Chapter- 3

Dosage Forms

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ABSTRACT

Dosage forms are the means by which drug molecules are delivered to sites of action within the body. They are essential for ensuring the safe, effective, and controlled delivery of medication to achieve the desired therapeutic effect. The introduction to dosage forms encompasses a wide range of formulations designed to meet various medical needs and patient preferences. Dosage forms are broadly classified based on their physical state and route of administration. The primary classifications include solid, liquid, and semi-solid forms. Solid dosage forms include tablets, capsules, powders, and granules, which are known for their stability and convenience. Liquid dosage forms such as solutions, suspensions, and emulsions are often used for patients who have difficulty swallowing solids, providing flexibility in dosing. Semi-solid forms, including creams, ointments, and gels, are typically used for topical applications to deliver medication directly to the skin or mucous membranes. Additionally, specialized forms like aerosols and transdermal patches offer unique delivery mechanisms. Definitions of dosage forms are crucial for understanding their applications and characteristics. Tablets are solid dosage forms containing medicinal substances with or without suitable diluents. Capsules are solid forms in which the drug is enclosed within a soluble container or shell. Solutions are liquid preparations containing one or more dissolved substances. Suspensions are liquid forms containing finely divided, undissolved drug particles dispersed throughout a liquid medium. Creams are semi-solid emulsions used for external application to the skin. Ointments are semi-solid preparations intended for external application with the drug incorporated into a suitable base. Each dosage form is designed to optimize drug delivery, stability, and patient compliance, ensuring effective treatment outcomes.

3.1 Introduction

Dosage forms refer to the physical form in which a drug is administered to a patient. They are crucial in ensuring the proper delivery, effectiveness, and safety of a medication. Here's a detailed look at various dosage forms:

1. Solid Dosage Forms

a. **Tablets**: Solid dosage forms that can be swallowed. They are made by compressing drug powders into a solid shape. Tablets can be coated or uncoated, and they can have

various release mechanisms, such as immediate-release, sustained-release, or controlled-release.

b. **Capsules**: These consist of a gelatin shell containing the drug in powder, granule, or liquid form. Capsules can be hard or soft, and like tablets, they can be designed for different release profiles.
c. **Powders**: Finely ground drug substances that are intended to be mixed with liquids or used directly. They can be used for oral, topical, or inhalational purposes.
d. **Granules**: Similar to powders but coarser. They are often used in oral dosage forms and can be mixed with liquids before administration.
e. **Lozenges and Troches**: Solid forms intended to dissolve in the mouth, releasing the drug slowly. They are used for local action in the mouth or throat or for systemic absorption through the mucous membranes.

2. Liquid Dosage Forms

a. **Solutions**: Homogeneous mixtures of a drug dissolved in a liquid solvent. They can be oral, topical, or injectable.
b. **Suspensions**: Systems where the drug is dispersed in a liquid but not dissolved. The drug particles are suspended and must be shaken before use to ensure uniform dosing.
c. **Emulsions**: Mixtures of two immiscible liquids (e.g., oil and water) with a drug dissolved in one of them. Emulsions are used for oral, topical, or injectable applications.
d. **Syrups**: Sweetened liquid preparations containing the drug, usually intended for oral administration. They often have added flavors and are used to mask the taste of the drug.
e. **Elixirs**: Clear, sweetened hydroalcoholic solutions containing the drug. They are used for oral administration and can dissolve both water-soluble and alcohol-soluble drugs.

3. Semisolid Dosage Forms

a. **Ointments**: Greasy or emollient preparations used for topical application. They are used to provide a barrier or to deliver drugs to the skin or mucous membranes.
b. **Creams**: Oil-in-water or water-in-oil emulsions used for topical application. They are less greasy than ointments and are absorbed more easily by the skin.
c. **Gels**: Semisolid systems in which the drug is dispersed in a gel matrix. They are used for topical application and can provide a cooling effect.
d. **Pastes**: Thick, semisolid preparations that contain a high percentage of solids. They are used for topical application and are less likely to spread than ointments or creams.

4. Special Dosage Forms

a. **Transdermal Patches**: Adhesive patches applied to the skin that deliver a drug slowly over a period of time. They provide a controlled release and can be used for systemic effects.
b. **Suppositories**: Solid or semisolid dosage forms intended to be inserted into body cavities (e.g., rectal or vaginal). They dissolve or melt to release the drug for local or systemic effects.
c. **Inhalers**: Devices that deliver drugs directly to the respiratory system. They can be metered-dose inhalers (MDIs), dry powder inhalers (DPIs), or nebulizers.

d. **Injectable Dosage Forms**: Includes solutions, suspensions, or emulsions prepared for injection. They can be administered intramuscularly, intravenously, subcutaneously, or intradermally.

5. Other Dosage Forms

a. **Nasal Sprays**: Liquids delivered through the nasal passages. They are used for local or systemic effects, such as decongestion or hormone replacement.
b. **Eye Drops and Ointments**: Formulations designed for ophthalmic use, providing treatment directly to the eyes.

3.2 Classification

Dosage forms can be classified based on their physical state, route of administration, and the system of drug release. Here is a detailed classification along with examples for each category:

1. Solid Dosage Forms

a. **Tablets:** Compressed solid forms containing active ingredients and excipients. Examples: Paracetamol tablets, Aspirin tablets.
b. **Capsules:** Gelatin shells filled with the active ingredient in powder, liquid, or pellet form. Examples: Amoxicillin capsules, Fish oil capsules.
c. **Powders:** Finely divided solid forms of drugs for internal or external use. Examples: Oral rehydration salts, talcum powder.
d. **Granules:** Agglomerated smaller particles that are often used as intermediates in the production of tablets or capsules. Examples: Effervescent granules, antibiotic granules for reconstitution.

2. Liquid Dosage Forms

a. **Solutions**: Homogeneous liquid preparations containing dissolved substances. Examples: Saline solution, Cough syrup.
b. **Suspensions:** Liquid preparations containing undissolved particles dispersed throughout the liquid. Examples: Antacid suspensions, pediatric antibiotic suspensions.
c. **Emulsions:** Mixtures of two immiscible liquids, one dispersed in the other in the form of droplets. Examples: Cod liver oil emulsion, skin lotions.

3. Semi-Solid Dosage Forms

a. **Ointments**: Semi-solid preparations intended for external application to the skin or mucous membranes. Examples: Hydrocortisone ointment, Neomycin ointment.
b. **Creams:** Semi-solid emulsions for external application. Examples: Hydrocortisone cream, antifungal creams.
c. **Gels:** Semi-solid preparations containing a gelled structure. Examples: Diclofenac gel, Aloe vera gel.
d. **Pastes:** Semi-solid preparations with a higher proportion of solid ingredients, making them stiffer. Examples: Zinc oxide paste, dental pastes.

4. Gaseous Dosage Forms:

a. **Aerosols:** Preparations that contain active ingredients dissolved or suspended in a propellant and intended for inhalation or topical application. Examples: Asthma inhalers, nasal sprays.

b. **Nebulizers:** Devices that convert liquid medication into a fine mist for inhalation. Examples: Salbutamol nebulizer solution, budesonide nebulizer solution.

5. Transdermal Dosage Forms

a. **Transdermal Patches**: Adhesive patches that deliver drugs through the skin into the bloodstream. Examples: Nicotine patches, Fentanyl patches.

6. Parenteral Dosage Forms

a. **Injections:** Sterile preparations intended for administration by injection into the body tissues. Examples: Insulin injections, morphine injections.
b. **Infusions:** Sterile solutions intended for administration via intravenous infusion. Examples: Normal saline infusion, glucose infusion.

7. Miscellaneous Dosage Forms

a. **Suppositories:** Solid forms intended for insertion into body orifices, where they melt or dissolve. Examples: Glycerin suppositories, rectal paracetamol suppositories.
b. **Implants:** Long-acting dosage forms placed subcutaneously to release drugs over extended periods. Examples: Contraceptive implants, hormonal implants.
c. **Lozenges:** Solid preparations that dissolve slowly in the mouth to release medication. Examples: Throat lozenges, vitamin C lozenges.

Dosage forms can be classified based on their physical state, route of administration, and release mechanism. Here's a comprehensive classification with examples:

1. Solid Dosage Forms

a. **Tablets**
    i. **Examples**:
        1. **Aspirin Tablets** (for pain relief)
        2. **Metformin Tablets** (for diabetes)
b. **Capsules**
    i. **Examples**:
        1. **Amoxicillin Capsules** (for bacterial infections)
        2. **Vitamin D Capsules** (dietary supplement)
c. **Powders**
    i. **Examples**:
        1. **Antacid Powder** (e.g., calcium carbonate powder for heartburn)
        2. **Protein Powder** (for dietary supplementation)
d. **Granules**
    i. **Examples**:
        1. **Granules for Oral Suspension** (e.g., erythromycin granules for pediatric use)
        2. **Electrolyte Granules** (e.g., Pedialyte for rehydration)
e. **Lozenges**
    i. **Examples**:
        1. **Cough Lozenges** (e.g., menthol lozenges for throat soothing)
        2. **Vitamin C Lozenges** (for immune support)

f. **Troches**
    i. **Examples**:
        1. **Antifungal Troches** (e.g., clotrimazole troches for oral thrush)
        2. **Nausea Relief Troches** (e.g., for motion sickness)

2. Liquid Dosage Forms

a. **Solutions**
    i. **Examples**:
        1. **Oral Solutions** (e.g., acetaminophen solution for fever)
        2. **IV Solutions** (e.g., saline solution for hydration)

b. **Suspensions**
    i. **Examples**:
        1. **Antibiotic Suspensions** (e.g., amoxicillin suspension for children)
        2. **Antacid Suspensions** (e.g., Maalox for heartburn)

c. **Emulsions**
    i. **Examples**:
        1. **Oral Emulsions** (e.g., castor oil emulsion as a laxative)
        2. **Topical Emulsions** (e.g., hydrocortisone emulsion for dermatitis)

d. **Syrups**
    i. **Examples**:
        1. **Cough Syrups** (e.g., dextromethorphan syrup for cough relief)
        2. **Antihistamine Syrups** (e.g., loratadine syrup for allergies)

e. **Elixirs**
    i. **Examples**:
        1. **Cough Elixirs** (e.g., with codeine for cough suppression)
        2. **Vitamin Elixirs** (e.g., multivitamin elixirs for dietary supplementation)

3. Semisolid Dosage Forms

a. **Ointments**
    i. **Examples**:
        1. **Antibiotic Ointments** (e.g., Neosporin for skin infections)
        2. **Steroid Ointments** (e.g., hydrocortisone ointment for inflammation)

b. **Creams**
    i. **Examples**:
        1. **Moisturizing Creams** (e.g., Eucerin for dry skin)
        2. **Antifungal Creams** (e.g., clotrimazole cream for athlete's foot)

c. **Gels**
    i. **Examples**:
        1. **Acne Gels** (e.g., benzoyl peroxide gel for acne treatment)
        2. **Pain Relief Gels** (e.g., ibuprofen gel for muscle pain)

d. **Pastes**
    i. **Examples**:
        1. **Zinc Oxide Paste** (e.g., for diaper rash)
        2. **Calamine Paste** (e.g., for insect bites and itching)

4. Special Dosage Forms

a. **Transdermal Patches**
   i. **Examples**:
      1. **Nicotine Patches** (e.g., for smoking cessation)
      2. **Estrogen Patches** (e.g., for hormone replacement therapy)

b. **Suppositories**
   i. **Examples**:
      1. **Rectal Suppositories** (e.g., bisacodyl for constipation)
      2. **Vaginal Suppositories** (e.g., antifungal suppositories for yeast infections)

c. **Inhalers**
   i. **Examples**:
      1. **Metered-Dose Inhalers (MDIs)** (e.g., albuterol for asthma)
      2. **Dry Powder Inhalers (DPIs)** (e.g., fluticasone for chronic obstructive pulmonary disease)

d. **Injectable Dosage Forms**
   i. **Examples**:
      1. **Intravenous (IV) Solutions** (e.g., glucose solution for energy)
      2. **Intramuscular (IM) Injections** (e.g., vitamin B12 injections for deficiency)

5. Other Dosage Forms

a. **Nasal Sprays**
   i. **Examples**:
      1. **Decongestant Nasal Sprays** (e.g., oxymetazoline for nasal congestion)
      2. **Hormonal Nasal Sprays** (e.g., calcitonin nasal spray for osteoporosis)

b. **Eye Drops and Ointments**
   i. **Examples**:
      1. **Anti-Glaucoma Eye Drops** (e.g., timolol for intraocular pressure)
      2. **Antibiotic Eye Ointments** (e.g., erythromycin for eye infections)

3.3 Definitions of Dosage Forms

1. **Tablets:** Solid, compressed dosage forms containing medicinal substances with or without suitable diluents. Tablets are designed to be swallowed whole, chewed, or dissolved in water. Example: Paracetamol tablets.
2. **Capsules**: Solid dosage forms in which the drug is enclosed within a soluble gelatin shell. Capsules can contain powders, liquids, or pellets. Example: Amoxicillin capsules.
3. **Powders:** Finely divided solid dosage forms that can be used internally or externally. Internal powders can be dissolved in water, while external powders are applied to the skin. Example: Oral rehydration salts.
4. **Granules:** Larger, agglomerated particles of powder often used as intermediates in tablet production or directly consumed by patients. Example: Effervescent granules.
5. **Solutions:** Liquid dosage forms in which the drug is completely dissolved in a suitable solvent. Solutions are homogeneous and can be taken orally, injected, or used topically. Example: Cough syrup.

6. **Suspensions**: Liquid dosage forms containing finely divided, undissolved drug particles dispersed in a liquid medium. Suspensions need to be shaken before use to ensure uniform distribution of the drug. Example: Antacid suspensions.
7. **Emulsions:** Mixtures of two immiscible liquids, where one liquid is dispersed in the form of small droplets throughout the other. Emulsions can be used internally or externally. Example: Cod liver oil emulsion.
8. **Ointments:** Semi-solid preparations intended for external application to the skin or mucous membranes. Ointments are typically greasy and provide a protective barrier. Example: Hydrocortisone ointment.
9. **Creams:** Semi-solid emulsions that are less greasy than ointments and used for external application. Creams are easy to apply and spread on the skin. Example: Antifungal creams.
10. **Gels:** Semi-solid preparations containing a gelling agent to provide stiffness to a solution or suspension. Gels are used for topical application. Example: Aloe vera gel.
11. **Pastes:** Semi-solid preparations with a higher proportion of solid ingredients than ointments, making them thicker and more absorptive. Pastes are used for protective and soothing purposes. Example: Zinc oxide paste.
12. **Aerosols:** Dosage forms containing active ingredients dissolved or suspended in a propellant and dispensed as a fine mist. Aerosols are used for inhalation or topical application. Example: Asthma inhalers.
13. **Nebulizers:** Devices that convert liquid medication into a fine mist for inhalation, allowing the medication to reach deep into the lungs. Example: Salbutamol nebulizer solution.
14. **Transdermal Patches**: Adhesive patches that deliver drugs through the skin into the bloodstream over a prolonged period. Example: Nicotine patches.
15. **Injections:** Sterile preparations intended for administration by injection into body tissues, such as intramuscularly, intravenously, or subcutaneously. Example: Insulin injections.
16. **Infusions**: Sterile solutions administered intravenously over a prolonged period. Example: Normal saline infusion.
17. **Suppositories:** Solid dosage forms intended for insertion into body orifices, such as the rectum or vagina, where they dissolve or melt. Example: Glycerin suppositories.
18. **Implants:** Long-acting dosage forms placed subcutaneously to release drugs over an extended period. Example: Contraceptive implants.
19. **Lozenges:** Solid preparations that dissolve slowly in the mouth, releasing the medication gradually. Example: Throat lozenges.

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