Pharmaceutical ointments and pastes

General description
Pharmaceutical ointments are semisolid systems that are applied externally, primarily to the skin and also to mucous membranes, e.g. the rectum, the vagina/vulva, the eye. Typically, medicated ointments are used for the treatment of infection, inflammation and pruritus. However, non-medicated ointments are commonly used due to their emollient/lubricating properties. Pharmaceutical pastes are generally composed of ointment bases that contain a high concentration (frequently 50% w/w) of dispersed drug. The viscosity of pharmaceutical pastes is greater than that of pharmaceutical ointments.

The formulation of ointments and pastes involves the dispersal or dissolution of the selected therapeutic agent into an ointment base and, therefore, in addition to the physical properties of the dispersed/dissolved drug, the physicochemical properties of the ointment base are fundamental to the clinical and non-clinical performance of this type of dosage form.

Advantages and disadvantages of pharmaceutical ointments, and pastes

Advantages:
- Pharmaceutical ointments may be easily spread on skin, being retained at the site of application as an occlusive layer, thereby preventing moisture loss from the skin.
- Pharmaceutical ointments are associated with lubricating/emollient properties, properties that may be employed to reduce trauma of an affected site upon spreading.
- In general, pharmaceutical ointments persist at the site of application, enabling the duration of drug release to be greater than for many other topical dosage forms. The increased viscosity of pharmaceutical pastes ensures that a thick film of the dosage form is applied to the site of action, which shows excellent persistence. This property is particularly useful if protection of an inflamed site is required, e.g. in eczema, psoriasis.
- Due to the high solids content, pharmaceutical pastes are often porous, allowing moisture
loss from the applied site. Furthermore, pastes may act to absorb moisture and chemicals within the exudates.

- The opaque nature of pastes (due to the high solids content) enables this formulation to be used as a sunblock.
- The chemical stability of therapeutic agents that are prone to hydrolysis will be dramatically enhanced by formulation within pharmaceutical ointments and pastes.

**Disadvantages:**

- Pharmaceutical ointments are generally greasy and difficult to remove (and are therefore often cosmetically unacceptable).
- Staining of clothes is often associated with the use of pharmaceutical pastes and ointments.
- The viscosity of pharmaceutical ointments, and in particular pastes, may be problematic in ensuring spreading of the dosage form over the affected site.
- Pharmaceutical ointments may not be applied to exuding sites (however, please note that this does not hold for pastes).
- Problems concerning drug release from pharmaceutical ointments may occur if the drug has limited solubility in the ointment base.
- Pharmaceutical pastes are generally not applied to the hair due to difficulties associated with removal.

**The choice of ointment base** is dependent on several factors, including: (1) the site of application; (2) the required rate of drug release; (3) the chemical stability of the drug; and (4) the effect of the therapeutic agent on formulation viscosity.

1) The site of application

In certain clinical conditions the site to which the ointment will be applied may be dry, e.g. psoriasis, or moist. If the area is dry, ointments are often used to occlude the site, thereby retaining moisture. Indeed, this effect is considered to play an important role in the treatment of certain clinical conditions. Conversely, occlusive ointment bases are not applied to sites in which there is fluid exudate.
2) The required rate of drug release
Following application, the therapeutic agent must be released to exert its pharmacological effect, either locally or, after absorption, systemically. Drug release from the ointment base requires solubility (albeit partial) of the therapeutic agent within the formulation. This will allow diffusion of the therapeutic agent (a molecular process) through the ointment base until it reaches the biological substrate. Therefore the choice of the ointment base is partially dictated by the physicochemical properties (and in particular the solubility) of the therapeutic agent.

3) The chemical stability of the drug
If a therapeutic agent is prone to hydrolysis, incorporation into a water-based formulation, e.g. O/W creams, may lead to drug degradation and hence a shortened shelf-life. This problem may be obviated by incorporating the drug into a hydrophobic ointment base. For example, the shelf-life of hydrocortisone is markedly greater in an ointment formulation than in O/W cream formulation.

4) The effect of the therapeutic agent on formulation viscosity
The effect of the physical incorporation of a therapeutic agent into an ointment base on the rheological properties of the formulated product will be dependent on the required drug concentration, the physical properties of the therapeutic agent (e.g. particle size, shape) and the chemical composition and viscosity of the ointment base. Therefore, it is important that an ointment base is selected that will produce a product that may be readily applied to the required site. In light of the high drug content, this point is particularly important in the formulation of pastes.

**Types of base for ointments and pastes**
There are four types of base that are used to formulate pharmaceutical ointments and pastes: (1) hydrocarbon; (2) absorption; (3) water-miscible/removable; and (4) water-soluble.
1-Hydrocarbon Bases (Oleaginous bases):
• They are water-free, and aqueous preparations may be incorporated into them only in small amounts.
• They are used chiefly for their emollient effect because they are retained on the skin for prolonged periods; do not permit the escape of moisture from the skin to the atmosphere.
• As such they act as occlusive dressings.

A-Petrolatum (Yellow Petrolatum, Vaseline)
• Petrolatum is a mixture of semi-solid hydrocarbons obtained from petroleum.
• Petrolatum is varying in color from yellowish to light amber.
• It melts at temperatures between 38° and 60°C.
• It may be used alone or in combination with other agents as an ointment base.

B-White Petrolatum (White Vaseline)
• It is petrolatum that has been decolorized; it differs only in this respect to petrolatum and is used for the same purpose.
• White petrolatum is more acceptable to a patient than petrolatum.

C-Yellow Ointment (Simple Ointment)
Each 100g of Yellow Ointment contains 5 gm of yellow wax and 95gm of petrolatum.

D-Mineral Oil (Liquid Petrolatum)
• It is a mixture of liquid hydrocarbons obtained from petroleum.
• It is useful as a levigating substance to wet and to incorporate solid substances, e.g., salicylic acid, zinc oxide, into the preparation of ointments that consist of oleaginous bases as their vehicle.
2-Absorption Bases:

-Absorption bases may be of two types:

(1) Those that permit the incorporation of aqueous solutions, resulting in the formation of W/O emulsions (ex. Hydrophilic Petrolatum and Anhydrous Lanolin).

(2) Those that are already W/O emulsions (emulsion bases) and permit the incorporation of small, additional quantities of aqueous solutions (ex. Lanolin and Cold Cream).

-These bases are useful as emollients—although they do not provide the degree of occlusive afforded by the oleaginous bases. On the other hand, they are also useful pharmaceutically to incorporate aqueous solutions of drugs, e.g., sodium sulfacetamide, into oleaginous bases.

(1) a- Hydrophilic Petrolatum

-It is composed of cholesterol, stearyl alcohol, white wax, and white petrolatum.
-It has the ability to absorb water, with the formation of W/O emulsion.

(1) b- Anhydrous Lanolin

-Anhydrous Lanolin is insoluble in water, but mixes without separation with about twice its weight of water.
-The incorporation of water results in the formation of a W/O emulsion.
-Although its rancid odor is offensive, this base finds particular use as a vehicle for the application of compound tincture of benzoin and sucrose to treat bedsores.

(2) a- Lanolin

-Lanolin is a semisolid, fat-like substance obtained from the wool of sheep. It is a W/O emulsion that contains between 25 and 30 % water. Additional water may be incorporated into lanolin by mixing.

(2) b- Cold Cream

-It is a semisolid, white, W/O emulsion prepared with Cetyl esters wax, white wax, mineral oil, sodium borate, and purified water.
-The sodium borate combines with the free fatty acids present in the waxes to form sodium soaps that act as the emulsifiers and makes the W/O emulsion stable.
-Cold Cream is employed as an emollient and ointment base.
3- Water-miscible/removable Bases:

- They are O/W emulsions that are capable of being washed from skin or clothing with water.
- These bases, which resemble creams in appearance, may be diluted with water or with aqueous solutions.
- From a therapeutic viewpoint, they have the ability to absorb serous discharges in dermatologic conditions.
- Certain medicinal agents may be better absorbed by the skin when present in a base of this type than in other types of bases.

- Hydrophilic Ointment

  - It contains sodium lauryl sulphate as the emulsifying agent, with stearyl alcohol and white petrolatum representing the oleaginous phase of the emulsion and propylene glycol and water representing the aqueous phase.
  - Methyl paraben and propyl paraben are used to preserve the ointment against microbial growth.

4- Water-soluble Bases:

- Unlike, water-removable bases, which contain both water-soluble and water-insoluble components, water soluble bases contain only water-soluble components.
- They are commonly referred to as "greaseless" because of the absence of any oleaginous materials.
- Because they soften greatly with the addition of water, aqueous solutions are not effectively incorporated into these bases, thus, they are better used for the incorporation of non-aqueous or solid substances.
- They are prepared by blending macrogols (poly ethylene glycol (PEG)) of high and low molecular weights.