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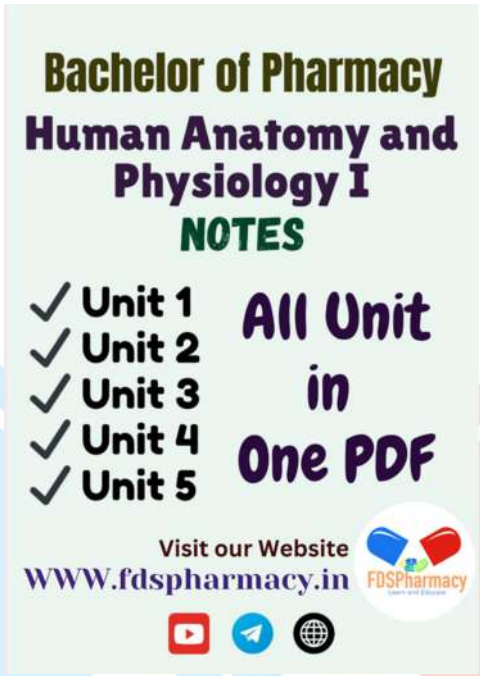
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PHARMACEUTICAL INORGANIC CHEMISTRY

UNIT 4

TOPIC :

- **Poison and Antidote :** Sodium thiosulphate*, Activated charcoal, Sodium nitrite

POISON

- A poison is any substance that, when introduced into the body by any route (oral, inhalation, injection, etc.), causes illness, injury, or death.
- Even a small quantity can be harmful or fatal.
- Poisons can be natural (plant, animal toxins) or synthetic (chemicals, drugs).

Classification of Poisoning

1. **Intentional Poisoning:**
   - Poison is taken or given deliberately to harm or kill.
   - Examples: Suicide, criminal poisoning, drug overdose
2. **Unintentional Poisoning:**
   - Occurs accidentally, often due to lack of knowledge.
   - Examples: Consuming expired medicine, pesticide exposure
3. **Undetermined Poisoning:**
   - The cause of poisoning is unclear or unknown.

Symptoms of Poisoning

- Reduced breathing rate
- Vomiting
- Diarrhoea
- Dilated Pupils
- Decreased Heart Rate

ANTIDOTES

→ Antidotes are the substances that are used to neutralize, counteract, or reverse the toxic effects of a poison in the body.
→ They may act by neutralizing the poison, blocking its absorption, or producing an opposite effect.
→ Antidotes are an essential part of emergency treatment in poisoning cases.

Classification of Antidotes

(Based on Mechanism of Action)

Antidotes are mainly classified into three types:

1. Physiological Antidotes

- Also known as Pharmacological Antidotes or Antagonists
- These antidotes act by producing a physiological effect opposite to that of the poison.
- They do not react chemically with the poison but oppose its action on body systems.

Example

- Sodium nitrite – used in cyanide poisoning, it induces methemoglobinemia to counteract cyanide

2. Chemical Antidotes

- These antidotes act by chemically reacting with the poison and converting it into a non-toxic or less toxic compound.
- They are specific to certain types of poisons.

Example

- Sodium thiosulphate – reacts with cyanide to form thiocyanate, a less toxic compound

3. Mechanical Antidotes

- These antidotes work by physically preventing the absorption of poison from the gastrointestinal tract or skin.
- They do not chemically or physiologically interact with the poison.
- Often used in first aid management.

Example

- Activated charcoal – adsorbs poison in the stomach and prevents its absorption

SODIUM THIOSULPHATE

- Molecular Formula: $Na_2S_2O_3 \cdot 5H_2O$
- Molecular Weight: 248.2 g/mol
- Synonym: Sodium Hyposulphite or Hypo

Method of Preparation

- Sodium thiosulphate is prepared by boiling sodium sulphite (Na_2SO_3) with sulphur (S):

  $Na2SO3 + S \rightarrow Na2S2O3$

Properties

- Occurs as large, colorless crystals
- Odourless
- Has a mild alkaline (slightly bitter) taste
- Soluble in water
- Insoluble in alcohol
- Efflorescent (loses water on exposure to air)

Uses:

- ✓ Antidote in Cyanide Poisoning:
  - Converts cyanide (CN^-) to thiocyanate (SCN^-), a non-toxic compound
  - Usually given with sodium nitrite
- ✓ Treatment of Skin Diseases:
  - Used externally for fungal infections, scabies, etc.
- ✓ In Photography:
  - Acts as a fixer to remove unreacted silver halides
- ✓ Analytical Chemistry:
  - Used in iodometric titrations

ACTIVATED CHARCOAL

- Synonym : Activated Carbon
- Molecular Formula : C (elemental carbon – amorphous)
- Molecular Weight : 12 g/mol

Preparation

Activated charcoal is prepared by:

1. Carbonizing organic materials like wood, coconut shell, sawdust, etc., at high temperature in the absence of air.
2. Then, it is "activated" by treating with steam, carbon dioxide, or acids at high temperatures.
   This process increases its surface area and porosity, enhancing its adsorptive capacity.

Properties

- It is a fine, black, odorless, tasteless, and porous powder.
- Insoluble in water and alcohol
- Has a very large surface area (up to 1000 m^2/g), making it highly adsorptive
- Chemically inert (does not react easily with other substances)
- Non-toxic and safe when administered correctly

Uses

1. As a Mechanical Antidote:
   - It adsorbs poisons and drugs in the GIT and prevents their absorption into the bloodstream
   - Used in oral poisoning cases (e.g. barbiturates, morphine, aspirin overdose)
2. Gastrointestinal Disorders:
   - Used in cases of flatulence, indigestion, and diarrhea
3. Water Purification:
   - Removes impurities, odors, and toxins from drinking water
4. Pharmaceutical and Cosmetic Products:
   - Included in face masks, toothpastes, and soaps for cleansing and detoxifying action

SODIUM NITRITE

- Chemical Formula : $NaNO_2$
- Molecular Weight : 69.00 g/mol
- Synonym: Sodium Nitrosum, Nitrous acid, sodium salt

Preparation

Sodium nitrite is prepared industrially by:

- Reducing sodium nitrate ($NaNO_3$) using lead or starch in the presence of heat:

  $NaNO3+Pb \xrightarrow{heat} NaNO2+PbO$

Or by:

- Absorbing nitrogen oxides ($NO + NO_2$) in a sodium carbonate solution.

Properties

- Appears as a white to slightly yellowish crystalline powder
- Odourless
- Has a saline, slightly bitter taste
- Soluble in water, sparingly soluble in alcohol
- Hygroscopic in nature (absorbs moisture from air)
- Acts as a mild oxidizing agent

Uses

1. As a Chemical Antidote (Cyanide Poisoning):
   - Converts hemoglobin into methemoglobin, which binds to cyanide and neutralizes it, forming non-toxic cyanomethemoglobin.
   - Always used along with Sodium Thiosulphate as part of cyanide antidote kit.
2. Vasodilator:
   - It relaxes smooth muscles of blood vessels, hence lowers blood pressure in certain cases.
3. Preservative in Meat Products:
   - Inhibits growth of Clostridium botulinum (causes botulism).
   - Gives meat its characteristic pink color.