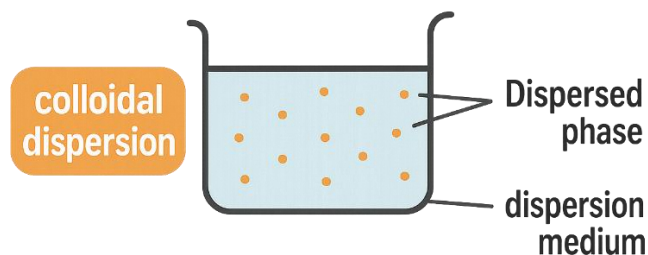


Colloidal dispersions

Introduction to Colloidal Dispersions

Definition

- A colloidal dispersion is a biphasic system where very small particles (1–1000 nm) of one substance (dispersed phase) are evenly distributed throughout another (dispersion medium).
- It bridges the gap between true solutions and coarse suspensions.
- In pharmaceuticals, colloidal systems are valued for their impact on drug stability, solubility, bioavailability, and therapeutic efficacy.



Key Characteristics

- Particle size: 1–1000 nm
- Two-phase system: Dispersed phase + continuous phase
- Heterogeneous, but appears macroscopically homogeneous
- Thermodynamically unstable, but kinetically stable
- Exhibits:
 - Tyndall effect (light scattering)
 - Brownian motion
 - Zeta potential

Types of Colloidal Systems

- Classified by:
 - Interaction with dispersion medium: Lyophilic vs. lyophobic
 - Physical state: Sols, gels, emulsions, aerosols, foams
 - Particle charge

Pharmaceutical Applications

Application Area	Examples
Parenteral delivery	Liposomes, nanoparticle suspensions
Topical formulations	Creams, gels, ointments

Ophthalmics	Colloidal eye drops, nanosuspensions
Sustained release	Coacervates, microspheres
Targeted therapy	PEGylated nanoparticles, stealth liposomes

Benefits:

- Enhanced solubility, stability, and bioavailability
- Controlled or sustained release of APIs
- Targeted delivery, reducing side effects

Classification of Dispersed Systems & Their General Characteristics

Definition of Dispersed Systems:

- Dispersed systems consist of two phases:
 - **Dispersed phase (internal phase):** The substance that is dispersed.
 - **Dispersion medium (continuous phase):** The substance in which the dispersed phase is distributed.

Classification of Dispersed Systems:

Dispersed systems are classified based on:

- **Particle size** of the dispersed phase
- **Physical state** of both the dispersed phase and dispersion medium

A. Based on Particle Size

Type	Particle Size Range	Example
Molecular (True) Solutions	< 1 nm	NaCl in water
Colloidal Dispersions	1 – 1000 nm (1 nm to 1 µm)	Milk, gels, magmas
Coarse Dispersions	> 1 µm	Suspensions, emulsions

B. Based on Physical States (Phases)

- There are 8 types depending on the physical state of dispersed phase and dispersion medium.

Dispersed Phase	Dispersion Medium	Type	Example
Solid	Gas	Solid aerosol	Smoke, airborne particles

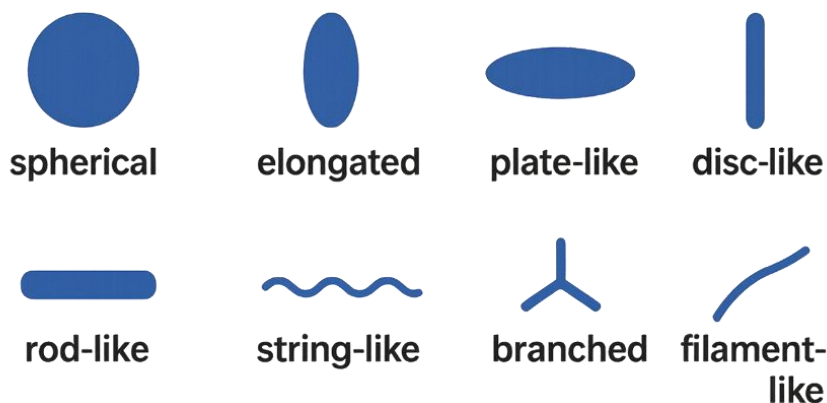
Liquid	Gas	Liquid aerosol	Mist, fog, sprays
Gas	Liquid	Foam	Shaving cream, whipped cream
Solid	Liquid	Sol	Paints, gold sol
Liquid	Liquid	Emulsion	Milk, creams
Gas	Solid	Solid foam	Pumice, foam rubber
Liquid	Solid	Gel	Gelatin, jelly
Solid	Solid	Solid sol	Colored glass, pearls

General Characteristics of Dispersed Systems:

- **Heterogeneous nature:** Composed of two distinct phases.
- **Stability:** Varies from very stable (true solutions) to unstable (coarse dispersions).
- **Visibility:** Particles in colloidal systems are not visible to the naked eye but can be detected under an ultramicroscope.
- **Filterability:** Colloidal particles can pass through ordinary filters but not through ultrafilters.
- **Brownian motion:** Colloidal particles exhibit random movement due to collisions with dispersion medium molecules.
- **Tyndall effect:** Scattering of light by colloidal particles, making the path of light visible.

Size & Shapes of Colloidal Particles

Size & Shapes of Colloidal Particles



Size of Colloidal Particles:

- **Range:** 1 nm to 1000 nm (i.e., 10^{-9} m to 10^{-6} m).
- Size influences:



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