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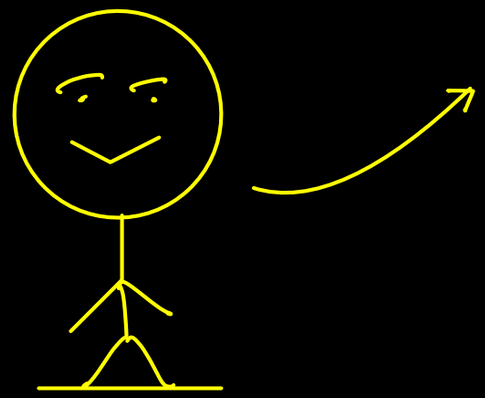
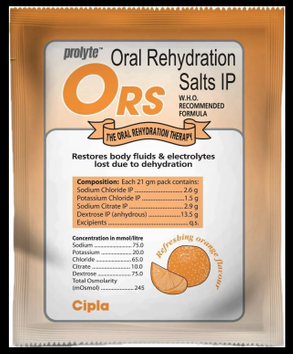
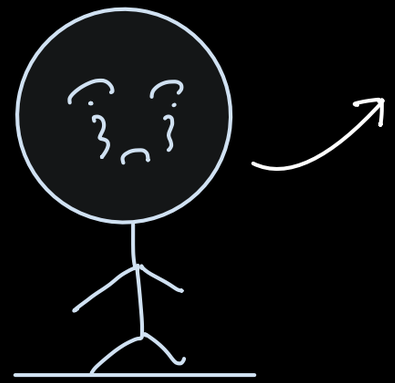
U-2 L-4

Major extra and intracellular electrolytes: Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance.







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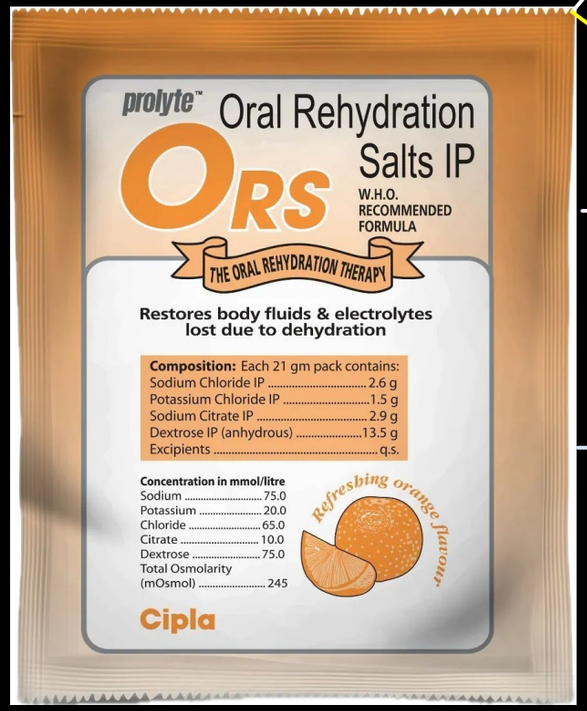
Diarr.

→ Sweating.

→ Vomiting.

→ Lead to Electrolyte Imbalance.



→ Oral Rehydration Salt.

→ Simple, Cost-effective Solution.

→ Consist of a Specific Mixture of Na, K Cl^-, Citrate, Dextrose.

→ Restoring Proper Hydration.

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Oral Rehydration Salts (ORS) is a simple, cost-effective solution used to treat dehydration caused by diarrhea, vomiting, or excessive sweating. It consists of a specific mixture of sodium, potassium, glucose, and other electrolytes in water, designed to rapidly replace lost fluids and electrolytes in the body.

The main goal of ORS is to replace lost fluids and electrolytes in the body, restoring proper hydration and preventing further complications.

Basic Composition of ORS:

Sodium (Na^+):

Typically around 3.5 grams per liter.

Helps to replace the sodium lost during dehydration and is crucial for fluid retention in the body.

Glucose ($C_6H_{12}O_6$):

Glucose → Facilate Na & H_2O Absorption in Intestine.

Usually about 20 grams per liter.

Facilitates the absorption of sodium and water in the intestines. The presence of glucose helps enhance sodium absorption through the sodium-glucose co-transport mechanism.

Potassium (K^+):

Helps replace potassium lost in stools and maintain cellular function.

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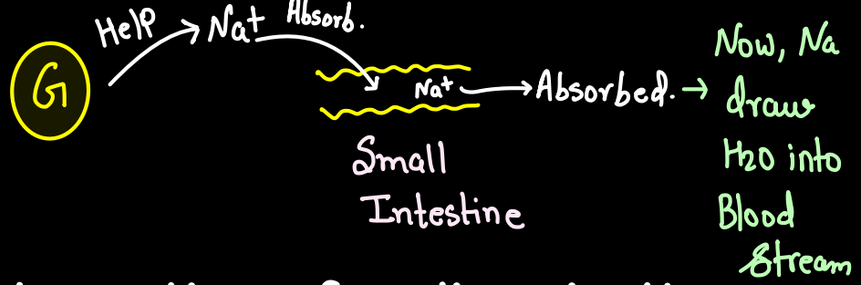
Chloride (Cl^-):

Balances sodium and helps maintain electrical neutrality.

Bicarbonate (HCO_3^-) or Citrate (depending on the formulation):

Helps correct metabolic acidosis (the blood's acidity level due to dehydration) and maintains the pH balance.



How ORS Works:

Fluid Absorption: The presence of glucose in ORS aids in the absorption of sodium in the small intestine via the sodium-glucose co-transport mechanism. When sodium is absorbed, it draws water into the bloodstream, helping to rehydrate the body.

Electrolyte Balance: ORS replenishes essential electrolytes like sodium, potassium, and bicarbonate, helping to restore normal electrolyte levels, which are critical for normal nerve and muscle function.

DEPTH OF BIOLOGY

Acid-Base Balance: The bicarbonate or citrate in ORS helps correct metabolic acidosis by neutralizing excess acid in the blood, thereby preventing or treating a condition known as acidosis.

Indications for Use:

ORS is most commonly used to manage:

Diarrhea: Acute gastroenteritis (often caused by viral, bacterial, or parasitic infections) is a leading cause of dehydration, especially in children.

Vomiting: Vomiting causes fluid loss and can result in dehydration, especially when paired with diarrhea.

Heat-related dehydration: Prolonged exposure to high temperatures, especially in hot climates or during physical exertion, can lead to dehydration.

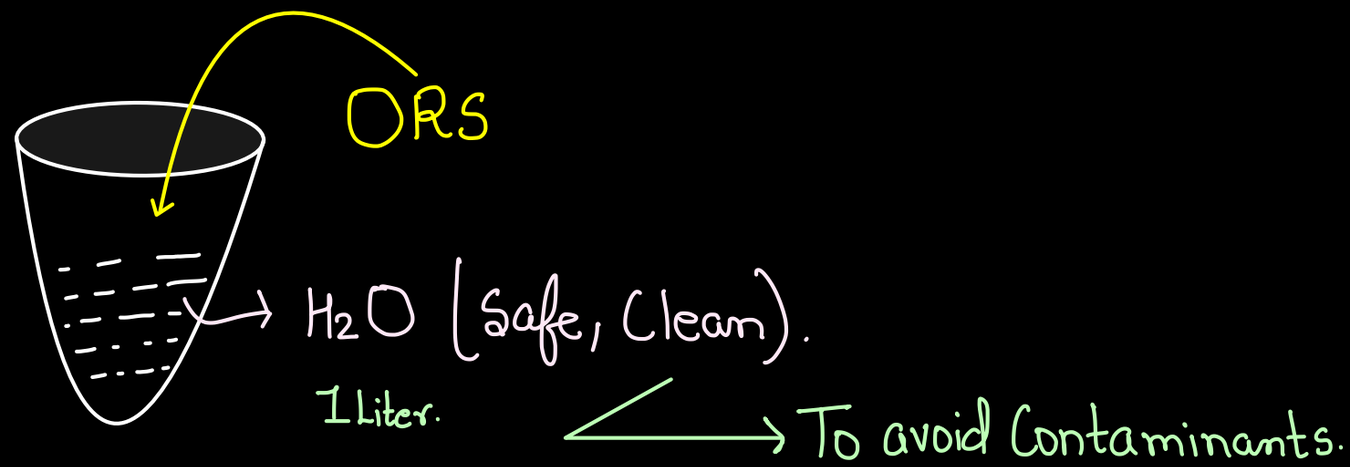
Excessive sweating: Situations like intense exercise or heat exposure can lead to significant fluid and electrolyte loss.

How to Prepare ORS:

Standard ORS Packet: Usually, ORS comes in a powdered form in packets.

Instructions: Mix the contents of one packet with 1 liter of clean water. It is essential to follow the instructions accurately to ensure the correct concentration of electrolytes and glucose.

Water Quality: Always use safe, clean drinking water for preparing ORS to avoid introducing contaminants that could worsen dehydration or cause infection.



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Administration of ORS:

For Children: Give small sips frequently, about 1–2 teaspoons every 1–2 minutes, especially during episodes of diarrhea or vomiting. For infants, use an oral syringe or spoon for controlled amounts.

For Adults: Adults can drink larger amounts, typically 200–400 mL every hour, depending on the severity of dehydration.

Continue use: Continue to offer ORS as long as signs of dehydration persist, and even once vomiting and diarrhea stop, as the body may still need fluid replacement.

DEPTH OF BIOLOGY

Advantages of ORS:

mix half a teaspoon of salt with six teaspoons of sugar in one liter of clean, boiled water, stirring until fully dissolved

Cost-effective: ORS is inexpensive and can be made at home if commercial preparations are unavailable.

Ease of use: It is simple to prepare and administer, requiring no special equipment or medical expertise.

Widely available: It is accessible in pharmacies and through health programs, especially in developing countries where dehydration is a major health concern.

Safe and Effective: The World Health Organization (WHO) and UNICEF endorse ORS as the primary treatment for dehydration from diarrhea and vomiting, and it has saved millions of lives worldwide.

DEPTH OF BIOLOGY

Limitations and Precautions:

Severe dehydration: If the person is severely dehydrated, unconscious, or unable to drink, ORS may not be sufficient, and intravenous (IV) fluids may be required.

Electrolyte Imbalance: ORS is designed to treat mild to moderate dehydration; it is not a cure for all electrolyte imbalances or medical conditions.

No Substitute for Medical Care: ORS is a supportive treatment, not a cure. If symptoms persist or worsen, or if the person shows signs of severe dehydration (such as lethargy, rapid heart rate, or low blood pressure), medical intervention is needed.

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Physiological acid base balance.

Physiological acid-base balance refers to the regulation of hydrogen ion (H^+) concentration in the body to maintain a stable pH

This balance is crucial for the proper functioning of enzymes, cellular processes, and overall metabolic functions.

Examples of Enzymes and Their Optimal pH:

1. Pepsin (found in the stomach):

Optimal pH: 1.5–2

Function: Pepsin is a digestive enzyme that breaks down proteins into peptides. It works best in the acidic environment of the stomach.

2. Salivary Amylase (found in saliva):

Optimal pH: 6.7–7.0

Function: This enzyme breaks down starch into sugars and works best in the neutral pH of the mouth.

3. Trypsin (found in the small intestine):

Optimal pH: 7.5–8.5

Function: Trypsin is a protease that continues the process of protein digestion in the small intestine, and it functions best in the slightly alkaline environment of the small intestine.

Here are the pH ranges of some human body fluids:

- **Blood**: 7.35–7.45
- **Urine**: 4.6–8.0
- **Saliva**: 6.5–7.5
- **Gastric fluid**: 0.5–2.0
- **Muscle cells**: 6.7–6.8
- **Interstitial fluid**: 7.35
- **Intracellular fluid**: Less than 7.0
- **Breast milk**: 7.0–7.45
- **Brain**: 7.1–7.2

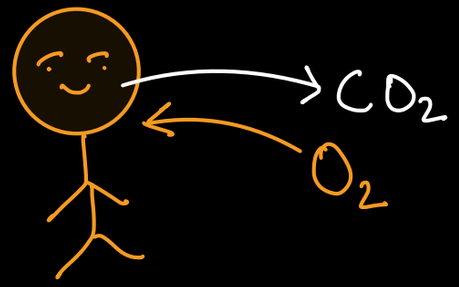
Body has its own buffer system to maintain physiological acid base balance & it prevent drastic change in the ph value of blood.

The mechanism is undertaken by kidney & lungs.

DEPTH OF BIOLOGY

1. **Respiratory Regulation:** The lungs play a role in regulating pH by controlling the levels of carbon dioxide (CO_2), which can combine with water to form carbonic acid. When CO_2 levels rise, the pH drops (acidosis), and CO_2 levels decrease, the pH rises (alkalosis). The body can adjust CO_2 levels through changes in breathing rate and depth.

2. **Renal Regulation:** The **kidneys help regulate pH** by excreting hydrogen ions (H^+) and reabsorbing bicarbonate (HCO_3^-) from urine. <u>This process is slower than respiratory regulation</u> but is vital for long-term pH balance

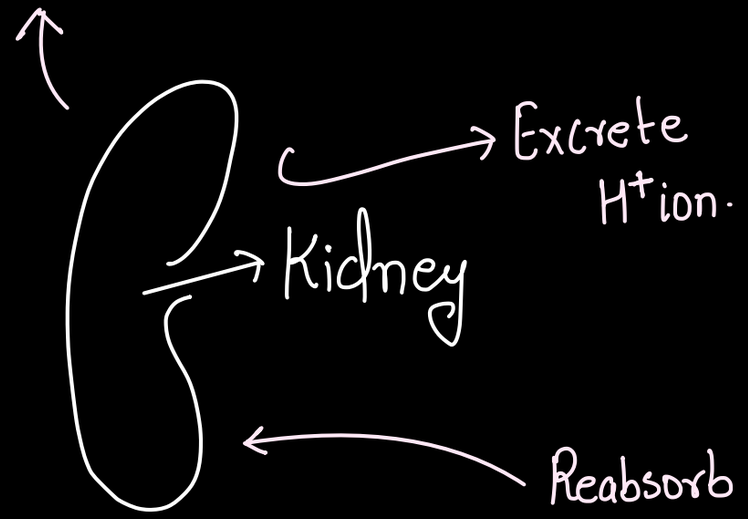


$CO_2 \uparrow \rightarrow$ Acidosis. (pH↓).

$CO_2 \downarrow \rightarrow$ Alkalosis. (pH↑).

$(CO_2 + H_2O \rightarrow H_2CO_3)$.

Carbonic Acid.



DEPTH OF BIOLOGY

Acidosis -occurs when the blood pH drops below the normal range (7.35–7.45), typically falling below 7.35. It can arise from either respiratory or metabolic causes

1. Respiratory Acidosis

Respiratory acidosis is caused by an accumulation of carbon dioxide (CO_2) in the blood, leading to an increase in carbonic acid, which lowers pH. It is typically due to conditions that impair CO_2 removal through the lungs.

$CO_2 \uparrow$ in blood. $\quad CO_2 + H_2O \longrightarrow H_2CO_3$ Carbonic Acid. $\rightarrow$ pH ↓ → May be due to Renal or Respiratory failure

Causes:

Chronic obstructive pulmonary disease (COPD): Chronic lung diseases, like emphysema and chronic bronchitis, limit the ability of the lungs to expel CO_2.

Severe asthma: An acute asthma attack can cause airway obstruction, reducing CO_2 exhalation.

Obesity hypoventilation syndrome: People with obesity may breathe more slowly and shallowly, trapping CO_2.

Central nervous system depression: Conditions that depress the respiratory center in the brain, such as drug overdose (e.g., opioids or sedatives) or head injury, can slow down breathing.

Neuromuscular disorders: Conditions like Guillain-Barré syndrome or myasthenia gravis that weaken the muscles responsible for breathing can impair CO_2 elimination.

2. Metabolic Acidosis

Metabolic acidosis is a condition where the body produces too much acid or the kidneys are unable to excrete enough acid, leading to a decrease in bicarbonate (HCO_3^-), the main buffer in the blood.

Acid↑ ⟶ HCO_3^- ↓.

Causes:

Diabetic ketoacidosis (DKA): In uncontrolled diabetes, especially type 1 diabetes, the body breaks down fats for energy, producing ketones (which are acidic). The accumulation of ketones in the blood leads to acidosis.

DEPTH OF BIOLOGY

Lactic acidosis: This occurs when there is an excess of lactic acid in the blood, often due to conditions like:

Severe hypoxia (e.g., shock, severe anemia, cardiac arrest)
Sepsis (infection-induced widespread inflammation)
Alcohol poisoning or metformin overdose

Renal failure: If the kidneys are unable to excrete hydrogen ions (H^+) and reabsorb bicarbonate, metabolic acidosis can occur, often seen in chronic kidney disease or acute kidney injury.

Diarrhea: Excessive loss of bicarbonate through the gastrointestinal tract (e.g., from severe diarrhea) can lead to acidosis.

Ingestion of acids: Toxic ingestion of substances like methanol, ethylene glycol (antifreeze), or salicylates (aspirin) can result in the accumulation of acids in the body, causing acidosis.

Symptoms of Acidosis:

Symptoms can vary based on the underlying cause but may include:

Rapid, shallow breathing (compensatory hyperventilation)

Fatigue

Confusion

Headache

Nausea or vomiting

Shortness of breath (dyspnea)

Weakness

Alkalosis-

Blood PH raise.

Alkalosis occurs when the blood pH rises above the normal range of 7.35-7.45, typically exceeding 7.45. It can result from either respiratory or metabolic causes.

1. Respiratory Alkalosis-

Respiratory alkalosis occurs when there is excessive loss of carbon dioxide (CO_2) from the body due to rapid or deep breathing, resulting in a reduction of carbonic acid and an increase in pH.

$CO_2 \downarrow \rightsquigarrow$ Due to rapid breathing.

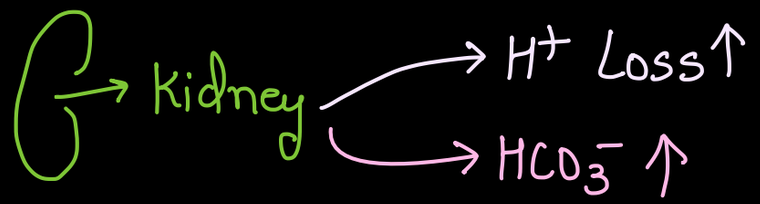
$$CO_2 \downarrow + H_2O \longrightarrow H_2CO_3 \downarrow$$

pH ↑

2. Metabolic Alkalosis

Metabolic alkalosis is caused by an increase in bicarbonate (HCO_3^-) in the blood or a loss of hydrogen ions (H^+), both of which lead to a rise in pH.

Causes:



Vomiting: The loss of gastric acid (hydrochloric acid) due to vomiting or nasogastric suction is a common cause of metabolic alkalosis. The body compensates by retaining bicarbonate.

Excessive use of diuretics: Diuretics, particularly loop diuretics (e.g., furosemide) or thiazide diuretics, can cause excessive loss of potassium (K^+) and hydrogen ions, leading to an increase in bicarbonate concentration.

Antacid or bicarbonate ingestion: Excessive use of antacids or oral sodium bicarbonate can result in an overload of bicarbonate in the body, causing alkalosis.

Renal disease: Conditions such as Bartter syndrome or Gitelman syndrome—inherited disorders affecting kidney salt transport—can lead to metabolic alkalosis due to loss of potassium and chloride, causing an imbalance in acid-base regulation.

DEPTH OF BIOLOGY

Symptoms of alkalosis

- **Confusion**: Can progress to stupor or coma
- **Lightheadedness**: Can feel dizzy
- **Muscle twitching**: Can feel like muscle cramps or spasms
- **Numbness or tingling**: Can feel like tingling in the fingers, toes, and around the lips
- **Nausea and vomiting**: Can be accompanied by loss of stomach acid
- **Hand tremor**: Can feel like tremors in the hands
- **Fatigue**: Can feel tired
- **Irritability**: Can feel irritable
- **Abnormal heart rhythm**: Can feel like an arrhythmia
- **Chest discomfort**: Can feel like shortness of breath