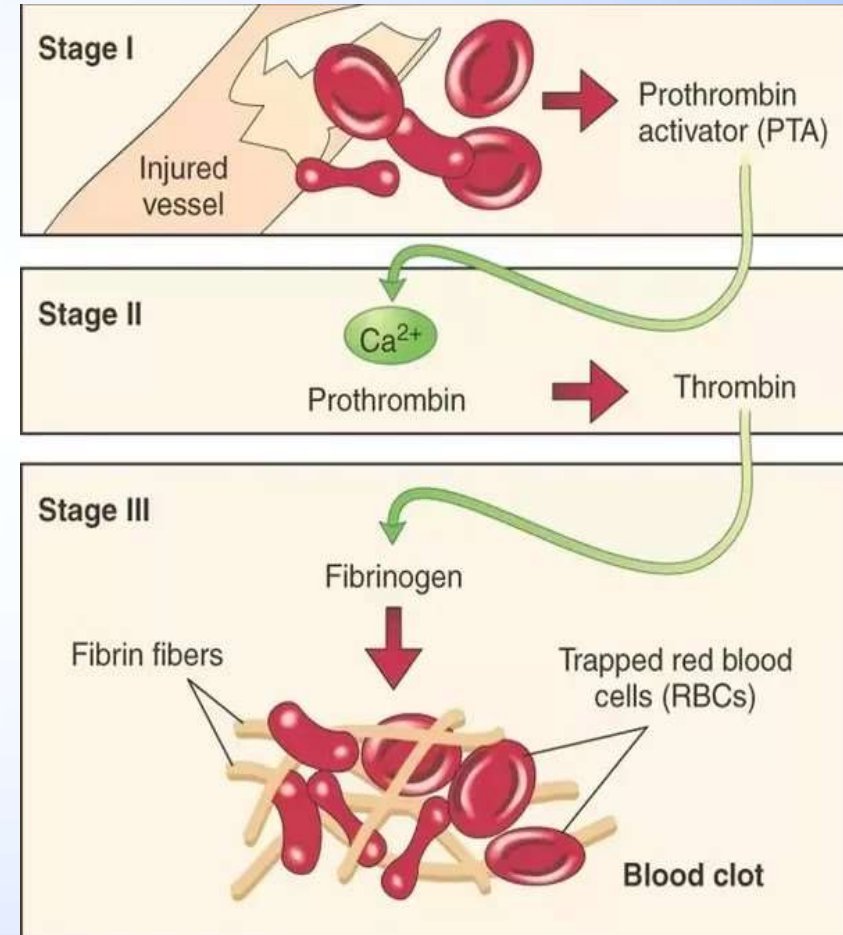


# Major physiological ions:

- Calcium (Ca)
  - Magnesium (Mg)
  - Sodium (Na)
  - Potassium (K)
  - Chloride (Cl<sup>-</sup>)
  - Bicarbonate (HCO<sub>3</sub><sup>-</sup>)
  - Phosphate (PO<sub>4</sub><sup>-</sup>)
  - Iron (Fe)
- 

# Importance of Calcium

- × Constituent of bones and teeth
- × Help in functioning of muscles
- × Clotting mechanism of blood
- × Need for growth of tissue & bones



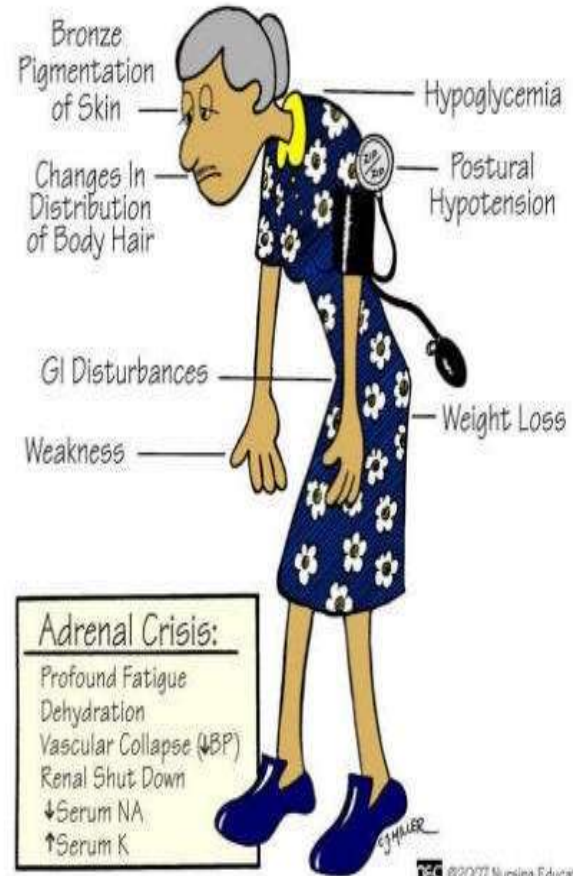
# Importance of Magnesium

- ♣ *Found in bone; combine with Ca*
- ♣ *Used for protein synthesis*
- ♣ *Important for Neuromuscular system*
- ♣ *Insufficient Mg ion can cause Cardiac Disturbance*

# Importance of Sodium

- × Principal cation of extracellular fluid
- × Maintain normal hydration
- × Maintain osmotic pressure
- × Low Na ion level can cause Diabetes, Addison's disease etc

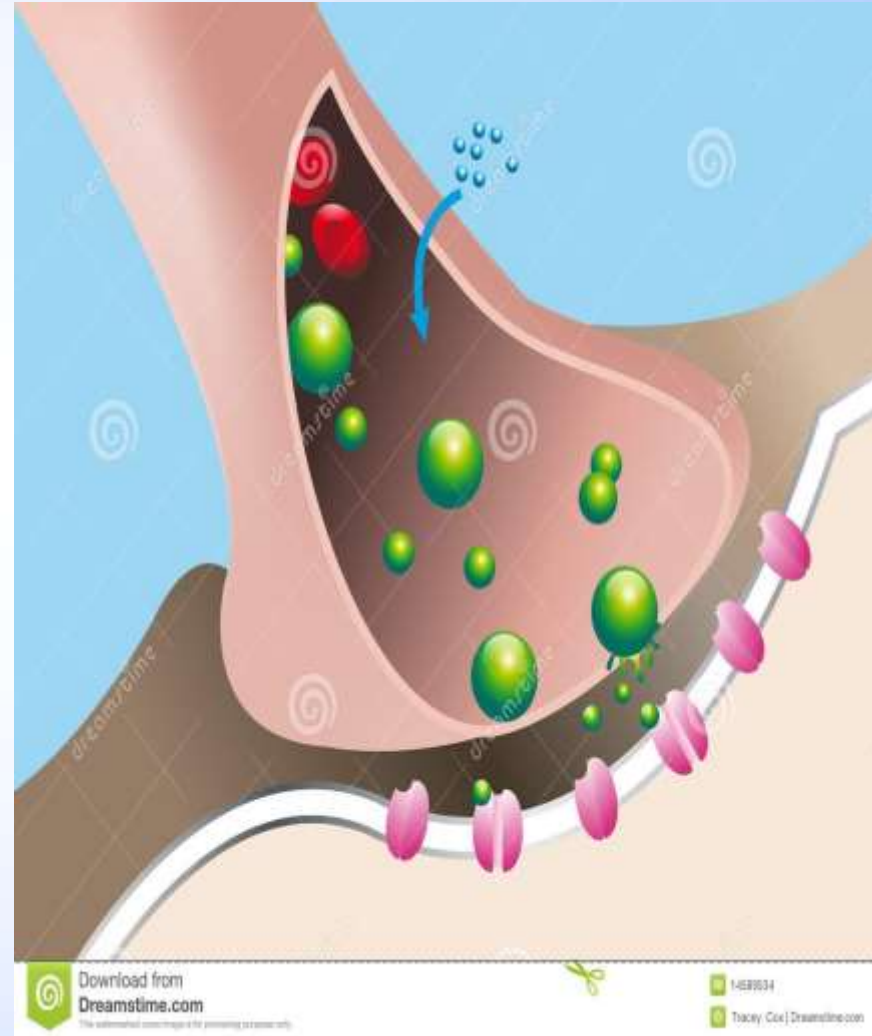
## ADDISON'S DISEASE





# Importance of Potassium

- ⌘ Major intracellular cation
- ⌘ Important for nerve impulse
- ⌘ Low level of K ion can cause changes in BP
- ⌘ High level of K ion can cause the damage of Kidney



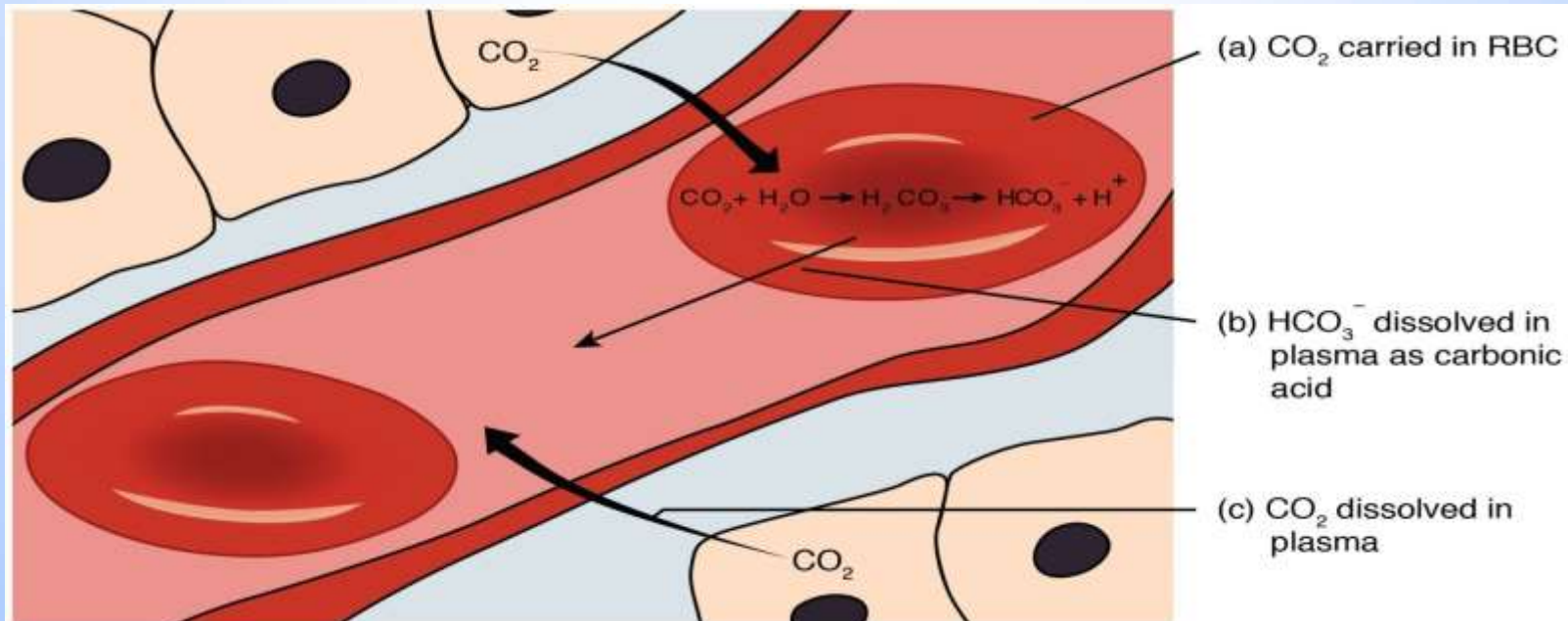


# Importance of Chloride

- × *Maintain the osmotic pressure*
- × *The major extracellular anion*
- × *Maintain proper hydration*
- × *Hyperchloremic condition can cause Congestive Heart Failure*

# Importance of Bicarbonate

- Along with Carbonic Acid, it is utilized as the body's most important – 'Buffer System'
- Lack of this ion can cause metabolic Acidosis or Alkalosis



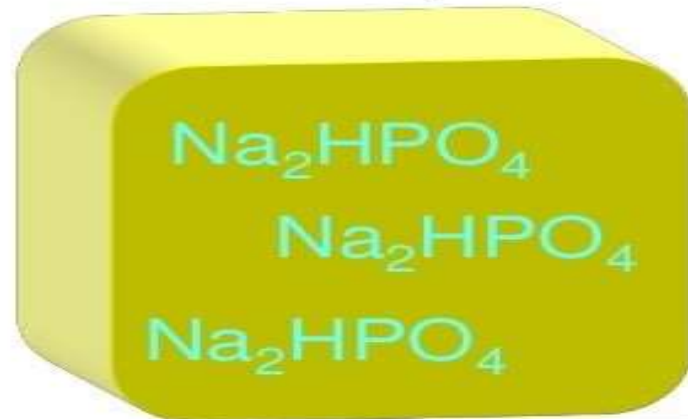
# Importance of Phosphate

- × It is also an important 'Buffer System'
- × Present in the bones and teeth

## PHOSPHATE BUFFER SYSTEM

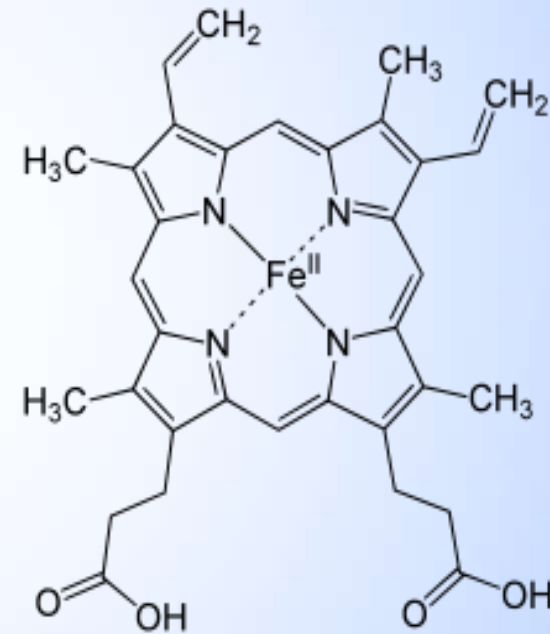


- Phosphates are more abundant within the cell and are rivaled as a buffer in the ICF by even more abundant protein



# Importance of Iron

- Create Haemoglobin
- Carries Oxygen & Carbon Dioxide indirectly
- Low level of Fe in blood cause Anaemia



# Sodium chloride

- ♣ *Mol weight = 58.44*
- ♣ *It contains not less than 99.5% of NaCl*
- ♣ *It is found in the sea*
- ♣ *It occurs as odourless, colourless, colourless crystals or white crystalline powder.*
- ♣ *Soluble in water.*
- ♣ *Slightly soluble in alcohol*



## Uses:

- ♣ Its is an electrolyte replensher ,emetic, topical inflammatory
- ♣ Used to treat extracellular volume depletion , dehydration.
- ♣ May be used in eye drops, nasal drops.
- ♣ Used in homeopathic
- ♣ Has adverse effect on vomitting, sweating, diarrhoea.



# Sodium Chloride Injection

*Sterile isotonic solution of sodium chloride in water for injection.*

- *Contains not less than 0.85 per cent and not more than 0.95 per cent w/v of NaCl.*
- *Contains no antimicrobial agents.*
- *It is a colourless solution.*
- *stored in single dose containers of glass or plastic.*





## ⌘ Test for purity

- × Heavy metals.
- × Pyrogens.
- × pH (between 4.5 and 7.0).

## ⌘ Uses

- × Used as fluid and electrolyte replenisher.
- × Isotonic vehicle.



source: [www.indiamart.com](http://www.indiamart.com)

# Sodium Chloride Hypertonic Injection

Sterile solution of sodium chloride in water for injection.

- Contains not less than **1.52** per cent and not more than **1.68** per cent w/v of NaCl.
- Contains no antimicrobial agents.
- It is a clear and colourless solution.
- stored in single dose containers of glass or plastic.



Source: [www.mcguffmedical.com](http://www.mcguffmedical.com)

## ⌘ Test for purities

- × Arsenic.
- × Heavy metal.
- × Pyrogens.
- × pH (between 5.0 to 7.5).

## ⌘ Uses

- × Used as fluid and electrolyte replenisher.



Source: [www.mcguiffmedical.com](http://www.mcguiffmedical.com)

# Compound Sodium Chloride Injection

- Contains:
  - ⌋ NaCl (0.82-0.90% w/v)
  - ⌋ KCl (0.028-0.0315%)
  - ⌋  $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$  (0.03-0.036%)
- Contains no microbial agents.



Source: [www.fresenius-kabi.com](http://www.fresenius-kabi.com)

## ⌘ Tests for purity

- × Arsenic.
- × Heavy metal.
- × Pyrogens.
- × pH (between 5.0 to 7.5).

## ⌘ Uses

- × Used as fluid and electrolyte replenisher.



Source: [www.fresenius-kabi.com](http://www.fresenius-kabi.com)



# Compound Sodium Chloride Solution

A sterile solution of Sodium Chloride, Potassium Chloride, Calcium Chloride in purified water.

- It is a colourless solution.
- Its tests for purity comply with the requirements stated under compound sodium chloride injection
- Used as an irrigation solution (for external use)



Source: [www.indiamart.com](http://www.indiamart.com)

# Sodium Chloride and Dextrose Injection

*A sterile solution of sodium chloride (0.11-0.9%), Dextrose (2.5-25%)*

- It is clear, colourless or faintly straw-coloured solution.*
- stored in single dose containers of glass or plastic.*



Source: [www.indiamart.com](http://www.indiamart.com)



## ⌘ Test for purities

- × 5-hydroxymethylfurfural and related substances.
- × Heavy metals.
- × Pyrogens.
- × pH (3.5-6.5).

## ⌘ Uses

- × Used as fluid, nutrient and electrolyte replenisher.



Source: [www.indiamart.com](http://www.indiamart.com)

# SODIUM LACTATE INJECTION



10 mL Single-dose Rx only NDC 0409-6664-11

**SODIUM LACTATE**  
Injection, USP

**50 mEq/10 mL (5 mEq/mL)**

**CAUTION: MUST BE DILUTED.**  
*For Intravenous Use.*

Each mL contains sodium lactate, anhydrous 560 mg. May contain HCl for pH adjustment. Sterile, nonpyrogenic. **Not for use in the treatment of lactic acidosis.** Usual dosage: See insert.

Dist. by Hospira, Inc., Lake Forest, IL 60045 USA RL-7081

LOT/EXP Area (SVP)

LOT/EXP Area (SVP)

# How We Can Prepare the Solution:

1

contains not less than 1.75% and not more than 1.95% of sodium lactate

2

1000 ml contains lactic acid (14 ml), sodium hydroxide (6.7 g) and heating solution in acid

3

NaOH in water for injection (400 ml), adding the lactic acid 0.15 ml of the solution gives a full orange colour with an autoclave at 115° to 116° for one hour

4

It is cooled, dilute hydrochloric acid added carefully until the solution produces a yellow colour with 0.05 ml of phenol red solution

5

Sufficient water for injection is added to the solution and dilute the solution to 1000ml

6

filtered and immediately sterilized by heating

# Physical Characters:

1

It is clear  
colourless  
solution.

2

It is stored in  
single-dose  
containers of  
glass or plastic

# Uses

It is a fluid and electrolyte replenisher.

## **ELECTROLYTES**

and why you need them



### **Magnesium**

Magnesium helps convert glucose to energy. It also helps to metabolize fat and help prevent cramps.



### **Sodium**

When used appropriately, sodium works with potassium to help muscle expansion and contraction.



### **Potassium**

Potassium plays a part in how nerves transmit and muscles contract. It helps to regulate water balance in the body.



### **Phosphorus**

This is used in nerve signaling, heartbeat, and is needed for the growth, maintenance, and repair of cells and tissues.



### **Calcium**

This mineral is extremely important for nerve transmission, muscle growth, and powerful muscle contractions.



### **Chloride**

This electrolyte helps to keep the tendons and joints healthy, but it also helps to regulate the balance of acid and alkali in the blood.

# Official Preparations of Sodium Chloride

Sodium Chloride Injection, I.P.

Sodium Chloride Hypertonic Injection, I.P.

Compound Sodium Chloride Injection, I.P.

Compound Sodium Chloride Solution, I.P.

Sodium Chloride and Dextrose Injection, I.P., U.S.P.

Sodium Lactate Injection, I.P.

Sodium Chloride Eye Lotion, B.P.

Sodium Chloride Ophthalmic Ointment, U.S.P.

Sodium Chloride Inhalation Solution, U.S.P.

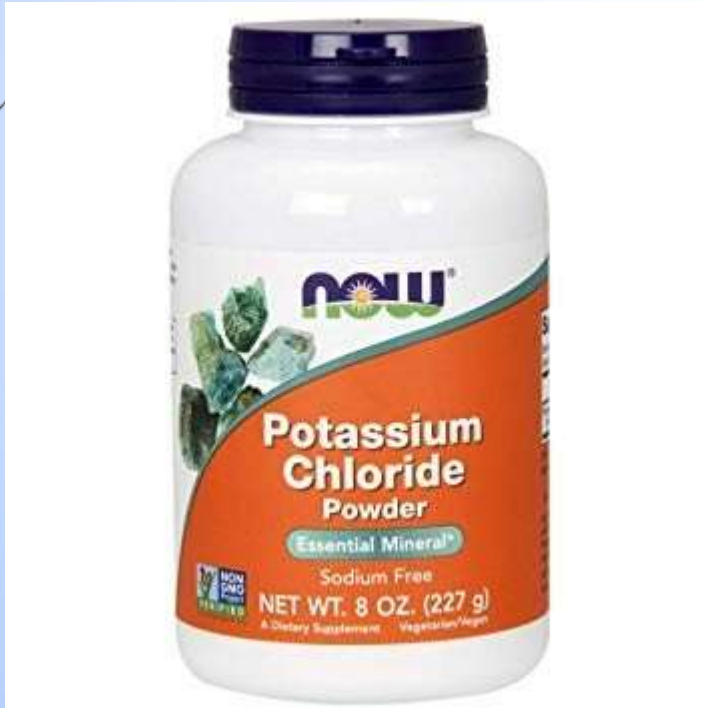
Bacteriostatic Sodium Chloride Injection, U.S.P.

Sodium Chloride Intravenous Infusion, B.P.

Sodium Chloride and Glucose Intravenous Infusion, B.P.

Sodium Chloride Irrigation, U.S.P.

# POTASSIUM CHLORIDE

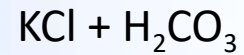
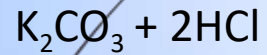




# Introduction

KCl; Mol. Weight=74.55

Potassium chloride contains not less than 99.0 per cent of. Potassium chloride can be prepared by reacting hydrochloride acid with potassium carbonate,



# Physical Characteristics:

- Potassium chloride occurs as odorless, colourless;
- cubical, elongated, or prismatic crystals or white crystalline powder ;
- taste is saline.
- It is soluble in water and glycerol : practically insoluble in alcohol and solvent ether.
- A solution is neutral to litmus.
- Hydrochloric acid, sodium or magnesium chlorides diminish its solubility in water.

# Incapatability:

Incapatability:  
with

Amphotericin,  
Amikacin  
sulphate

Dobutamine  
hydrochloride,  
and fixed oil  
emulsions

# Uses:

1

electrolyte  
replenisher

2

used in the  
treatment of  
potassium  
deficiency

3

familial  
paralysis ,  
myasthenia  
gravis (muscle  
weakness)  
meniere's  
syndrome  
(disease of the  
inner ear)

4

as an antidote  
in digitalis  
intoxication.

# What happened :Excessive Use

1  
hyperkalaemia  
causing muscles  
weakness

2  
Paralysis

3  
Hypotension

4  
Heart block and  
cardiac arrest.

# OFFICIAL POTASSIUM CHLORIDE PREPARATIONS

## **Potassium Chloride and Sodium chloride Intravenous Infusion(BP)**

It is a sterile colourless solution of potassium chloride and sodium chloride in water.

## **Potassium Chloride and Glucose Intravenous Infusion (B.P.)**

It is a sterile colourless or faintly straw-coloured solution of Potassium chloride and either anhydrous glucose or glucose in water.

## **Potassium Chloride, Sodium Chloride and Glucose Intravenous Infusions (B. P.)**

It is a sterile solution of potassium chloride, sodium chloride and either anhydrous glucose or glucose in water.

## **Effervescent Potassium Chloride Tablets (B.P.)**

Potassium Chloride Elixir, U. S. P

Potassium Chloride Mixture, A. P. F.

Potassium Chloride Injection, U. S. P.

Potassium chloride in Dextrose Injection, U. S. P.

Potassium chloride Oral Solution, U. S. P.

Potassium Chloride Extended-release Capsules Tablets. U. S. P.

Potassium Chloride, potassium Bicarbonate, and Potassium citrate Effervescent Tablets for Oral Solution , U. S. P.

# Electrolytes used in acid base in acid base therapy

*The sodium salts of bicarbonate, lactate, acetate and sometimes citrate and ammonium salts are used to treat metabolic acidosis. supply of bicarbonate increase the  $\text{HCO}_3/\text{H}_2\text{CO}_3$  ratio. lactate, acetate and citrate ions are degraded to  $\text{CO}_2$  and water by tricarboxylic acid cycle.*

*The major functions of electrolytes are to maintain electrolytic imbalance, including acid base balance and osmotic equilibrium and to facilitate specific metabolic function through supply of specific ion to body fluids.*



# Sodium acetate:

$\text{CH}_3\text{COONa} \cdot 3 \text{H}_2\text{O}$  mol weight = 136.08

Sodium acetate contains not less than 99.0 per cent of  $\text{CH}_3\text{COONa} \cdot 3\text{H}_2\text{O}$ . It is prepared by neutralization of acetic acid with sodium carbonate or sodium hydroxide, and then crystallizing the product.



## Characters:

1. Colourless & odourless
2. soluble in water and alcohol
3. 5% solution in Water has a pH of 7.5 to 9.2.
4. kept in airtight containers.

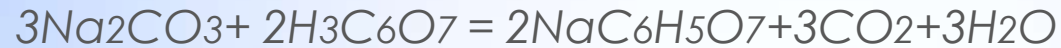
## Uses:

1. Used as pharmaceutical aid
2. Acidulant in food
3. used as effective buffer in metabolic acedosis.

# Sodium citrate:

$C_6H_5Na_3O_7 \cdot 2H_2O$ ; mol weight = 294.1

Sodium citrate is trisodium 2-hydroxy-propane-1,2,3 tricarboxylate dihydrate. it contains about 99% of  $C_6H_5Na_3O_7$ . it is prepared by mixing of calculated amounts of hot solution of citric acid and sodium carbonate and crystallizing the product.



## Characters:

1. white crystalline powder.
2. slightly deliquescent in moist air.
3. freely soluble in water
4. partially soluble in ethanol.
5. stored in air-tight containers..

## Uses :

1. used as systemic alkalinizing substance.
2. it has anti clotting properties.
3. used to preservation of blood for transfusion purpose.

# Potassium citrate

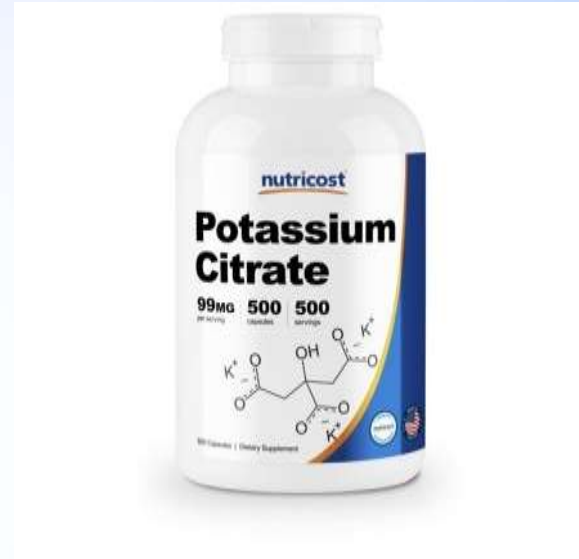
Molecular formula:  $\text{K}(\text{OOC})\text{CH}_2\text{CH}(\text{OH})(\text{COOK})\text{CH}_2\text{COOK} \cdot \text{H}_2\text{O}$

Molecular weight: 324.42

Potassium citrate is a potassium salt of citric acid with the molecular formula  $\text{K}_3\text{C}_6\text{H}_5\text{O}_7$ . It is a white, hygroscopic crystalline powder. It is odorless with a saline taste. It contains 38.28% potassium by mass. In the monohydrate form it is highly hygroscopic and deliquescent.

## uses

- × Used as systemic alkalizer.
- × Used as gastric antacid.
- × Used to control kidney stones.
- × Used in many soft drink as a buffering agents.
- × Used to relieve painful irritation.



# Sodium Bicarbonate Injection

- × It is a sterile solution of sodium bicarbonate in water for injection.
- × pH 7.0 to 8.5
- × It is preserved in single dose containers.
- × It contains not less than 95% and not more than 105% of labelled amount of  $\text{NaHCO}_3$



# Ammonium Chloride injection

- × Ammonium chloride is an inorganic compound with the formula  $\text{NH}_4\text{Cl}$  and a white crystalline salt that is highly soluble in water. Solutions of ammonium chloride are mildly acidic.
- × Ammonium chloride injection is a sterile solution of ammonium chloride in water for injection .
- × It contains not less than 95% and not more than 105% of labelled amount of  $\text{NH}_4\text{Cl}$
- × It is preserved in single dose or in multiple dose containers.



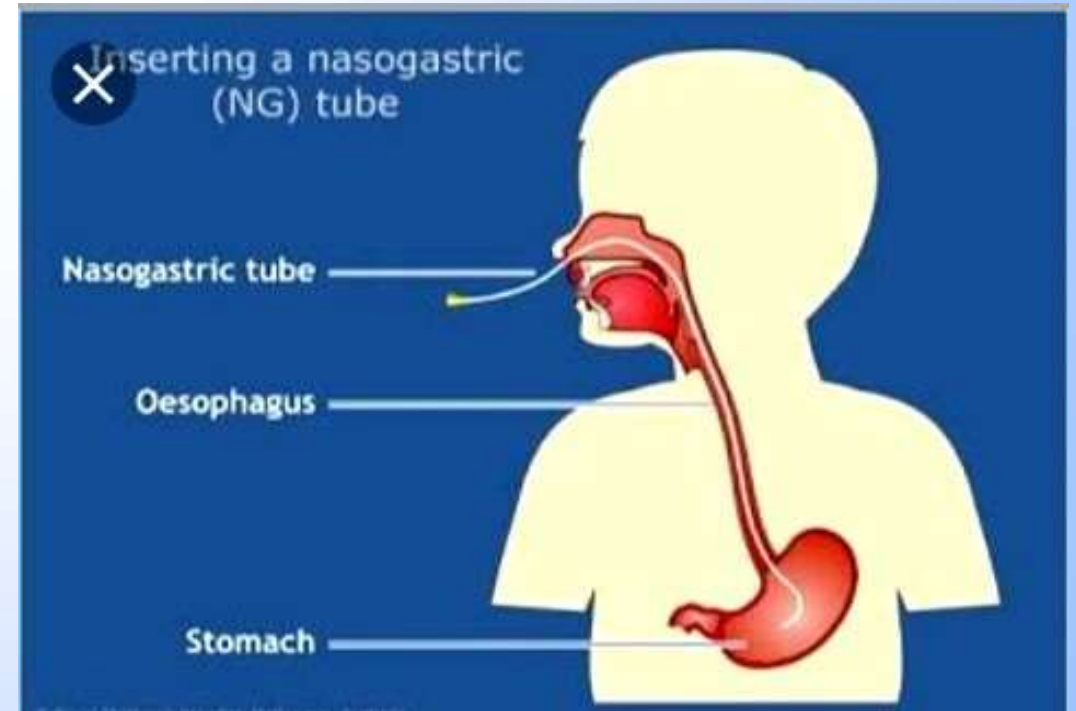
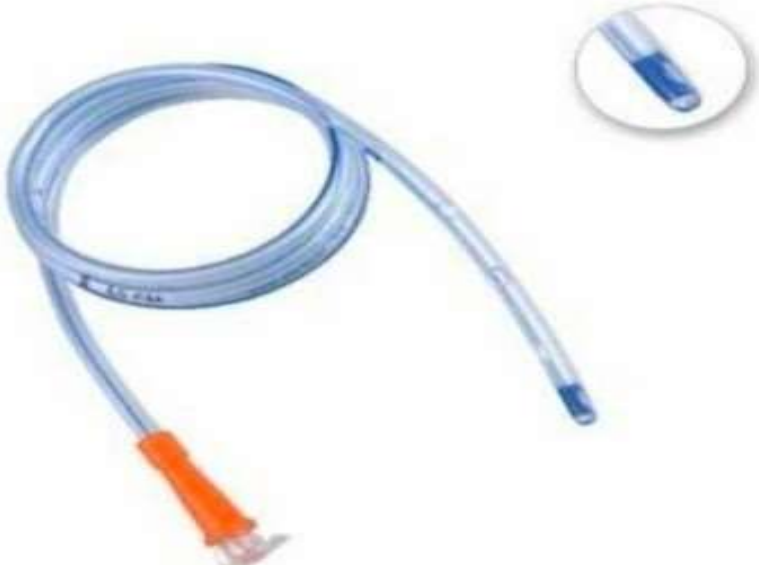
# *Electrolyte combination therapy*

- × When a patient undergoes a surgery , he is unable to take normal diet, therefore he is given infusion's containing saline and glucose he also needs additional electrolytes . which are intended for the fluid maintain of the body. Usually the combination of electrolyte are prepared and given to the patient according to his requirement this type treatment is called electrolyte combination therapy.

# Oral Rehydration Therapy

Oral rehydration therapy (ORT) is a type of fluid replacement used to prevent and treat dehydration, especially that due to diarrhea. Oral rehydration therapy can also be given by a nasogastric tube.

**Nasogastric intubation** is a medical process involving the insertion of a plastic tube through the nose, past the throat, and down into the stomach.



# Oral rehydration therapy consists of two phases of treatment:

(1) a **rehydration phase**, in which water and electrolytes are given as ORS to replace existing losses.

(2) a **maintenance phase**, which includes replacement of ongoing fluid and electrolyte losses and adequate dietary intake Oral rehydration therapy can be-

1. ORT solutions
2. Rice based solutions
3. Glucose



# Salt intake and Hypertension

*Reduced salt intake lowering the blood pressure and enhance the effect of drug treatment.*



# Multiple Electrolyte Powders

## Oral rehydration salt(Electral)

Each packet (35g) contains-

- Sodium chloride-1.25 g.
- Potassium chloride-1.50 g.
- Sodium Citrate-2.90 g.
- Anhydrous dextrose-27 g.

## Used in-

- ↳ Replacement of fluid & electrolytes loss.
- ↳ Maintenance of hydrogen in diarrhoea due to Rota virus, E. coli.
- ↳ Muscle weakness & muscle cramps.
- ↳ For athletes & industrial workers.

# Oral Rehydration Salts(WHO,UNICEF)

It contains:

- Sodium chloride-3.5 g
- Potassium chloride-1.5 g
- Sodium bicarbonate-2.5 g or
- Sodium citrate dihydrate-2.9 g
- Anhydrous glucose-20 g for solution in 1litre of water.





# Multiple Electrolyte Solutions

## 1. Oralyte Ready-P oral solution:

*A sterile solution containing –*

- ↳ Sodium chloride-117 mg.*
- ↳ Sodium acetate-136 mg.*
- ↳ Magnesium acetate-196 mg.*
- ↳ Magnesium chloride-30 mg.*
- ↳ Calcium chloride-37 mg.*

## 2. Paediatric Solution for Intravenous Use:

*A sterile solution containing -*

*↳ Dextrose-5 g*

*↳ Sodium Acetate-0.3 g*

*↳ Potassium chloride-0.10 g*

*↳ Magnesium chloride -0.03 g*

*↳ Dibasic potassium phosphate-0.025 g*

*↳ Sodium metabisulphate-0.02 g*

*↳ & the pH adjusted with HCl.*

### **3.Elliott's B Solution:**

*A sterile solution containing*

*∟ Sodium chloride-730 mg*

*∟ Potassium chloride- 30 mg*

*∟ Calcium chloride dihydrate- 20 mg*

*∟ Magnesium sulphate-30 mg*

*∟ Sodium phosphate heptahydrate- 20 mg*

*∟ Glucose- 20 mg*

*∟ Sodium bicarbonate-190 mg*

*∟ Phenol red-10 micro gm & water for injection to 100 mL.*



#### **4.Ringer's injection (U.S.P):**

*A sterile solution containing*

*↳ Sodium chloride-860 mg*

*↳ Potassium chloride-30 mg*

*↳ Calcium chloride dihydrate-33 mg & water for injection to 100 mL.*

# Dialysis Solutions

*In dialysis, bicarbonate is the best given as acetate or lactate in order to avoid the release of carbon dioxide into solution.*

- ×Used in-*
- ×Management of Renal Failure*
- ×Poisoning*
- ×Removal of toxic substances & electrolytes*

**Haemodialysis**-The exchange of ions between the solution and the patients blood is made across a synthetic semi-permeable membrane.

**Peritoneal dialysis**-The exchange is made across the membranes of the peritoneal cavity.

### **Intraperitoneal Dialysis Fluid(I.P.):**

↳ Sodium chloride-5.56 g.

↳ Sodium acetate-4.76 g.

↳ Calcium chloride-0.22 g.

↳ Magnesium chloride-0.152 g.

↳ Sodium metabisulphite-0.15 g.

↳ Anhydrous dextrose -17 g & purified water sufficient to produce (1000 ml).