

Chapter 4: Solutions, Suspensions, and Emulsions for Oral, Parenteral, and Ophthalmic Administration

1. Solution:



A medicinal solution is a liquid dosage form in which at least one active ingredient is dissolved in a solvent such as water or ethanol. It can be administered by various routes, such as orally (often with a dosing unit), by injection, or by topical application, and is used to treat various ailments with a variety of medications.

Characteristics and Uses

- **Composition:** An active ingredient is dissolved in a solvent, such as water, ethanol, or glycerol.
- **Form:** Liquid; it can be oral, injectable, or for external use.
- **Administration:**
 - o **Oral:** Diluted in water or taken undiluted, using a syringe or a calibrated dosing spoon.
 - o **Injectable:** Administered by injection.
 - o **Cutaneous/Transdermal:** Applied to the skin.
 - o **Other:** Via mucous membranes.
- **Examples:** Solutions can be syrups, drops, injectable solutions (e.g., for diabetics), or solutions for cutaneous application.

Types of Drug Solutions

- Oral Solutions: Designed to be swallowed, these are often used for medications that cannot be administered in tablet form.
- Injectable Solutions: Prepared for injection into the body, these are often used for rapid treatment or for individuals who cannot take medication orally.
- Dermal/Transdermal Solutions: Applied to the skin for local action or for systemic absorption through the skin.

- PREPARING DRUG SOLUTIONS:

Preparing a drug solution involves several key steps, including adhering to hygiene and safety rules, verifying the prescription's accuracy, reconstituting or mixing the medication with the appropriate solvents, and correctly identifying the final product. It is essential to wash your hands, use a clean workspace, and check the integrity and expiration dates of the products before beginning.

Preparation Steps

1. Preparation and Hygiene

- Wash your hands thoroughly with soap or use an alcohol-based hand sanitizer.
- Ensure you are in a clean and quiet workspace, ideally a dedicated and well-lit area.
- Prepare the necessary equipment (syringes, needles, gauze, etc.) and clean or disinfect it as needed.

2. Prescription Verification

- Verify that the patient's identity, the medication name, the dosage, and the medical prescription match.
- Check the expiration date and the integrity of the medication packaging.

3. Preparing the Solution

- For lyophilized (powder) forms:
 - o Disinfect the bottle stopper and the ampoule containing the solvent (often purified water).
 - o Break the ampoule, connect it to a syringe, and withdraw the required amount of solvent, making sure to expel any air.

o Inject the solvent into the powder vial, allow the medication to dissolve, and then draw it back into the syringe.

- For oral solutions:

o Use the appropriate measuring device (spoon, graduated syringe) to measure the prescribed dose.

o If necessary, you can add flavorings or preservatives.

4. Identification and Administration

- Label the preparation with the name of the medication, the dosage, the patient's name, and the date and time of preparation.

- Administer the medication as soon as possible, ideally immediately after preparation.

- Dispose of waste properly (needles in a sharps container, gauze and packaging in the appropriate bins).

- Disinfect your hands after administering the medication.

2. Suspension:



A medication suspension is a liquid formulation in which small solid particles of medication are dispersed in a liquid, but not dissolved. It is a common form for oral medications, particularly for children, and must always be shaken well before each use to ensure correct dosing. A medication

suspension can also refer to an administrative decision to temporarily prohibit its sale or dispensing for safety reasons.

Composition and Properties

- **Heterogeneous System:** This consists of two distinct phases: a solid phase (the medication) dispersed in a liquid phase (the solvent).
- **Particle Size:** The solid particles are generally very fine, ranging from a few micrometers to fifty micrometers.
- **Sedimentation:** Over time, the solid particles tend to settle at the bottom of the bottle.
- **Action Required:** To homogenize the mixture and ensure the correct dose is administered, it is essential to shake the suspension vigorously before each administration.

Types and Uses

- **Oral Suspensions:** This is a very common form, particularly for antibiotics intended for children, as it facilitates swallowing.

Powder for suspension: Some medications are sold as a dry powder that must be reconstituted with water at the time of use, which improves their stability and shelf life.

- **Other forms:** Suspensions can be used for external applications (lotions, eye drops) or parenteral administration, but they are primarily used orally.

Administrative suspension

- An administrative suspension is a temporary measure taken by health authorities (such as the ANSM in France) that prohibits a medication from being placed on the market.
- This decision may be due to a quality or safety issue, or to missing data.
- It may concern a specific batch or the entire product.

- Preparing a drug suspension:

Preparing a drug suspension involves dispersing a solid, insoluble active ingredient in a liquid, following several steps: grinding and sieving the solid if necessary, gradually adding the liquid while

vigorously stirring to wet the particles, and then adding suspending agents (such as thickeners) to ensure stability. Once the mixture is homogenized, the medication can be administered after the suspension has been shaken before each use.

General steps for preparing a drug suspension:

1. Preparation of ingredients:

- Grind and sieve the solid active ingredient, if necessary.
- Prepare the suspension liquid (usually cooled boiled water).
- Prepare the excipients (thickening agents, sweeteners, etc.).

Dispersion and homogenization:

- Gradually add the liquid to the solid while stirring vigorously (or using a high-energy mill on an industrial scale).
- Incorporate the suspending agents (e.g., gum arabic) to help stabilize the mixture.
- Continue stirring until a homogeneous suspension is obtained, free of lumps or undispersed particles.

Stability and administration:

- Allow the suspension to stand for a while to eliminate air bubbles.
- Ensure that particles are easily redispersed by shaking the bottle before each use.
- Check that the suspension has an appropriate viscosity, which allows it to flow and reduces rapid sedimentation.

Key points:

- A suspension is a solution where solid particles are dispersed in a liquid, as opposed to a solution where the solid is completely dissolved.
- The preparation may vary depending on the type of medication and the volume to be prepared, but the general principle remains the same.
- It is important to follow the specific instructions of your doctor or pharmacist when preparing medications in suspension, as they may include steps or ingredients specific to your situation.

3. Emulsions:



A medicated emulsion is a liquid or semi-solid preparation in which an active ingredient is dispersed as small droplets in another immiscible liquid, such as oil and water. These medications are often used for topical applications such as burns (Biafine) or fungal infections (Econazole), or for systemic administration by infusion, as in the case of Omegaven. Emulsion formulation can improve the stability, efficacy, or tolerability of a medication.

Common examples of medications in emulsion form:

- Biafine Emulsion: Used for superficial burns, sunburn, and non-infected wounds.
- Econazole Emulsion: An antifungal used to treat fungal skin infections.
- Locoid Fluid Emulsion: A corticosteroid used to treat certain skin conditions such as eczema or psoriasis, particularly suitable for hairy or sweaty areas.
- Ascabiol: Used to treat scabies and thrombotic disorders.
- Omegaven: An emulsion for infusion that delivers omega-3 fatty acids into the bloodstream.

Understanding the Nature of a Medicated Emulsion

- Composition: Emulsions are composed of two liquid phases that do not mix, such as oil and water.

- **Role of Emulsifying Agents:** Surfactants are added to stabilize the mixture and prevent the phases from separating.
- **Type:** Emulsions are classified as either oil-in-water (O/W), where the oil phase is dispersed within the aqueous phase, or water-in-oil (W/O), where the opposite is true.
- **Use:** Some emulsions are intended for topical application to the skin, while others are designed for intravenous administration.

4. Dry emulsion:

The term "dry emulsion" can refer to a technological emulsion (a powder or granule that releases a liquid emulsion upon hydration by adding water) or to a cosmetic product (a light emulsion for oily or combination skin). In the first case, it is a technical formulation that protects sensitive active ingredients and improves stability. In the second, it is a skincare product with a light texture and a matte finish to prevent shine.

Technological Dry Emulsions

- **Definition:** This is a solid-state emulsion (powder or granules) where oil droplets are encapsulated in a polymer matrix.
- **Principle:** Drying removes the water, creating a stable powder. Rehydration regenerates the liquid emulsion.
- **Econazole Emulsion:** An antifungal used to treat fungal skin infections.
- **Locoid Fluid Emulsion:** A corticosteroid used to treat certain skin conditions such as eczema or psoriasis, particularly suitable for hairy or sweaty areas.
- **Ascabiol:** Used to treat scabies and thrombotic disorders.
- **Omegaven:** An emulsion for infusion that delivers omega-3 fatty acids into the bloodstream.

Advantages: Improves the stability of formulations and protects water-sensitive active molecules.

- **Applications:** Used in various sectors such as pharmaceuticals and food.

Preparation of a dry emulsion:

To prepare a dry emulsion, drying methods, such as freeze-drying, are used to stabilize a liquid emulsion, which is initially prepared by mixing immiscible liquids (such as oil and water) with an emulsifier. The general steps include phase mixing, the addition of an emulsifier, and then the drying process.

For manufacturing, the steps vary depending on the product and scale.

a. Preparation of the liquid emulsion

- Phase mixing: Vigorously mix and shake the two immiscible liquids (often oil and water) to disperse one phase into the other.
- Adding an emulsifier: Add an emulsifier (such as lecithin, soap, or a protein) to stabilize the mixture and prevent phase separation.

Mixing Methods:

- o Laboratory/Small Scale: Use a mortar and pestle, or a mechanical mixer.
- o Industrial Scale: Use large mixing tanks with high-speed turbines or homogenizers.
- o In the Kitchen: Drizzle in the oil while vigorously whisking the other phase (e.g., vinegar and seasonings).
- Controlled Addition: Add the dispersed phase to the continuous phase at a controlled rate for better dispersion.

b. Drying to Obtain the Dry Emulsion

- Freezing and Drying (Freeze-Drying): For heat-sensitive products, freeze the liquid emulsion, then subject it to vacuum drying.

Regeneration: The freeze-dried product can be regenerated by simply adding water to return to its original state.

- Other methods: Other drying methods can be used depending on the desired final product.