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عنوان المحاضرة باللغة الانجليزية	**Suspension dosage form**
عنوان المحاضرة باللغة العربية	الجرع الدوائية المعلقة
رقم المحاضرة	4
المصادر والمراجع	Pharmaceutical Dosage forms and Drug Delivery Systems By Haward A. Ansel; latest edition.
	Sprowel's American Pharmacy.

محتوى المحاضرة

Suspension Dosage form

- Solutions
- Dispersions

Colloidal Dispersion: 1 nm to 0.5 µm
Fine Dispersion: 0.5 to 10 µm
Coarse Dispersion: 10 to 50 µm

Coarse Dispersion (10 to 50 µm)

- Emulsion
- Suspension

Differences in term of Separation

A pharmaceutical suspension is a coarse dispersion in which insoluble particles, generally greater than 1 μm in diameter, are dispersed in a liquid medium, usually aqueous.

Suspensions: preparations containing finely divided drug particles (the suspensoid) distributed somewhat uniformly throughout a vehicle in which the drug exhibits minimum degree of solubility.

Suspensions

- Some suspensions are available in **ready-to-use form**, i.e., already distributed through a liquid vehicle with or without stabilizers and additives.
- Other preparations are available as **dry powders** intended for suspension in liquid vehicles.

✓ Drugs unstable for long periods in aqueous vehicles (e.g., many antibiotics) are supplied as dry powders for reconstitution at dispensing.

Uses of Aqueous Suspensions

- Most commonly used for **oral administration** of insoluble drugs.
- May also be used for **parenteral, topical, ophthalmic** administration.

Important Note

- Complete and uniform redistribution of the dispersed phase is essential for accurate dosing.
- Achieved by moderate agitation of the container.

Reasons for Suspensions – Advantages

- Stability

- Taste masking
- Ease of swallowing
- Solubility
- Bioavailability

Disadvantages

- Physical instability
- Bulky
- Aesthetic problems

Features Desired in a Pharmaceutical Suspension

- Settle slowly and redisperse easily (stable).
- Particle size remains fairly constant.
- Suitable viscosity → pour readily and evenly.
- Acceptable taste, odor, color.
- Must not decompose or support microbial growth during storage.

Classification of Suspensions

Based on Classes

- Oral
- External
- Parenteral

Based on Particle Size

- Colloidal
- Coarse
- Nanosuspension

Based on Proportion of Solids

- Diluted
- Concentrated

Based on Electrokinetic Nature

- Flocculated
- Deflocculated

Properties of Suspension

- Sedimentation behavior
- Electrokinetic properties

Factors affecting stability:

- Particle size
- Wetting of particles (surfactant/wetting agent)
- Particle movement / viscosity / sedimentation
- Electrical charge (zeta potential)
- Flocculation vs deflocculation
- Brownian motion

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1. Sedimentation behavior

Settling of particles/floccules occurs under gravity.

Stokes' Law

Sedimentation rate ∝ square of particle diameter.

- Ideal particle size: 1–50 μm.
- Avoid too large particles:
    - Rapid sedimentation, unstable

    - 5 µm: gritty, cause irritation (eye/injection)
    - 25 µm: may block needles
- Avoid too small particles:
    - Tend to form **compact cake** difficult to redisperse

Particle Size Reduction

- Reduction improves stability (slows sedimentation).
- Achieved by:
    - **Micropulverization** (10–50 µm, oral/topical).
    - **Jet milling / micronizing** (<10 µm, parenteral/ophthalmic).
    - **Spray drying** → very fine powders via drying drug solution with warm air.

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2. Density of particles & medium

- Particles denser than aqueous vehicle → faster settling.
- Less dense particles → float, hard to redisperse.
- If equal → suspension more stable.

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3. Viscosity of dispersion medium

- Higher viscosity reduces sedimentation.
- But too high viscosity → poor pouring & redispersion.
- Controlled by vehicle + solid content.
- Often improved with **suspending agents**:
    - Carboxymethylcellulose (CMC)
    - Methylcellulose

- Microcrystalline cellulose
- Polyvinylpyrrolidone (PVP)
- Xanthan gum
- Bentonite

Effect of Particle Shape on Stability

- **Needle-shaped particles** → form hard, non-redispersible cake.
- **Barrel-shaped particles** → more stable.

Solid Particle – Liquid Interactions

- Solubility requires chemical similarity.
- Many modern hydrophobic drugs → poor water solubility → formulated as suspensions.

Electrical Double Layer Theory

- Hydrophobic drugs in water acquire charge due to ionization of water.
- OH^- adsorbs on particle surface → negative charge.
- Two layers form:
  - **Fixed layer** (Stern) – tightly bound ions.
  - **Diffuse layer** (Gouy–Chapman) – mobile ions.

Zeta potential (ζ): potential difference between medium & stationary fluid layer on particle.

Zeta potential & colloid stability:

- 0 to ±5 mV → rapid coagulation.
- ±10 to ±30 mV → incipient instability.
- ±30 to ±40 mV → moderate stability.

- ±40 to ±60 mV → good stability.
- ±61 mV → excellent stability.

Effect of Excipients on Double Layer

- Electrolytes (e.g., NaCl) increase mobile charges.
- Surfactants change charge magnitude and sometimes its sign.

Particle Interactions

1. Van der Waals attraction
2. Electrostatic repulsion

- Higher repulsive force (zeta potential around ±30 mV) → particles remain apart → stable suspension.