UNIT – II (A) ACIDS, BASES AND BUFFERES

POINTS TO BE COVERED IN THIS TOPIC

- INTRODUCTION
- BUFFER EQUATIONS AND BUFFER CAPACITY IN GENERAL
- BUFFERS IN PHARMACEUTICAL SYSTEMS
- PREPARATION
- STABILITY
- BUFFERED ISOTONIC SOLUTIONS
- MEASUREMENTS OF TONICITY
- CALCULATIONS AND METHODS OF ADJUSTING ISOTONICITY

INTRODUCTION

➢ ACID

Acid

Blue litmus turns red

- An **acid** is any **hydrogen-containing substance** that is capable of **donating a proton (hydrogen ion)** to another substance.
- It converts **blue litmus** paper **into red**
- Having the **PH <7, taste** is **sour and react** with bases to form **salts and water.**
- E.g. - **Hydrochloric acid**, **Boric Acid**, **Citric Acid and Acetylsalicylic Acid**

➢ BASE

Base

Red litmus turns blue

- A **base** is a **molecule or ion** able to accept a **hydrogen ion** from an **acid**
- It converts **red litmus paper** to **blue**
- Having the **PH >7, bitter** is **taste and react** with Acids to form **salts and water.**
- E.g. **Sodium Hydroxide, Calcium hydroxide, Magnesium hydroxide and Potassium oxide**

➢ CONCEPTS OF ACID AND BASE

❖ ARRHENIUS THEORY

✓ **Acids**

- An **Acid** is a substance that can **release hydrogen ion (H+)** when **dissolved in water.**
- Example: $HCl \rightarrow H^+ + Cl^-$

✓ **Base**

- A **Base** is a substance that can **release a Hydroxyl ion (OH-)** when **dissolved in water.**
- Example :- $NaOH \rightarrow Na^+ + OH^-$

✓ **Limitation of Arrhenius theory**

- The theory **defines acids** and **bases** in term of **aqueous solutions** not in term of substance themselves.
- The theory does not **explain acidic and basic nature** of substance in **non- aqueous solutions.**
- Unable to **explain basic nature** of certain substances like Na_2CO_3, NH_3 which do **not possess hydroxyl groups** and inability to explain **acidic nature** of certain substances like CO_2, SO_2, SO_3 which do **not possess hydrogen.**
- Unable to **explain reaction** between **acids and bases** in absence of solvent.

❖ LOWRY BRONSTED THEORY

✓ **Acid**: **Acid** is the substance **which donate proton**. E.g. H^+, NH_4^+, BF_3

✓ **Base**: **Base** is the substance which **accept proton.** E.g. OH^-, NH_3^+

✓ **Conjugate acid base pair**

- **A pair of acid** and **base** which differ only by a **proton** is called as **conjugated acid base pair.**
- **Acid donates** or **loses a proton** to form **conjugated base.**
- **Base accepts** a proton to form a **conjugated acid.**
- E.g. – **Cl^- is a conjugated** base of **HCl**

  H_3O^+ is a conjugated acid of **base H_2O**

❖ LEWIS THEORY

✓ **Acid**: Acid is the **molecule or ion** that accept the **lone pair of electrons.**
E.g. H+, NH4+, Na+, Cu++, Al+++

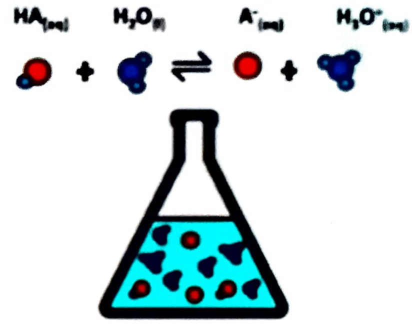
✓ **Base**: Base is the **molecule or ion** that donate the **lone pair of electrons.**
E.g. OH-, Cl-, CN-

$$\underset{\text{Acid}}{HA\,(aq)} + \underset{\text{Base}}{H_2O\,(l)} \longrightarrow \underset{\text{Conjugated base}}{A^-(aq)} + \underset{\text{Hydronium ion}}{H_3O^+(aq)}$$

$$\underset{\text{Acid}}{B\,(aq)} + \underset{\text{Base}}{H_2O\,(l)} \longrightarrow \underset{\text{Conjugated acid}}{BH^+(aq)} + \underset{\text{Hydroxide ion}}{OH^-(aq)}$$

BUFFER EQUATIONS AND BUFFER CAPACITY IN GENERAL

➢ DEFINITION



- **Buffers are compounds** or mixtures of compounds that by their **presence** in the **solution resist** changes in the **pH** upon the addition of **small quantities** of **acid or alkali.**

➢ TYPES OF BUFFERS

- Generally buffers are of **two types**

❖ **Acidic Buffers:** An **acidic buffer** is a combination of **weak acid** and its **salt** with a **strong base**. i.e. **Weak acid & salt** with **strong base** (conjugate base).

E.g. CH_3COOH and CH_3COONa, H_2CO_3 and $NaHCO_3$, H_3PO_4 and NaH_2PO_4, $HCOOH$ and CH_3COONa

❖ **Basic Buffers:** A **basic buffer** is a combination of **weak base** and its **salt with a strong acid**. i.e. **Weak base & salt** with strong acid (conjugate acid).

E.g. NH_4OH and NH_4Cl, NH_3 and NH_4Cl, NH_3 and $(NH_4)_2CO_3$

➢ BUFFER EQUATION

- **Buffers are characterized** by the fact that their **pH remains** constant are not affected by dilution , by the addition of **small amounts** of **acids or bases** and are not affected by **prolonged storage** of the solution.
- The **addition of small amounts** of acid or base to **moderate pH** solutions results in absorption by buffer with **minimal pH changes.**
- Calculations involving **weak acids require** a knowledge of the **pKa of the acid.**
- It is possible to **calculate the pH** of the **buffer solution** by rearranging the equation.
- For **dielectric constant**

$$[H_3O^+] = Ka\frac{[CH_3COOH]}{[CH_3COO^-]}$$

- A solutions acetic acid concentrations can be viewed as the total amount of acid in the solution since acetic acid is not readily ionized.
- In an alternate form the term [CH3COOH] may replace the term [acid] , as well as [CH3COOH] for salt.

$$[H_3O^+] = Ka\frac{[acid]}{[salt]}$$

- Calculating the pH of buffer solutions containing both acid and its conjugate base can be performed by rearranging and rewriting the dissociation constant equation as follows

$$[H^+] = Ka\frac{[HA]}{[A]}$$

- The acid concentration [HA] corresponds to its conjugate base concentration [A-] , in logarithmic form , equation 3 is

$$pH = pKa + \log\frac{[A^-]}{[HA]}$$

i.e.

$$pH = pKa + \log\frac{[Salt]}{[Acid]}$$

- Similar to weak acid buffers , weak base buffers can be derived from their corresponding salt equations so

$$[OH^-] = Kb\frac{[Base]}{[Salt]}$$

- Equation is derived by substituting value for OH^-

$$Kw/H3O^- = Kb\frac{[Base]}{[Salt]}$$

i.e.

$$= pKb + \log \frac{Salt}{Base}$$

Or

$$pH = pKw - pKb + \log \frac{Base}{Salt}$$

- Salt , acid and base are all represented by their molar concentration.
- A pH of a solution can be calculated using Henderson – Hasselbalch equations and acid and base solutions.

BUFFER CAPACITY

- The amount of an acid or base that can be added to a 1 liter of a buffer solution before its pH changes significantly.
- It is indicated by the term buffer index (B).
- Mathematically buffer capacity is expressed as

$$\beta = \Delta B / \Delta pH \text{ ....1}$$

- ΔB = amount of acid or base added to change the pH by 1 unit
- ΔpH = change in pH

FACTORS AFFECTING BUFFER CAPACITY

- Ratio of [A-]/[HA]
- Total buffer concentration
- Temperature
- Ionic strength

✓ RATIO OF [A-]/[HA]

- The buffer capacity depends essentially on the ratio of the salt to the acid or base.
- The actual concentrations of A^- and HA influences the effectiveness of a buffer.
- The more is the A^- and HA molecules available, the less of an effect of the addition of a strong acid or base on the pH of a system.

✓ TOTAL BUFFER CONCENTRATION

- **Buffer capacity** depends upon the **total buffer concentration.** For example, it will take **more acid or base** to deplete a 0.5 M buffer than a 0.05 M buffer. The relationship between **buffer capacity and buffer concentrations** is given by the Van Slyke equation:

$$\beta = 2.303C\left\{\frac{Ka[H_3O^+]}{(Ka+[H_3O^+])^2}\right\}$$

✓ TEMPERATURE

- **Buffers are required** to be maintained at a **constant temperature.**
- Any change in the **temperature** of **the buffer results** in a reduction in the **effectiveness of the buffer.**
- Buffer **containing base** and its salt were found to show **greater changes** in **buffer capacity** with temperature.

✓ IONIC STRENGTH

- **Ionic strength** is reduced by dilution.
- Change in **ionic strength changes** the **pH of buffer solution** resulting in decreased **buffer capacity.**
- So, whenever the **pH of buffer solution** is mentioned **ionic strength** should be specified.

Temperature	Actual pH		
	Phthalate buffer	Phosphate buffer	Borate buffer
0	4.01	7.12	-
10	4.00	7.06	10.15
20	4.00	7.02	10.06
25	4.00	7.00	10.00
30	4.01	-	9.96
40	4.03	6.97	9.97
50	-	-	9.80
60	4.09	6.98	9.73

BUFFERS IN PHARMACEUTICAL SYSTEMS

❖ BUFFER IN PHARMACEUTICAL SYSTEMS

✓ **The In vivo biologic buffer system**

- In the **blood , pH** is maintained at **approximately 7.4.**
- As **buffer in the plasma** , **carbonic acid** and **bicarbonate** as well as **acid/ alkali sodium salts** of **phosphoric acid** are present in the **blood, plasma proteins**, which act as acids, can combine **with bases** to act as buffers.

✓ **Lacrimal fluids**

- It has been **found that lacrimal fluid**, also known as **tears,** can be diluted at **1:15 with neutral distilled water.**
- There is a **pH range of 7 to 8** or slightly above in tears, **ranging from 7.4 to 7.4.**
- The **cornea** is generally thought to be **unaffected by eye drops** with a **pH range from 4 to 10.**

✓ **Urine**

- **Normal 24 hour urine** collections of adults have a **pH averaging** about **6.0** , they may be as low as **4.5 or as high as 7.8.**
- Whenever urine **pH falls below** a normal level , **hydrogen ions** are excreted by the **kidneys.**
- The **kidneys retain hydrogen ions** in urine that have a **pH above 7.4** to return the **pH to a normal value.**

✓ **Pharmaceutical buffers**

▪ **Preparations for the eye (ophthalmic preparations)**

- The **pH range** of **lacrimal fluid** is generally maintained by buffers in **ophthalmic preparations.**
- Although **lacrimal fluid** has a **pH between 7 and 8** , it has a good **buffering capacity** and can tolerate preparations with pH values between **3.5 and 10.5 without** causing discomfort.

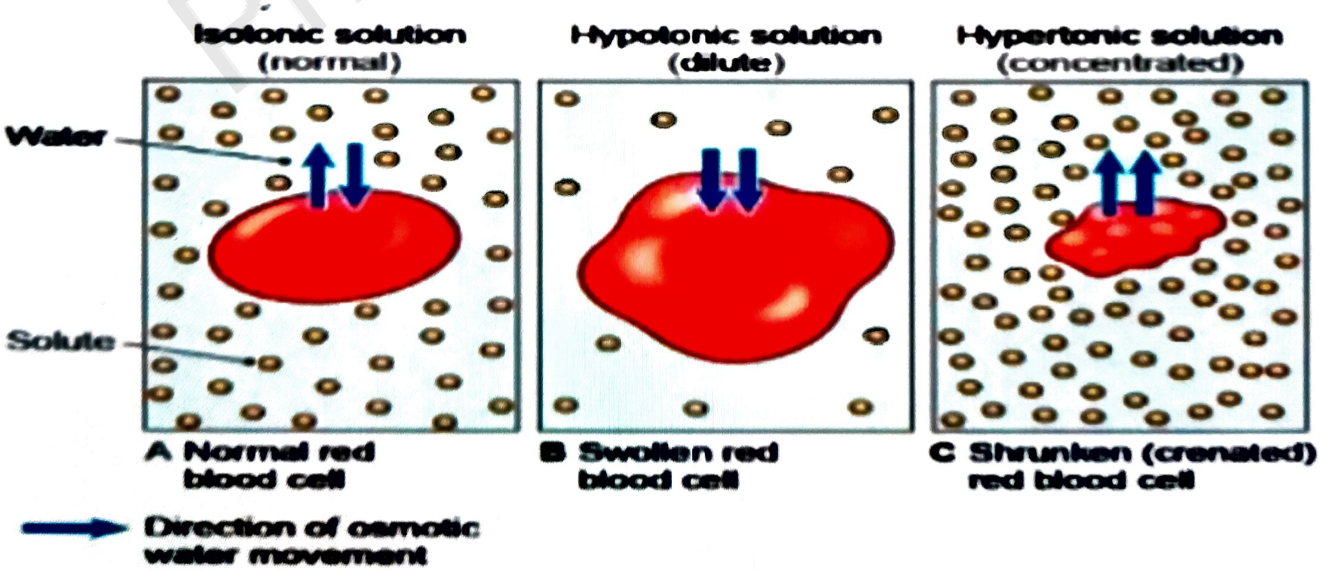
- **In creams and ointments**
  - A **buffer** is used to ensure the **stability of topical products .**
  - Among the **most common buffers** found in **creams and ointments** are **citric acid** and its **salt and phosphoric acid.**

❖ PREPARATION OF BUFFER

- The **weak acid** should have a **pKa** that approximates that of the **pH** at which the **buffer should be used.**
- **Calculations** involving pH within the range of **4 to 10** can be approximated using the **buffer equation.** Use it to determine the **concentration of salt** and **weak acid** required to reach the **desired pH.**
- Obtain a **buffer capacity** that is appropriate by considering the individual **buffer salt** and acid concentrations. It is usually sufficient to use a **concentration of 0.05 to 0.5 M** and to use a **buffer with a capacity of 0.01 to 0.1.**
- In addition to **chemical availability**, sterility of the **final solution**, **stability of a drug** and buffer during aging, **cost of materials**, and **lack of toxicity** are also **important considerations** in selecting a pharmaceutical buffer. For instance, a **borate buffer, being toxic**, cannot be used as a **stabilizer for parenteral** or **oral administration.**
- Determine the **buffer capacity** and pH of the **completed buffered** solution with a **pH meter**. In some cases, pH papers can also be used as a gauge for **determining buffer capacity** and pH. pH can sometimes differ from the **experimental value** when the **electrolyte concentration** is high, especially when using the buffer equation. It is **reasonable** to expect this to occur when the **activity coefficient** is not taken into consideration, and this **emphasizes** the need to perform the **actual determination.**

BUFFERED ISOTONIC SOLUTIONS

- A small amount of blood mixed with various toxicities of aqueous sodium chloride solutions illustrates the need for isotonic solutions when applied to delicate membranes.
  1. **Isotonic** - 0.9 g of NaCl per 100 ml maintains the normal size of cells if blood is added to the solution. Solution and red blood cell contents are essentially the same in terms of salt concentration and osmotic pressure
  2. **Hypertonic** - The red blood cells floating in a NaCl solution of 2.0% are hypertonic by passing through their cell membranes, making an effort to dilute the nearby salt solution. Cells shrink as a result of this outward flow of water and become wrinkled or crenated.
  3. **Hypotonic** - Blood that is mixed with 0.2% NaCl solution or distilled water causes the blood cells to swell and eventually burst, releasing hemoglobin. The concentration of salt in this scenario is understood as being concerning the content of the blood cells. Haemolysis is a term used to describe this process.



MEASUREMENTS OF TONICITY

❖ **HAEMOLYTIC METHOD**

- In this **method**, **RBC's** are **suspended** in various solution and the **appearance of RBC's** is observed for **swelling**, **bursting**, **shrinking and wrinkling of the blood cell.**

❖ **CRYOSCOPIC METHOD**

- **Freezing point depression** property is most widely used.
- Freezing point is **0°c** and when any substance such as **NaCl is added**, the **freezing point decreases.**
- **Freezing point depression**, ΔTf of blood is – **0.52°c.** hence **ΔTf value** of the drug solution must be **0.52°c.**

CALCULATIONS AND METHODS OF ADJUSTING ISOTONICITY

i. CLASS – I METHOD

- **NaCl** or some other substance is **added to the solution** of the drug to **lower the freezing point** of **solution to -0.52° C** and thus make the **isotonic solution.**
- e.g. **Cryoscopic and NaCl equivalent**

✓ **NaCl equivalent method**

- **NaCl equivalent** (E) of a drug is the **amount of NaCl** i.e. equivalent to 1 gm of the drug.
- **PSA = 0.9 –** (PSM × E of medicament)
- **PSA** = percentage strength of medicament
- **PSM** = percentage of NaCl for adjust tonicity

ii. CLASS - II METHOD

- **H_2O is added** to the drug in **sufficient amount** to make it isotonic. Then the **preparation is brought** to its **final volume** with an **isotonic or buffer isotonic solution (0.9%NaCl).**

✓ White Vincent Method

- This method involve addition of H_2O to a given amount of drug. The volume of H_2O that should be added in given amount of the it isotonic solution. It is calculated by using this formula

$$V = W \times E \times 111.1$$

- Where, V = Volume of H_2O needed to make the solution. isotonic.
- W = Given weight.
- E = NaCl equivalent of the drug.

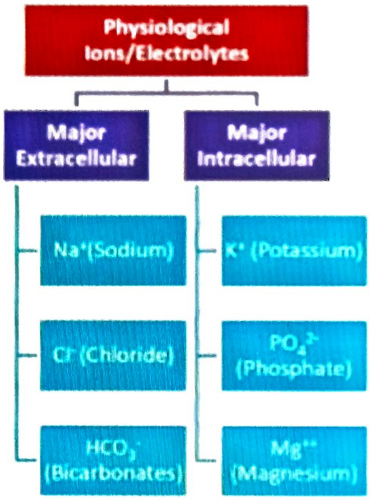
UNIT – II (B) MAJOR EXTRA AND INTRACELLULAR ELECTROLYTES

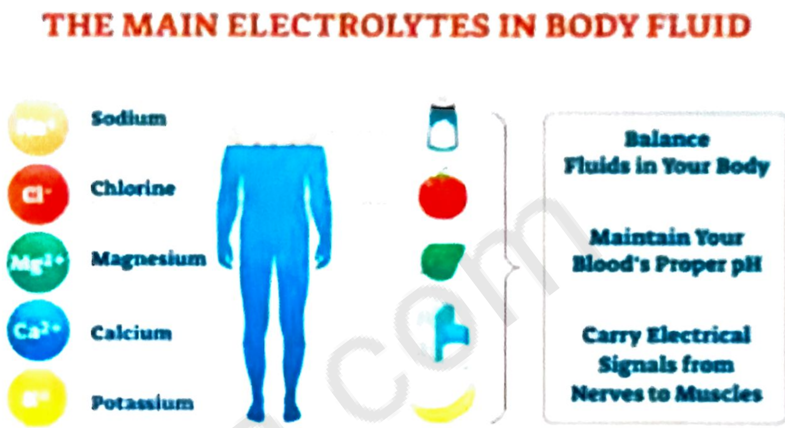
POINTS TO BE COVERED IN THIS TOPIC

- INTRODUCTION
- FUNCTIONS OF MAJOR PHYSIOLOGICAL IONS
- ELECTROLYTES USED IN THE REPLACEMENT THERAPY
- PHYSIOLOGICAL ACID BASE BALANCE

INTRODUCTION

- An **electrolyte** is any substance that **dissociates** into ions in **aqueous solution.**
- Ions can be **positively charged (cations)** or **negatively charged (anions).**
- The **major electrolytes** found in the **human body are:**





FUNCTIONS OF MAJOR PHYSIOLOGICAL IONS

❖ ROLE OF SODIUM

- This **plays a crucial** role in the excitability of **muscles and neurons** . It is also of **crucial importance** in **regulating fluid balance** in the body.
- **Sodium levels** are **extremely closely** regulated by kidney function.
- Major factors that **control the GFR** include the blood pressure at the glomerulus and the stimulation of **renal arteriole** by the **sympathetic nervous system.**

❖ ROLE OF POTASSIUM

- Its **main role** in the body is to help **maintain normal levels** of fluid inside our cells.
- Sodium, its **counterpart, maintains** normal fluid levels outside of cells.
- **Potassium** also helps muscles to **contract and supports** normal blood pressure.

❖ ROLE OF CALCIUM

- It helps form and maintain healthy teeth and bones.
- A proper level of calcium in the body over a lifetime can help prevent osteoporosis.
- Besides transmitting nerve impulses across synapse , calcium is essential for clotting blood and contracting muscles.

❖ ROLE OF PHOSPHATE

- Nucleic acids and high-energy molecules such as ATP require phosphorus for synthesis.
- Furthermore, it contribute to maintaining the pH balance of the body.

❖ ROLE OF MAGNESIUM

- Among the functions of magnesium within cells are to assist sodium-potassium pumps and aid enzymes.
- It has an important role in muscle contraction, conduction of action potentials, and the production of bone and teeth.

❖ ROLE OF CHLORIDE

- Cl- channels reside both in the plasma membrane and in intracellular organelles.
- Their functions range from ion homeostasis to cell volume regulation, transepithelial transport, and regulation of electrical excitability.

❖ ROLE OF BICARBONATE

- It serves as a component of the major buffer system, thereby playing a critical role in pH homeostasis.
- Bicarbonate can also be utilized by a variety of ion transporters, often working in coupled systems, to transport other ions and organic substrates across cell membranes.

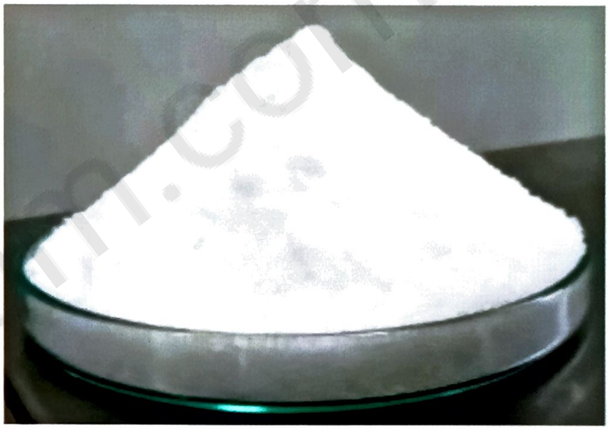
ELECTROLYTES USED IN THE REPLACEMENT THERAPY

1. SODIUM CHLORIDE

- **Molecular formula** - NaCl
- **Molecular weight** - 58.44

❖ PHYSICAL PROPERTIES

- **Appearance** - Sodium chloride is a white crystalline crystal
- **Odour** - Odourless
- **Melting Point** - 801° C (1,474° F)
- **Boiling Point** - 1,413° C (2,575° F)
- **Density** - 2.16 g/cm3



❖ CHEMICAL PROPERTIES

- Freely soluble in **water, glycerine**
- **Nonreactive stable** compounds
- **Saline in taste**

❖ PREPARATION

- Naturally It can be **obtained from Rock salt strata** & **Sea water**. But from these sources it can be obtained in **impure form**. The pure form of salt can be obtained by the **filtration process** & finally the dried form can be collected by **evaporation process.**
- It can also be **prepared in laboratory** in small scale by the **acid- base reaction.**

❖ USES

- It is used **as electrolyte replenisher.**
- Its **0.9% solution** is isotonic (having same osmotic pressure) as blood.
- It is also used as **taste enhancer** in the preparation of dishes.
- It is also used in **Wet dressings & irrigation of body cavities.**

2. Potassium Chloride (Potassium muriate, Potash muriate)

- **Molecular formula-** KCl
- **Molecular weight-** 74.5513 g/mol

❖ PROPERTIES

- Strong **saline taste**
- It is **odorless** and has a **white vitreous crystal** or **colorless appearance**.
- **KCl is highly soluble** in water and a variety of polar solvents, and **insoluble** in many organic solvents.

❖ USES

- It is used as **electrolytes replenisher.**
- **pH buffers**
- Preparation of **fertilizers, explosives, potassium metal** and **potassium hydroxide.**
- In **treatment of hypokalemia** (potassium deficiencydisorder)
- Used in treatment of **digitalis poisoning**
- Used in treatment of **myasthenia gravis**

❖ PREPARATIONS

- In the **laboratory, KCl** can be prepared by reacting bases of **potassium with hydrochloric acid.**
- The ensuing **acid-base neutralization reaction** will yield water and **potassium chloride** as the products.

3. Calcium gluconate

- **Molecular formula** - $C_{12}H_{22}CaO_{14}$
- **Molecular weight** - 430.373 g/mol

❖ PROPERTIES

- **Stable in air.**
- Loses water **at 120 °C.**
- **Calcium gluconate** is decomposed by dilute **mineral acids into gluconic acid** and the calcium salt of the **mineral acid used.**
- It is precipitated from its **aqueous solution** by the **addition of alcohol.**

❖ USES

- **Calcium gluconate** is a medication used to **manage hypocalcemia, cardiac arrest,** and **cardiotoxicity** due to hyperkalemia or hypermagneseia.

❖ PREPARATION

- It is prepared by **boiling a solution** of **gluconic acid** with excess of **calcium carbonate**, **filtering and crystallising** the substance from filtrate.

$$2CH_2(OH)(CHOH)_4COOH + CaCO_3 + CaCO_3 + CO_2 + H_2O$$

4. ORAL REHYDRATION SALT

- **Oral rehydration salt** contain **anhydrous glucose**, **sodium chloride, potassium chloride** and either **sodium bicarbonate or sodium citrate.**
- These **dry preparations** are to be mixed in **specific amounts of water** along with certain **flavouring agents** and a suitable agents for **free flow of powder.**
- These are used for **oral rehydration therapy**. In **ancient times,** homemade ORS is used which constitutes of **one tablespoonful of salt, two tablespoonful of sugar** in **1 litre of water.**
- The following **three formulations** are usually prepared. When glucose is used, **sodium bicarbonate** is packed separately. The quantities given below are preparing **1 litre solution.**

Ingredients	Formula I	Formula II	Formula III
Sodium chloride	1.0 gm	3.5 gm	3.5 gm
Potassium chloride	1.5 gm	1.5 gm	1.5 gm
Sodium bicarbonate	1.5 gm	2.5 gm	_
Sodium citrate	_	_	2.9 gm
Anhydrous glucose	36.4 gm	20.0 gm	20.0 gm
glucose	40.0 gm	22.0 gm	_

PHYSIOLOGICAL ACID BASE BALANCE

- Body fluids are having balanced quantity of acids and bases and this quantity is maintained by intricate mechanism.
- The maintenance of this balance quantity is necessary for biochemical reaction talking places in body, because biochemical reaction are very sensitive to even small change of acids and bases.
- Example: Low pH value in stomach is requiring for functioning of enzyme pepsin which is useful for digestion of food.
- The pH values of certain body fluids are:

Body fluids	pH value
Gastric juice	1.5 – 3.5
Urine	4.5 – 8.0
Saliva	5.4 – 7.5
Bile	6.0 – 8.5
Semen	7.2 – 7.6
Blood	7.4 – 7.5

- Body is having its own buffer system which prevents drastic change in the pH value of blood.
- It also helps to convert strong acids and bases into weak acids or bases.
- Lungs and kidney are the main organ which helps to maintain buffer system in the body.

❖ CONDITIONS WHERE METABOLIC ALKALOSIS OCCURS:

1. **Loss** of chloride ions
2. **Administration of diuretics**
3. Excessive **ingestion of alkaline drugs**
4. **Endocrine disorder**

❖ CONDITIONS WHERE METABOLIC ACIDOSIS OCCURS:

1. **Absorption** of excess metabolic acids
2. **Formation of excessive quantities** of metabolic acids like carbonic acids.
3. Failure to **excrete metabolic acids.**
4. **Loss of base** from body fluids
5. **Diabetes mellitus**
6. **Diarrhoea**
7. **Uremia**
8. **Excess vomiting**

UNIT – II (C) DENTAL PRODUCTS

POINTS TO BE COVERED IN THIS TOPIC

- INTRODUCTION
- ROLE OF SODIUM FLUORIDE
- CALCIUM CARBONATE
- SODIUM FLUORIDE
- ZINC EUGENOL CEMENT

INTRODUCTION

- **Dental products** are those substances which **prevent the dental caries, dental decay** and give the **freshness and cleanness** to the mouth and teeth.
- In market it is mainly available in the **form of toothpaste, tooth powder, mouthwash, tooth gel, dentifrice etc.**

➢ TYPES OF DENTAL PRODUCTS

- **Anticaries agent**
- **Dentifrices**
- **Desensiting agents**
- **Cement and fillers**
- **Abrasive**

❖ ANTICARIES AGENT

- **Dental caries** or **tooth decay** is more or **less a disease** of the **teeth** caused by acids produced by the action of **microorganisms on carbohydrates.**
- Example – **Sodium fluoride , Stannous fluoride**

❖ DENTIFRICES

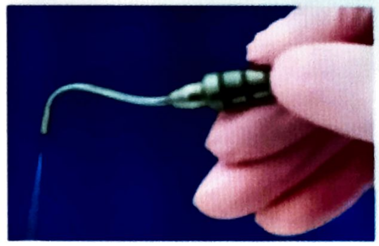
- **Dentifrices** are the substances that are used along with the **toothbrush** for **cleaning and polishing** accessible surfaces of **teeth.**
- These are **generally** in the form of **paste , powder , gel** or **liquid.**
- Examples – **calcium carbonate** , **dibasic calcium phosphate** , **calcium phosphate** , **sodium metaphosphate.**

❖ DESENSITIZING AGENT

- The **desensitizers** tend to **decrease hypersensitivity** of the **teeth** when applied to their **outer surface** , **especially were erosion** has occurred near the **gum line.**
- Example – **Strontium chloride** , **zinc chloride**

❖ CEMENT AND FILLERS

- **Dental cements** are used to **temporarily cover protection** that had **gone operation.**
- It is applied as **paste** which **solidify later.**
- **Eugenol is antiseptic** and act as **local anaesthetic** is used in **cement** as a mediated product.
- **Gold and silver** are used as **permanent filling.**



❖ ABRASIVE

- A **dental abrasive** is an important part of **dental services.**
- This specialty deals with the **finishing and polishing** of **dental appliances** like complete dentures, **removable partial dentures, crown and bridges** and the direct dental **restorative materials.**

ROLE OF SODIUM FLUORIDE

- **Fluoride is anticariogenic** as it replaces the **hydroxyl ion** in **hydroxy apatite** with the fluoride ion to form **fluorapatite** in the outer surface of the enamel.
- It can be administrated by **two routes- Orally and Topically.**
- Fluoride in **low concentration** (1-2 parts per million), if present in **drinking water,** also causes, the **decrease in development** of incidence of caries in the population.
- Fluoride can also be administrated orally as **Sodium Fluoride** tablets or drops added in **water or fruit juice.**
- But it is not beneficial as such. A **2% aqueous solution** of sodium fluoride and **8% solution** of **stannous fluoride** are extensively used for topical application.
- Two such well established **fluorides are Sodium fluoride** and **Stannous fluoride.**

CALCIUM CARBONATE

- **Chemical formula** - $CaCO_3$
- **Molecular weight** – 100.09

❖ METHOD OF PREPARATION

- **Calcium carbonate** is precipitated when **carbon dioxide** is passed through **lime water** or a solution of **sodium carbonate** is added to **calcium chloride** which results into the formation of calcium carbonate.

$$CaCO_3 + CO_2 + H_2O \rightarrow Ca(HCO_3)_2$$

$$CaCl_2 + Na_2CO_3 \rightarrow CaCO_3 + 2\,NaCl$$

❖ PHYSICAL PROPERTIES

- **Calcium carbonate** occurs as a white, **odourless, tasteless, micro crystalline powder** which is stable in air.
- It is practically soluble in **dilute hydrochloric acid** and **nitric acid** but is insoluble in **water and alcohol.**

❖ USES

- It is used **externally as dentrifice**, as a dental cleaning **polishing agent** for most **tooth paste** and **tooth powders.**
- It is used as **insecticides.**
- Due to its **fast action, calcium carbonate** is used as an antacid, as a **calcium supplement** in deficiency states; as **a food additive.**
- It is also used in the preparation of **homoepathic medicine.**

SODIUM FLUORIDE

- **Chemical formula** – NaF
- **Molecular weight** – 41.99

❖ PREPARATION

- It is prepared by **reacting hydrofluoric acid** with **sodium carbonate.**
- **Sodium fluoride** being not very soluble **precipitates out.**

$$2HF + Na_2CO_3 \rightarrow 2NaF + H_2O + CO_2 \uparrow$$

- Alternatively , the **another method involves** the double decomposition of **calcium fluoride with sodium carbonate.**

$$CaF_2 + Na_2CO_3 \rightarrow 2NaF + CaCO_3$$

PROPERTIES

- It occurs as **colourless, odourless crystals** or as **white powder.**
- It is **soluble in water** but is **insoluble in alcohol.**
- On acidification of **salt solution**, **hydrofluoric acid** is produced.
- This is weak acid and is **poisonous.**
- Aqueous solution of salt yields **alkaline solution.**

STORAGE

- Aqueous solution of **Sodium Fluoride** corrodes **ordinary glass bottles** and hence the solution should be prepared in **distilled water** and stored in dark, **pyrex bottles.**

USES

- It is used in the preparation of **dental caries** because of its **fluoride ion concentration.**
- It is a constituent of some **insecticides and rodenticides.**
- It is used in the preparation of a **tooth paste** which constituent about **75 % of sodium fluoride** and **25% of glycerol.**

ZINC EUGENOL CEMENT

COMPOSITION

a. Liquid

- **Eugenol (react with zinc oxide)**
- **Olive oil (plasticizer)**

b. Powder

- **Zinc oxide** (principal ingredient)
- **Zinc stearate** (accelerator, plasticizer)
- **Zinc acetate** (accelerator, improve strength)
- **White rosin** (to reduce brittleness of set cement)

❖ PROPERTIES

- It is the **cement of low strength**, **low abrasive resistance**, and low flow after setting, so it is used for **temporary filling** not be more then few days.
- It has **adhesive effect** on **exposed dentin.**
- It is least irritating than other dental cements.

❖ USES

- It is used as an **impression material** during construction of **complete dentures** and is used in the **mucostatic technique** of taking impressions.