Pharmaceutical and Cosmetic Preparations

3rd Stage

College of Pharmacy

Lecture: 4

Semisolid Dosage Forms

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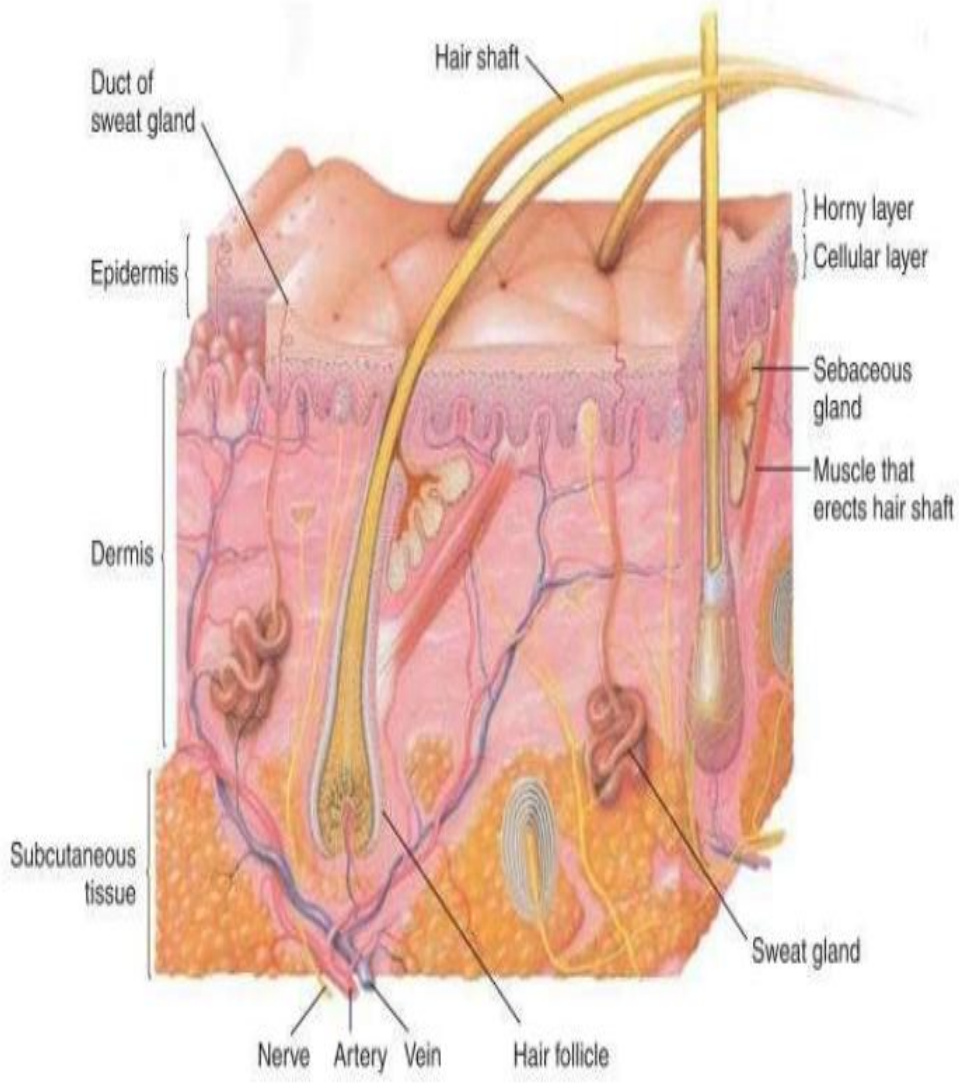
Semisolid Dosage Forms

- **Ointments, creams, and gels** are semisolid dosage forms intended for **topical application**.
  - They may be applied to the skin,
  - Placed on the surface of the eye
  - Or used nasally, vaginally, and rectally.
- Most of these preparations are used for the effects of the therapeutic agents they contain.
- The unmedicated ones are used for their physical effects as protectants or lubricants.
- Topical preparations are used for both **local and systemic** effects.
- **A topical drug (API) dosage** form would be designed to deliver the drug into the **skin** in treating skin disorders, where the **skin** is the target Organ

Systemic effects

- **Skin** consists of **three anatomical layers**: the epidermis, the dermis, and a subcutaneous fat layer.
- **A transdermal** product is designed to deliver drugs through the skin (percutaneous absorption) to the general circulation for systemic effects, with the **skin** not being the target organ.
- **Systemic drug absorption** should always be **considered** when using topical products if the patient is **pregnant or nursing**, because drugs can enter the fetal blood supply and breast milk and be transferred to the fetus or nursing infant.
- Recently, there was an **increase** in the number of topical ointments, creams, and gels designed to **deliver a drug systemically**. This is often accomplished by the addition of **penetration enhancers** to the topical vehicle



- **The rate of drug movement across skin layer depends on:**
  - the drug concentration in the vehicle,
  - Physicochemical properties of the drug substance such as solubility, partition coefficient, pKa, and molecular wight
  - The characteristics of the base or vehicle, hydrophilic– lipophilic character and viscosity
  - Conditions of the skin itself "broken, hydrated other features of the skin.

Ointments

- **Ointments** are semisolid preparations intended for external application to the skin or mucous membranes. Ointments may be medicated or unmedicated.
  - **Unmedicated** ointments are used for the physical effects they provide as protectants, emollients, or lubricants.
- Ointment bases, as described, may be used for their physical effects or as vehicles for medicated ointments.

Ointment Bases

- **Ointment bases** are generally classified by the United States Pharmacopeia (USP) into **four groups** :
  1. **Oleaginous bases**
  2. **Absorption bases**
  3. **Water removable bases**
  4. **Water-soluble bases**

Ideal properties of all ointment bases

1. Stable, Neutral
2. Nonirritating, Non-dehydrating, Non-hygroscopic
3. Compatible with medications
4. Free from objectionable odor and Non-staining

Oleaginous Bases (Hydrocarbon bases)

- **Oleaginous** bases are also termed **Hydrocarbon bases**. On application to the skin:
  1. They have an emollient effect
  2. Protect against the escape of moisture
  3. They are effective as occlusive dressings
  4. Can remain on the skin for long periods without drying out,
     - Because of their **immiscibility with water**, they are difficult to wash off.
     - Water and aqueous preparations may be incorporated, but only in small amounts and with some difficulty.
     - When powdered substances are to be incorporated into hydrocarbon bases, liquid petrolatum (mineral oil) may be used as the levigating agent.
- **Examples**:
  - **Petrolatum "Vaseline,"**
  - **White petrolatum "White Vaseline."**
  - **Yellow ointment**
  - **White ointment**

- **Petrolatum, USP**, is a purified mixture of semisolid hydrocarbons obtained from petroleum. It has a yellow to light amber color. it is also **known** as yellow petrolatum and petroleum jelly. A commercial product is **Vaseline**.
- **White petrolatum, USP**, is a purified mixture of semisolid hydrocarbons obtained from petroleum that has been wholly or nearly decolorized. White petrolatum is also **known** as white petroleum jelly. The commercial product is **White Vaseline**
- **Yellow ointment, USP**, this ointment has the following formula for the preparation of 1,000 g:
  - Yellow wax 50 g
  - Petrolatum 950 g
  - ➢ Yellow wax is purified wax obtained from the honeycomb of the bee
- **White Ointment, USP**. This ointment differs from yellow ointment by substitution of white wax **(bleached and purified yellow wax)** and white petrolatum in the formula.
  - White wax 50 g
  - White Petrolatum 950 g

Absorption Bases

- These bases are of **two** types:

1. those that permit the incorporation of solutions resulting in the formation of w/o emulsion for example, **Hydrophilic petrolatum**.
2. Those that are w/o emulsions that permit the incorporation of additional quantities of aqueous solutions, for example, **lanolin**
    - They are used as **emollients**
    - They are **not easily removed from the skin** by water washing, because the **external phase is oleaginous**
    - They do not provide the degree of occlusion afforded by the oleaginous bases. Examples: **Hydrophilic petrolatum, lanolin, and modified lanolin**

Absorption Bases

- **Hydrophilic Petrolatum, USP**, has the following formula for the preparation of 1000g

  Cholesterol 30 g
  Stearyl alc. 30 g
  White wax 80 g
  White petrolatum 860 g

  - Commercial products, Aquaphor and Aquabase variations of hydrophilic petrolatum, have the capacity to absorb up to three times their weight in water and are useful to help incorporate a water-soluble drug, for example, tobramycin sulfate, into an oleaginous ointment base
- **Lanolin, USP**
  - **Lanolin**, USP (anhydrous lanolin), obtained from the wool of sheep, is a purified waxlike substance that has been cleaned, deodorized, and decolorized.
  - It contains **not more than 0.25% water**.

Water-Removable Bases (Water-washable)

- They are oil-in- water emulsions (o/w) resembling **creams**.
  - Because the **external phase of the emulsion is aqueous**,
    - They are easily washed from skin and are often called water-washable bases.
    - They may be diluted with water or aqueous solutions.
    - They can absorb serous discharges.
- **Hydrophilic Ointment, USP**, is an example of this type of base.
- Hydrophilic Ointment, USP, has the following formula for 1000 g:

Methylparaben	0.25 g
Propylparaben	0.15g
Sodium lauryl sulfate	10 g
Propylene glycol	120g
Stearyl alcohol	250g
White petrolatum	250 g
Purified water	370 g

Water-Soluble Bases (Greaseless)

- These bases **do not contain oleaginous components**.
- They are completely water washable.
- Because they **soften** greatly **with the addition of water**, large amounts of aqueous solutions are not effectively incorporated into these bases.
- Example: **Polyethylene Glycol Ointment NF**
  - The general formula for the preparation of 1,000 g of **PEG ointment** is:

    PEG 335 400 g
    PEG 4000 600 g

Classification and properties of USP ointment bases

Hydrocarbon base	Absorption base	Water removable base	Water soluble base
White petrolatum USP White ointment USP	Hydrophilic petrolatum USP Lanolin USP	Hydrophilic ointment USP	Polyethylene Glycol ointment NF
Hydrocarbons	Anhydrous or W/O emulsion or hydrous	O/W emulsion	Water soluble
Highly occlusive	Moderate to high	Low to moderate	Minimal
Maintain prolonged contact with application site	Allows incorporation of aqueous solutions	Water-washable; may be diluted with water	Water-washable; no water- insoluble residue
Emollient effect	Emollient effect	Allows absorption of serous discharge	

Selection of the appropriate ointment base

- Selection of the base to use in the formulation of an ointment depends on careful assessment of several factors, including the following:
    1. The **release rate** of the drug substance from the base.
    2. **Desirability** of topical or systemic action.
    3. **Desirability of occlusion** of the moisture from the skin.
    4. **Stability of the drug** in the ointment base.
    5. Effect of the **drug** on the **consistency** of the base.
    6. **Water washability** of the base.
    7. **Characteristics** of the **surface** to which it is applied.
- For example, an ointment is generally applied to dry, scaly skin; a cream is applied to weeping or oozing surfaces

Preparation of Ointments

- Depending primarily on the nature of the ingredients, ointments are prepared by two general methods:
  a. Incorporation
  b. Fusion
- **Incorporation method**
  - In this method, the **components** are **mixed** until uniform preparation is attained.
  - On a small scale, the pharmacist may **mix** the **components** using a **mortar** and **pestle**, or a **spatula** may be used to rub the ingredients together **on an ointment slab** (a large glass or porcelain plate or pill tile).
    - If the components of an ointment react with metal (as does iodine), hard rubber or silicone spatulas may be used.
    - The ointment is prepared by thoroughly rubbing and working the components together on the hard surface until the product is smooth and uniform.
    - **Incorporation of solids**. When preparing an ointment by spatulation, the pharmacist works the ointment with a stainless-steel spatula having a long, broad blade and periodically removes the accumulation of ointment on the large spatula with a smaller one.
    - For incorporating a **gummy material**, such as camphor, **pulverization** by **intervention** can be used. The material is dissolved in a solvent and spread out on the pill tile. The solvent is allowed to evaporate, leaving a thin film of the material onto which the other ingredient or ingredients are spread.
    - **Incorporation of liquids**. Liquid substances or solutions of drugs are added to an ointment only after due consideration of the ointment base's capacity to accept the volume required. For example, only very small amounts of an aqueous solution may be incorporated into an oleaginous ointment, whereas hydrophilic ointment bases readily accept aqueous solutions.

Levigation in ointment preparation

- It is often desirable to reduce the particle size of a powder or crystalline material before incorporation into the ointment base so the final product will not be gritty.
- The **reduction in particle size** of the powder be done by levigating, or mixing the solid material in a vehicle in which it is insoluble to make a smooth dispersion. “wet grinding. ”
    - **The levigating agent** like mineral oil or glycerin should be physically and chemically compatible with the drug and the base.
    - The levigating agent is used in an **equal volume** of the solid material.
    - A mortar and pestle are used in levigation.
    - Levigation **allows** both the reduction in particle size and the dispersion of the substance in the vehicle.
    - Solids soluble in a common **solvent** that will affect neither the stability of the drug nor the efficacy of the product may first be dissolved in that solvent (e.g., water or alcohol) and **the solution added** to the **ointment base** by spatulation or in a mortar and pestle.

- **On a large scale**, Ointment or roller mills can be used to force coarsely formed ointments through stainless steel or ceramic rollers to produce ointments uniform in composition and smooth in texture.

Fusion Method

- By this method, **all or some** of the components of an ointment are **combined and melted together** and **cooled with constant stirring** until congealed.
- **Other components** like heat-labile substances and volatile oils are **added after cooling** the mixture to prevent their decomposition and volatilization, respectively.
- Substances may be added to the congealing mixture as solutions or insoluble powders levigated with a portion of the base.
- **On a small scale**, fusion may be done by using a porcelain dish or a glass beaker.
- **On a large scale**, it is carried out in large steam-jacketed kettles.
- After congealing, the ointment may be passed through an ointment mill “large scale”, or rubbed with a spatula or in a mortar “small scale” to ensure uniform texture.
  - Medicated ointments containing components like **beeswax, stearyl alcohol, and high molecular weight PEGs** are best prepared by the **fusion method** rather than the incorporation method.
  - By fusion method, the materials with the highest melting points are heated to the lowest required temperature to produce a melt, then the additional substances are added with constant stirring during cooling the melt until the melt is congealed. In this way, not all components are subjected to the highest temperature.

Compendial requirements for ointments

- Ointments and other semisolid dosage forms must meet USP tests for:
  - Microbial content
  - Minimum fill
  - Packaging, storage, and labeling.

❑ Microbial Content

- Except for ophthalmic preparations, **topical** applications are **not required to be sterile**.
- **Topical preparations** must meet the acceptable standards for microbial contents
- Preparations **that contain water** tend to **support microbial growth** to a greater extent than water-free preparations.
- Dermatological products should be **examined** for the absence of Staphylococcus aureus and Pseudomonas aeruginosa .
- Other products intended for rectal, vaginal, and urethral application should be tested for yeasts and molds.
- **Preparations subjected to microbial growth** must contain **preservatives**.
- Among the antimicrobial preservatives used to inhibit microbial growth in topical preparations are methylparaben, propylparaben, phenols, benzoic acid, sorbic acid, and quaternary ammonium salts.
- **Microbial limit** test is conducted for both raw materials and finished products.

➢ the USP states certain products should be routinely tested for microorganisms because of the way they are used.

Compendial requirements for ointments

❑ Minimum fill

- The USP's **minimum fill test** is used to determine the net weight or volume of the content of the filled containers to ensure proper content compared with the labeled amount.

❑ Packaging, Storage, and Labeling

- Ointments and other semisolid preparations are packaged either in **large-mouth ointment jars** or in **metal or plastic tubes.**
- **Topical dermatologic** products are packaged either in **jars or in tubes**, whereas ophthalmic, nasal, vaginal, and rectal semisolid products are almost always packaged in tubes.
- Ointment **jars** are either clear or opaque glass or plastic.
- The jars and tubes should be compatible and stable with the intended product.
- **Tubes are superior to jars** because they are *lighter in weight, relatively inexpensive, conveniently used, compatible with most formulative ingredients, and provide greater protection against external contamination and environmental conditions*. They are made of aluminum or plastic, sometimes equipped with applicator.
- Semisolid preparations must be **stored** in well-closed containers to protect against contamination and in a cool place to protect against product separation in heat.
- When required, **light-sensitive** preparations are packaged in opaque or light-resistant containers.
- In addition to the usual labeling requirements for pharmaceutical products, the **USP directs** that the labeling for certain ointments and creams include the type of base used (e.g., water soluble or water insoluble).

Ophthalmic ointments

- **Ophthalmic ointments** differ from conventional ointments in that they **must be sterile**.
- In selecting an **ointment base** for an ophthalmic preparation, it must meet several qualities, such as
  - Must not be irritating to the eye
  - Must permit the diffusion of the medicinal substance throughout the secretions bathing the eye
  - Ointment bases used for ophthalmic should have a softening point close to body temperature, both for comfort and for drug release.
    - **Mixtures** of mineral oil and white petrolatum are commonly used as the base in medicated and non-medicated (lubricating) ophthalmic ointments.
    - Usually, the **medicinal agents** are added to an ointment base either as a solution or as a finely micronized powder. The ointment is made uniform and smooth by fine milling
- **Residence time**
  - In general, **ocular ophthalmic drug** penetration is limited by:

1. The **short residence time** on the surface of the eye is due to rapid removal by tearing and other natural mechanisms.
2. The **small surface area of the cornea** for drug absorption,
3. The **cornea's natural resistance to drug penetration**.

- Compared with ophthalmic solutions, **ophthalmic ointments and gels** provide **extended residence time** on the surface of the eye, **increasing** the duration of their surface effects and **bioavailability** for **absorption** into the ocular tissues.
- **Ophthalmic ointments** are cleared from the eye **as slowly as 0.5% per minute**, compared with solutions, which can lose up to 16% of their volume per minute

Ophthalmic ointments

- **Sterility and preservation of ophthalmic ointments**
  - In addition to the quality standards for ointments, **ophthalmic ointments** must meet the USP sterility tests and the test for metal particles in ophthalmic ointment
  - Rendering an **ophthalmic ointment sterile** requires special aseptic techniques and processing.
  - Each **drug**, along **with** other **components**, is **rendered sterile separately**, aseptically weighed, and incorporated in preparing a final product that meets the sterility requirement.
    - ➢ This is done because of difficulty in terminal product sterilization, such as a lack of penetration of steam into the ointment base and instability of components owing to high dry heating.
  - Antimicrobial preservatives such as methylparaben and propylparaben combinations, chlorobutanol, and benzalkonium chloride are used as needed.
  - The USP test for metal particles is microscopic examination of a heat melted ophthalmic ointment.
- **Features and uses of nasal ointments**
  - Among the dosage forms used in the topical treatment of the nasal mucosa are ointments.
  - The nose is a respiratory organ, a passageway for air to the lungs.
  - Its surface is coated with a continuous **thin layer of mucus** produced by subepithelial mucous glands.
  - **Drugs introduced** into the nasal passage are primarily for local effects on the mucous membranes and underlying tissues.
  - Nasal decongestants, such as Levomenthol nasal ointment, antibiotic nasal ointments, Mupirocin and neomycin nasal ointment for Staphylococcal rhinitis

Rectal Ointments

- **Features and uses of rectal preparations**
  - Among the dosage forms used in the topical treatment of anorectal conditions are ointments, gels, creams, and cream- like aerosol foams.
  - Ointments, creams, and gels are used for topical application to the perianal area and for insertion within the anal canal.
  - They largely are largely used to **treat local conditions** of anorectal pruritus, inflammation, and the pain and discomfort associated with hemorrhoids.
  - The drugs include astringents (e.g., zinc oxide), protectants and lubricants (e.g., cocoa butter, lanolin), local anesthetics (e.g., pramoxine HCl), antipruritics, anti-inflammatory agents (e.g., hydrocortisone), and antiepileptics (diazepam).
  - The **rectal route** is used for systemic absorption of therapeutic levels of certain drugs, such as during vomiting when the oral route is unsatisfactory.
  - **The bases** used in anorectal ointments and creams include **combinations** of PEG 300 and 3350, emulsion cream bases using cetyl alcohol and cetyl esters wax, and white petrolatum and mineral oil.
  - When antimicrobial **preservatives** are required, methylparaben, propylparaben, benzyl alcohol, and butylated hydroxyanisole are frequently used

Pastes

- **Pastes** are semisolid preparations intended for application to the skin.
- They generally contain a larger proportion of solid material (such as 25%) than ointments and therefore are stiffer.
- Pastes can be prepared in the same manner as ointments, by direct mixing or the use of heat to soften the base before incorporating the solids, which have been comminuted and sieved.
- However, when a **levigating agent** is to be used to render the powdered component smooth, a **portion of the base is often used** rather than a liquid, which would soften the paste.
- Because of the **stiffness** of pastes, they remain in place after application and are effectively employed to absorb serous secretions.
- Because of their **stiffness** and **impenetrability**, pastes are not suited for application to hairy parts of the body.
- Among the few pastes in use today is zinc oxide paste, which is prepared by mixing 25% each of zinc oxide and starch with white petrolatum.
- The product is very firm and is better able to protect the skin and absorb secretions than zinc oxide ointment

Creams

- Pharmaceutical creams are semisolid preparations containing one or more medicinal agents dissolved or dispersed in either a water-in-oil (w/o) emulsion or an oil-in-water (o/w) emulsion intended for external use.
- Their consistency and rheological properties are based on whether the emulsion is o/w or w/o and on the nature of the solid in the internal phase.
- **Creams** are used topically, rectally, and vaginally.
- Creams are preferred by many patients and physicians because they are easier to spread and remove
- **Example:**
  - Vanishing creams are oil-in-water emulsions (o/w) containing a large percentage of water, stearic acid, and other oleaginous components. They are **named** so because water is evaporating, leaving a thin layer of the stearic acid and other oleaginous components.
- **Preparation of creams**
  - Preparation usually involves separating the formula components into two portions: **lipid and aqueous.**
  - The **lipid portion** contains all water-insoluble components, and the **aqueous portion** contains the water-soluble components.
  - **Both** phases are heated to a temperature above the melting point of the highest melting component. The phases then are then mixed, and the mixture is stirred until it has congealed.
  - **Creams** usually **require** the addition of a preservative(s) unless they are compounded immediately prior to use and intended to be consumed in a relatively short period of time

Gels

- Gels are semi-solid preparations consisting of a single-phase liquid basis gelled by a suitable gelling agent (gelator) .
- Active substance(s) are dissolved or dispersed in the basis (Eur Ph 2019).
- They are three dimensional (3-D) Liquid/Solid colloidal system

Classification of gels

- According to the fluid or liquid entrapped in the 3-D three-dimensional structure
  1. Hydrogel (aqueous, hydroalcoholic)
  2. Organogels (organic liquid or oils) non crystalline, non-greasy, thermoplastic (ethyl cellulose)
  3. Xerogel (aerogel) are gels in which the vehicle has been removed, leaving a polymer network, entrapping air, e.g., polymer films.

Gels

Hydrogels

- Hydrogels are classified as **gels** in which water is entrapped, a gelling agent is highly adsorbent, and it retains large amounts of water and aqueous solutions, have poor thermal and environmental stability, and have poor affinity to hydrophobic compounds
- Gels have a good appearance, usually translucent or transparent.
- Medicated gels may be prepared for administration by various routes, including the skin, and to the mucous membranes of the eye, the nose, the vagina, and the rectum, giving high rates of release of the medicament and rapid absorption.
- Hydrophilic gelling agents used are:
    1. **Synthetic macromolecules**, such as carbomer, polyvinyl alcohol (PVA), povidone PVP, poloxame
    2. **Cellulose derivatives**, such as CMC (Carboxymethylcellulose), HPMC (hydroxypropyl methylcellulose) hydroxypropyl cellulose
    3. **Natural polymers**, such as pectin, sodium alginate, hyaluronic acid, xanthan gum, carrageenan, guar gum, gelatin, and chitosan

Gelation mechanism of hydrophilic polymers

- Pharmaceutical gels are most commonly (but not exclusively) manufactured by dispersing hydrophilic polymers within an appropriate aqueous vehicle.
- When dissolved within an aqueous phase, hydrophilic polymers behave as lyophilic colloids, and their unique physical properties result from the self-association of the dispersed polymer and its interaction with the aqueous medium.
- There are two types of self-association that may be demonstrated by lyophilic colloids:

1. Chemical (irreversible) gel

- The **interaction** between the **polymer chains** is mediated by permanent covalent bonds and is mediated by molecules that cross-link the adjacent chains (termed cross-linkers). Such as (hydroxyethyl methacrylate) crosslinked with (ethylene glycol dimethacrylate)
- These gels exhibit unique physicochemical properties, including:
  - The ability to absorb a considerable mass of aqueous fluid (often 100 times the original mass) whilst still retaining a three-dimensional structure.
  - **Hydrogels** exhibit robust mechanical properties, being **resistant** to fracture following exposure to **stresses** frequently up to 1 kPa. Moreover, hydrogels exhibit **excellent flexibility**.
  - **They do not exhibit flow** when exposed to an applied stress due to the inability of the stress to overcome (destroy) the covalent bonds.

Gelation mechanism of hydrophilic polymers

1. Chemical (irreversible) gel

- Due to this ability to **absorb a large mass of fluid** (whilst retaining their mechanical properties), hydrogels are **clinically used as wound dressings, as lubricious coatings** on urethral catheters and as soft contact lenses.
- In addition, **hydrogels** may be used for the **controlled delivery** of therapeutic agents at the site of implantation.

Gelation mechanism of hydrophilic polymers

2. Physical (reversible gels)

- In this type, the **interactions** between the polymer chains are reversible and are facilitated by weaker bonds, e.g. hydrogen bonding, ionic association or van der Waals interactions. The application of stresses to type 2 gels will end in the temporary destruction of these bonds, thereby enabling the formulation to flow. As a result, **physical gels** are referred to as **pseudoplastic** (shear-thinning) systems.
- Following the removal of stress, the inter macromolecular bonds are reformed, and the viscosity of the formulation returns to its equilibrium value. These types of gel transform when triggered from the liquid sol (colloidal suspension S/L state) to the semisolid gel (L/S state).
- If the change occurs upon application to the body, it is called ***In situ gel***
  a. **Temperature Changes**: Heating or cooling can induce aggregation
     - Heat-set protein gels, gelatin, upon cooling, it will gel.
     - Thermo-reversible hydrogels: Poloxamer, upon increasing the temperature to body temperature, it will gel.
  b. **pH Changes**: Altering pH can affect polymer charge and interactions, causing gelling.
     - Increasing the pH beyond the pKa of the polyacrylic polymer (Carbomer)will induce gelation, e.g., Fucithalmic viscous tears
     - Decreasing the pH below the pKa of Chitosan will induce gelation
  c. **Ionic Interactions**: Adding specific ions (like calcium for gellan gum) can bridge polymer chains, leading to gelation. Also, pectin and sodium alginate will gel upon exposure to divalent ions such as calcium e.g Gaviscon
  d. **Solvent Exchange**: Removing or adding a non-solvent can shift polymer solubility and promote network formation.
  e. **Crystallization/Helices:** Formation of ordered structures, like helices, within the polymer chains (e .g, sodium hyaluronate joint injection)

Gel preparation (Main Procedure)

- Hydrophilic gelling agent is dispersed in water with continuous stirring (at the appropriate temperature for the gelling agent).
- The drug is dissolved in a suitable solvent with the preservatives and other additives. This solution is added to the gelling agent dispersion.
- In addition to the gelling agent and water, gels may be formulated to contain a drug substance, solvents, such as alcohol and/or propylene glycol; antimicrobial preservatives, such as methylparaben propyl paraben; and stabilizers, such as edetate disodium.

Nasal gels

- Another example of Nasal topical preparations is nasal gels, which are very similar to ointments used for local effect: Antihistamine Nasal Gels, Decongestant Nasal Gels, Saline Nasal Gels, Moisturizing Nasal Gels Used for Allergic Rhinitis, Sinusitis , Colds and Flu, Dry Nasal Mucosa and Post- Nasal Drip

Ophthalmic gels

- Ophthalmic gels are used to treat various eye conditions, including dry eyes, eye irritation, and eye lubrication. They must be sterile.

Emulgel

- Emulgel is an emerging topical drug formulation that is becoming increasingly popular due to its advantages over conventional topical preparations.
- **The emulgel** is a **combination of an emulsion and a gel** and thus has a dual release control system.
- Its biggest and most favorable advantage has been the ability to incorporate hydrophobic drugs, thus making it emerge as a more popular choice these days.
- The emulgel is also greaseless, transparent; it can be easily spread and removed, has a long shelf- life, is thixotropic, and is also pleasant looking.

Active Ingredient	Proprietary Product	Gelling Agent	Route and Use
Metronidazole	MetroGel Vaginal	Carbomer 934P	Vaginal: bacterial vaginosis
Clobetasol propionate	Temovate Gel	Carbomer 934P	Dermatologic: antipruritic
Cyanocobalamin	Nascobal	Methylcellulose	Nasal: hematologic
Diclofenac sodium	Voltaren emulgel	Carbomer	Systemic effect (transdermal)