Inorganic Pharmaceutical Chemistry:

Topical Agents

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Introduction

- Skin is the largest organ of the human body, with an average size of 1.7 m^2 in an adult. Using a large portion of the skin as a route of absorption of topical drugs to deliver drugs into the body is not a new concept.
- Agents that are applied on the skin or mucous membranes or in the body cavities have local or systemic effects. For example, creams, ointment, and lotions are applied topically on the skin. Eye drops are instilled directly into the eyes.
- Medication applied in this way is known as topical medication

➢Classes

1. Protectives
2. Antimicrobial and Astringents

Principles of Topical Therapy

- Topical therapy allows direct delivery of drugs to the skin with minimal risk of systemic side effects.
- The effectiveness of topical drugs depends on their ability to penetrate the epidermis. This is influenced by the choice and concentration of a drug, its vehicle or base, and the age and degree of hydration of the skin.
- Substances enter aged skin more easily, but clearance into the circulation is slower because of changes in the dermal matrix and reduced vasculature; thus, the skin may be more susceptible to both beneficial and adverse effects of topical medication.
- The use of emollients to increase skin hydration before the application of topical agents such as **corticosteroids** may increase their penetration fivefold.
- The specific condition and body site to be treated are also important; for example, absorption is greater at flexural sites, and less potent corticosteroids are therefore required.

Protectives

- Protectives are agents that produce their effect by covering the skin or mucous membrane and preventing inflammation at the site of application. Forms a coat or film on the site of application, and prevents contact with harmful causes (bacteria, moisture …etc).

➢Properties of protective agents:

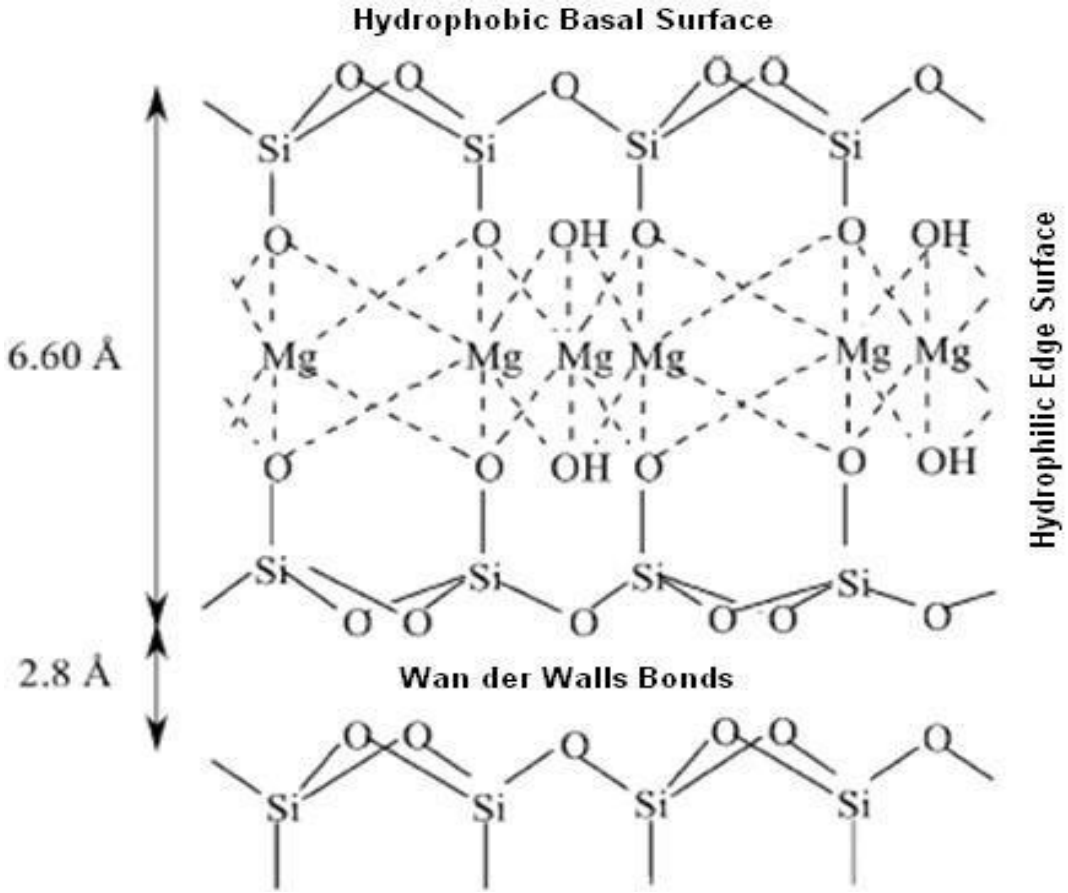
1. Insoluble in water
2. Chemically inert

➢ Protective Products:-

1. Talc

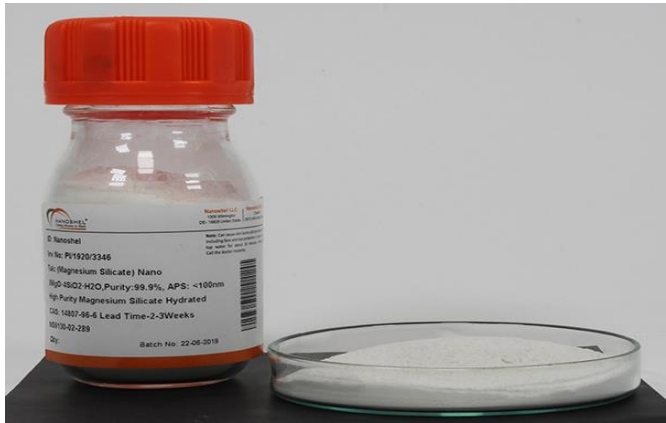
The name talc is believed to be derived from the Arabic word talc or tolk meaning mica. Talc nanoparticles are a hydrous magnesium silicate mineral.

Talcum: M.wt is 379.27 g/mol and Molecular Formula is ($3MgO.4SiO_2.H_2O$).



➢ Uses

It has very low adsorbent properties, which is an important consideration for its use as a filtering aid, allowing filtration without the danger of removing important constituents, e.g., alkaloids, dyes, etc. also used as a lubricant aid, and protecting the skin from irritation due to friction.



2. Titanium dioxide (TiO_2)

- It has a high refractive index, making it useful for screening out ultraviolet radiation, hence, it is present in sunscreen products.

3. Silicon polymer (silicon oil)

- It adheres very well with skin and prevents contact with air thus not applied on broken skin, it is used as a prophylactic against chemical irritation.

4. Zinc oxide ZnO

- It in soluble in water, and alcohol, it reacts with dilute acids and aqueous solution of ammonium compounds to form water-soluble products

➢Uses

- The U.S.P. classifies it as an astringent and topical protective. The antimicrobial-astringent action is due to the release of a small amount of zinc ions from hydrolysis in the acidic moisture on the skin.

$$ZnO + 2HCl \longrightarrow ZnCl_2 + H_2O$$

Antimicrobial and Astringents

- Agents that inhibit or kill the growth of microorganisms e.g. bacteria, fungi, etc.

❑*Classification*

1. **Antiseptic:** agents that prevent infection by killing or inhibiting the growth of microorganisms when applied topically on damaged tissue.
2. **Germicide:** agents kill microorganism as bactericidal, and fungicidal.
3. **Disinfectant:** any agents that kill or inhibit the growth of microorganisms when applied on objects such as equipment, room, etc.
4. **Sterilization:** refers to a disinfectant procedure that involves the use of chemicals or mechanical processes as heat which is much too stringent for use on human tissue.

❖**According to their mechanism of action, they can be classified into three general categories:**

I. Oxidation

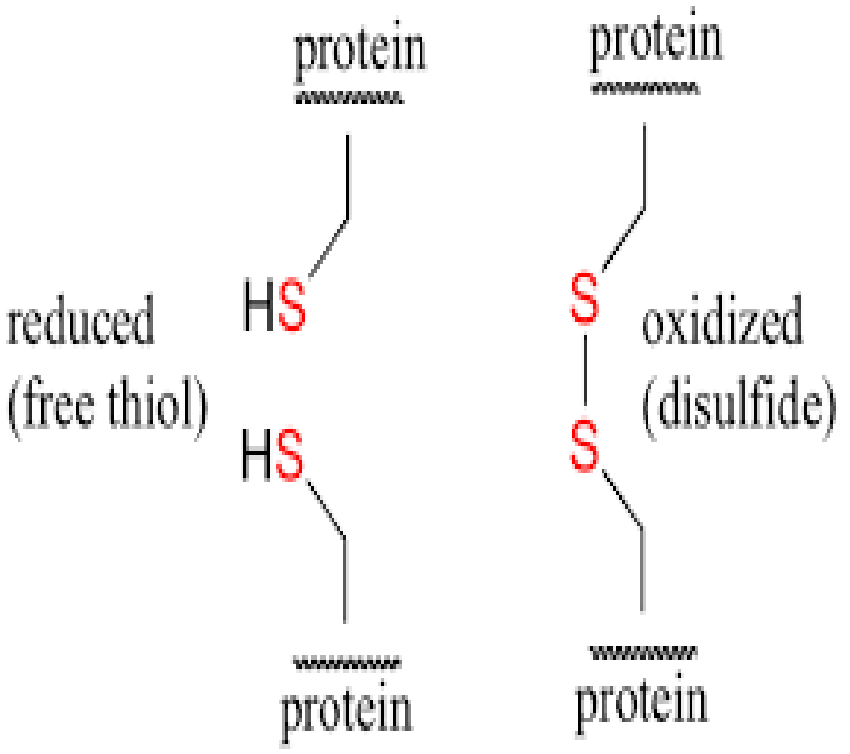
- Those compounds (oxidizing agents) act as antimicrobial agents by liberating oxygen causing oxidation of active function groups such as (the thiol group (-SH)) of the protein enzymes of microorganisms and inactivating them.

Antimicrobial and astringent products:

1. Hydrogen peroxide H_2O_2

✓ Is a mild oxidizing antiseptic (used undiluted on wounds), this action is produced when the solution comes in contact with open or abraded tissue, exposing the chemical to the enzyme, catalase. This enzyme catalyzes the decomposition of H2O2 into water and oxygen.

✓ In theory, the liberated oxygen acts as an oxidizing agent on bacteria, providing antiseptic action, particularly on those organisms obligated to survive through anaerobic metabolism.



- ✓ The official solution containing 3% H_2O_2 is often referred to as a 1 .e.i) noitulos emulov-10ml of solution liberates 10ml of oxygen). In diluted form, it can be used as a mouthwash but continued use may lead to irritation of the mouth.

2. Potassium Permanganate $KMnO_4$

It solution has antibacterial, and antifungal for external used in concentration ranging from (0.2% - 0.006%).

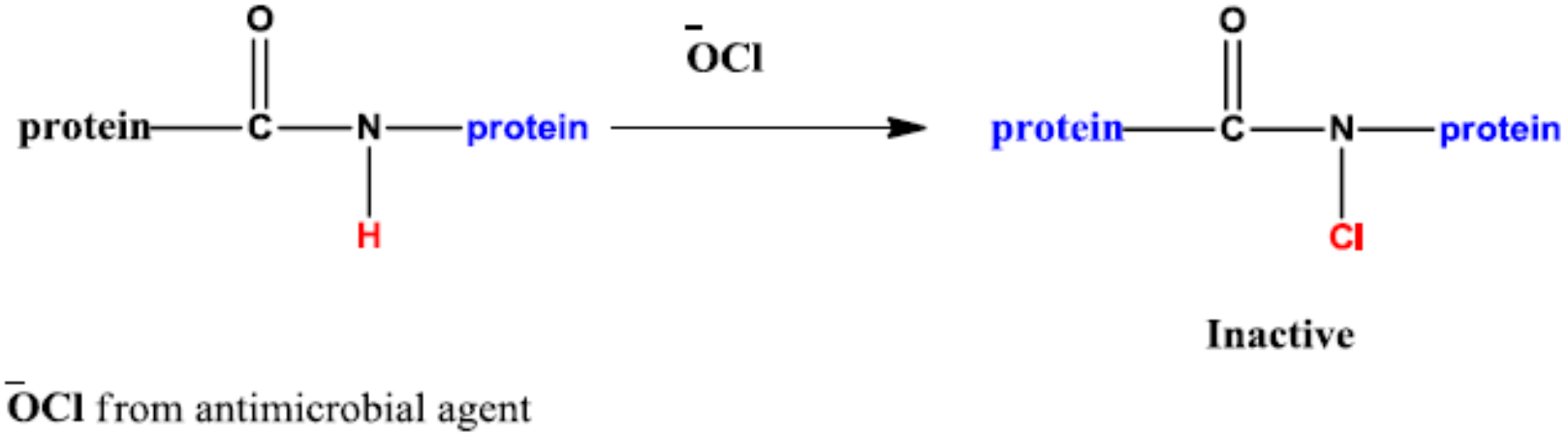
3. Zinc peroxide ZnO_2

4. Sodium perborate $NaBO_3$

5. Iodine tincture , povidone-iodine

II. Halogenations

- It involves destruction to the function of protein because substations of halogen as chlorine atom for the hydrogen (mainly for primary and secondary amide R-C=O-NH_2), cause a conformational change of protein, subsequently inactivating it.



Products:

- **Sodium hypochlorite solution (NaOCl)**

III. Protein precipitation

- ✓This type of mechanism involves the interaction of the protein with metallic ions having large charge\ radius ratios or strong electrostatic fields such as Cu(II), Ag(I), Zn(II), and Al(III). The interaction of metal ions with protein is non-specific, and at sufficient concentration will react with the host as well as microbial protein. This action is usually designated as being astringent.

Products:

- **Silver nitrate $AgNO_3$**