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Colloidal dispersions; lyophilic; lyophobic

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Outlines

- Introduction.
- Colloidal dispersion.
- Classification:
  - Lyophilic
  - Lyophobic
  - Association
- Applications

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Terms

- Pharmaceutical system: Bounded space of exact quantity of a material substances.
- Pharmaceutical mixture: "Dispersion" quantity of two or more substances mixed together.
- Phase: distinct part in dispersion
- Binary solution: solute in a vehicle

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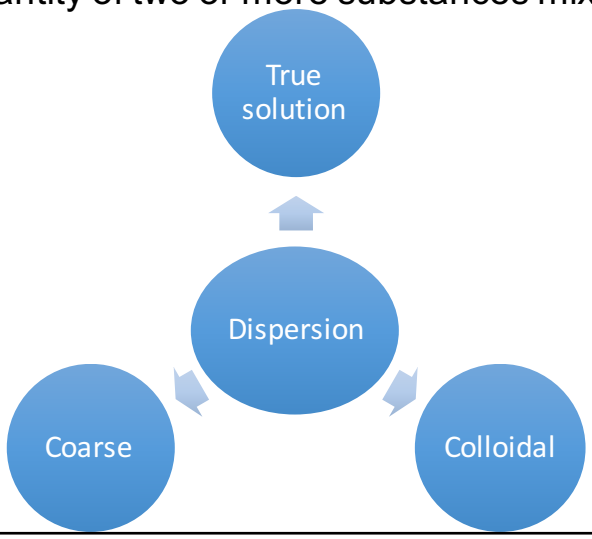
Pharmaceutical mixtures

"**Dispersion**" quantity of two or more substances mixed together



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Introduction

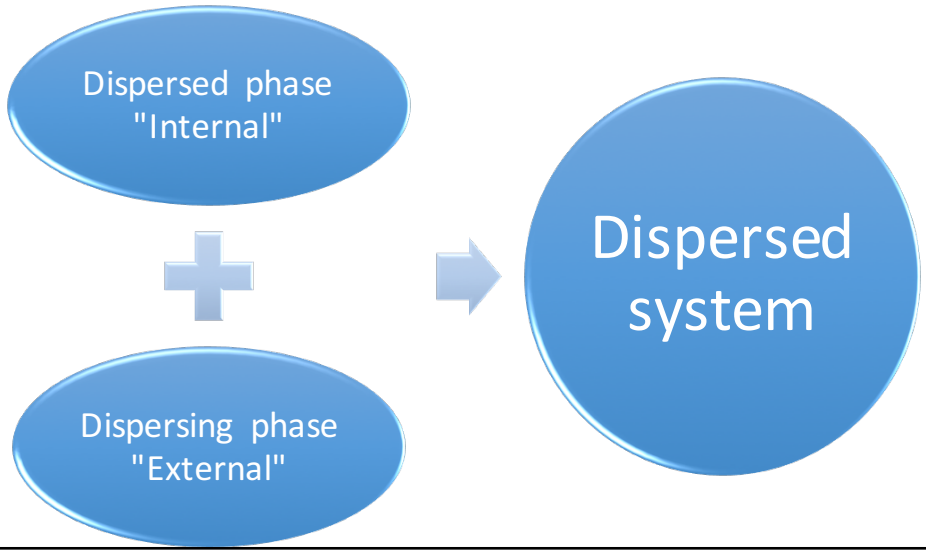

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Table 5.1 Types of disperse systems

Dispersed phase	Dispersion medium	Name	Examples
Liquid	Gas	Liquid aerosol	Fogs, mists, aerosols
Solid	Gas	Solid aerosol	Smoke, powder aerosols
Gas	Liquid	Foam	Foam on surfactant solutions
Liquid	Liquid	Emulsion	Milk, pharmaceutical emulsions
Solid	Liquid	Sol, suspension	Silver iodide sol, aluminium hydroxide suspension
Gas	Solid	Solid foam	Expanded polystyrene
Liquid	Solid	Solid emulsion	Liquids dispersed in soft paraffin, opals, pearls
Solid	Solid	Solid suspension	Pigmented plastics, colloidal gold in glass, ruby glass

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Properties	Molecular Dispersion	Colloidal Dispersion	Coarse Dispersion
Size	< 1nm	1-500 nm	> 500
Diffusion	Fast	Very slow	Don't diffuse
Microscope	Particles invisible in electron microscope	Particles resolved by electron microscope.	Particles are visible under ordinary microscope.
Filtration	Pass through semipermeable membranes and filter paper.	Pass through filter paper but not pass through semipermeable membrane.	Do not pass through filter paper or semipermeable membrane.
Example	O2, glucose in water	Polymer and protein in water	Suspension and emulsion

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Notes

- There is no clear distinction between the boarder
  Molecular and Colloidal dispersions or
  Colloidal and Coarse dispersions.
- For example, certain macro - (large) molecules , such as the polysaccharides, proteins, and polymers in general, are of sufficient , size that they may be classified as forming both *molecular* and *colloidal* dispersions.
- Some suspensions and emulsions may contain a range of particles sizes such that the smaller particles lie within the *colloidal* range while the larger ones are classified as *coarse* particles.

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Colloidal Dispersions

Examples of colloidal systems

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According to the type of interaction between dispersed phase and dispersion media, Colloidal dispersion can be classified into:

Lyophilic colloids	Lyophobic colloids	Association colloids
• ***Solvent loving***	• ***Solvent Hating***	• ***Amphiphilic***

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Lyophilic Colloids " Solvent Loving"

- In this type of colloids there is a great attraction "affinity" between the dispersed phase and the dispersion medium.
- The dispersed phase generally consists of soluble macromolecules, such as proteins and carbohydrates.
- These are thermodynamically true solutions; that is, they are best treated as a single phase system.
- Obtained simply by dissolving the material in the solvent (due to the high affinity).

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- According to the type of dispersion media, this type is also subdivided into:

➢ **Hydrophilic colloids:** the dispersion medium is water.

Examples: starch, gelatin and acacia in water.

➢ **Lipophilic or oleophilic:** the dispersion media are oils or solvent of low polarity or low dielectric constant.

Example: polystyrene in benzene; magnesium stearate in cottonseed oil.

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Notes

- The dispersed phase does not precipitate easily.
- The sols are quite stable as the solute particle surrounded by two stability factors:

  a- negative or positive charge

  b- layer of solvent

- If the dispersion medium is separated from the dispersed phase, the sol can be reconstituted by simply remixing with the dispersion medium. Hence, these sols are called reversible sols

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Lyophobic Colloids "Solvent hating"

- In this type of colloids there is a small or little attraction "affinity" between the dispersed phase and the dispersion medium.
- Lyophobic colloids generally composed of inorganic particles dispersed in water.
- Examples of such materials are gold, silver, sulfur, silver iodide and arsenous sulfide.

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Lyophobic Colloids "Solvent hating"

- These colloids are easily precipitated on the addition of small amounts of electrolytes, by heating or by shaking.
- Less stable as the particles surrounded only with a layer of positive or negative charge.
- Once precipitated, it is not easy to reconstitute the sol by simple mixing with the dispersion medium. Hence, these sols are called irreversible sols.
- Not obtained simply i.e need special method for preparation

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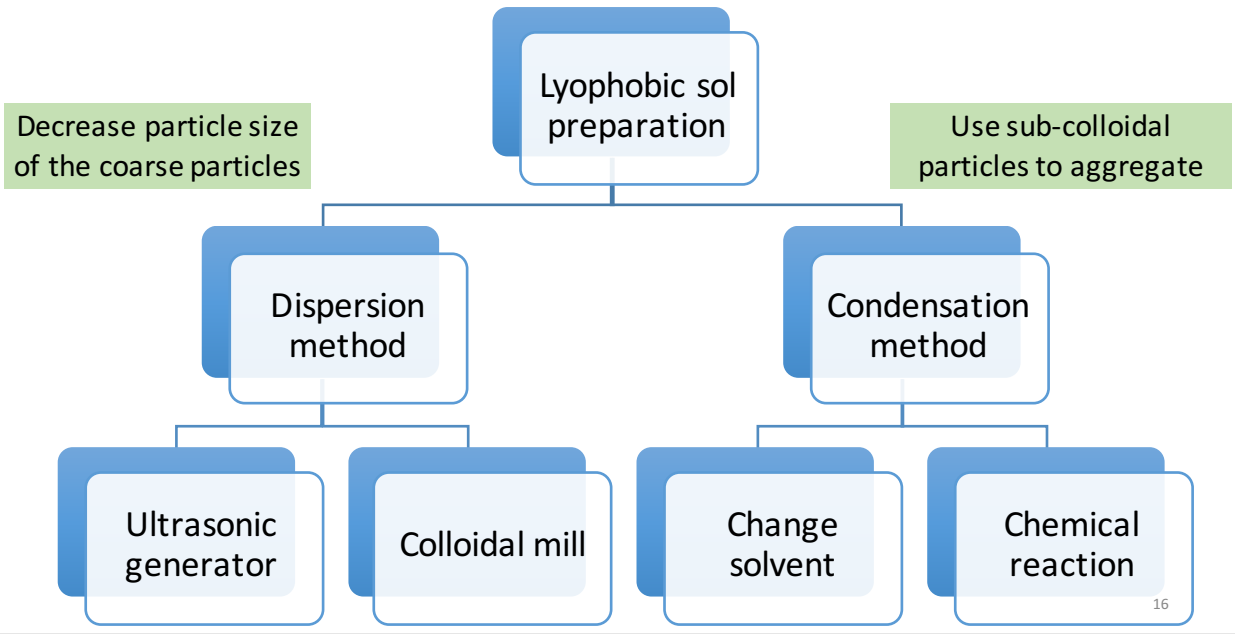

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Association Colloids "Amphiphilic"

- In this type of colloids the particles of the dispersed phase exhibit both lyophilic and lyophobic properties with respect to the dispersion medium.
- Association colloids are aggregates or "associations'' of surface active molecules.
- These molecules are soluble in the solvent, and their molecular dimensions are below the colloidal size range.

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- When present in solution at concentrations above a certain critical value (the critical micelle concentration), these molecules tend to form association colloids (micelles).
- At low concentration: amphiphiles exist separately (subcolloidal size)
- At high concentration: form aggregates or micelles (50 or more monomers) (colloidal size)

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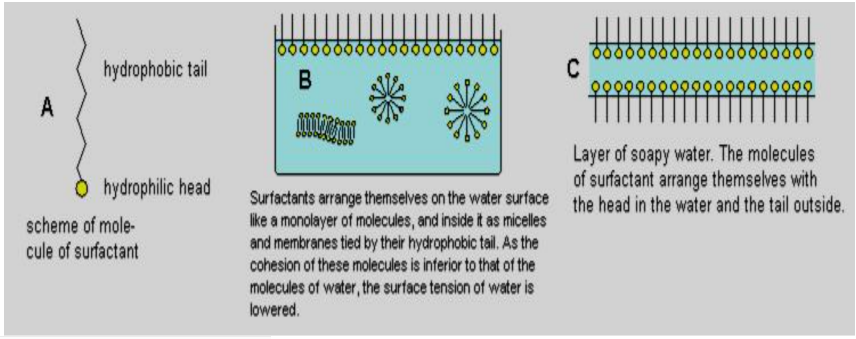

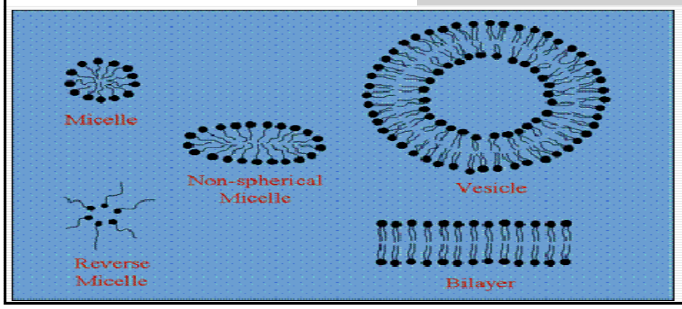

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Association Colloids "Amphiphilic"

- As with lyophilic sols, formation of association colloids is spontaneous, provided that the concentration of the amphiphile in solution exceeds the cmc.
- Amphiphiles may be

1. Anionic (e.g., Na. lauryl sulfate)
2. Cationic (e.g., cetyl triethylammonium bromide)
3. Nonionic (e.g., polyoxyethylene lauryl ether)
4. Ampholytic (zwitterionic) e.g., dimethyl dodecyl ammonio propane sulfonate.

Home work

- Compare between lyophilic, lyophobic and association colloids in terms of :

1. Dispersion phase.
2. Solvation.
3. Method of preparation.
4. Viscosity.
5. Effect of electrolytes addition.

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Biological and Pharmaceutical Applications of Colloids

- Many biological structures are colloidal in nature, such as blood (a dispersion of corpuscles in serum) and bone (a dispersion of calcium phosphate in collagen).

- There are also many macromolecular dispersions in the body, including enzymes and other proteins.

- Colloids are used medically for diagnostic imaging (radio labeled, parentally administered colloids).

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- There are many colloidal drug delivery systems (including nanoparticles, microspheres, and liposomes) that may be used for the purposes of drug targeting, controlled release, and protection of the drug substance.

- Colloid drug-delivery systems are used topically, orally, parentally, and by inhalation.

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Examples

1) Colloidal silver iodide, silver chloride & silver protein are effective *germicides* & not cause irritation as ionic silver salts.
2) Colloidal copper used in *cancer.*
3) Colloidal gold used as *diagnostic* agent.
4) Colloidal mercury used in *syphilis.*
5) Association colloids (SAA) are used to *increase solubility & stability* of certain compounds in aqueous & oily pharmaceutical preparations.

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Examples

6) Efficiency of certain substances is increased when used in colloidal form due to large surface area.

e.g. efficiency of kaolin in adsorbing toxins from GIT.

e.g. efficiency of aluminum hydroxide as antacid.

7) Blood plasma substitutes as dextran, PVP & gelatin are hydrophilic colloids used to restore or maintain blood volume.

8) Iron - dextran complex form non-ionic hydrophilic sols used for treatment of anemia.

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Thanks for your attention