International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 1 Jan-Feb 2023, pp: 2471-2480 www.ijprajournal.com ISSN: 2249-7781

Study of Colloidal Dispersion In Pharmaceutical Products; A Review

[1]Kadam Krishna S.
[2]Pawar Jaydeep B.
[3]Dr. Nirmal Sunil A.
HSBPVT's GOI, Faculty of pharmacy, kashti Ahmednagar, Maharashtra 414701

Submitted: 25-02-2023 Accepted: 06-03-2023

ABSTRACT:
This paper introduces the study of colloidal dispersions in the pharmaceutical products. These include the comparison of molecular dispersion, coarse dispersion and colloidal dispersions. The colloidal dispersions are polyphasic phase containing dispersed phase. In the dispersion the dispersed phase is distributed in the dispersion medium. The dispersed system is classified on the basis of particle size. The particle size is varying from their types. The shape of colloidal particle in dispersion is very important because the more extended the particle the greater it surface area. the colloidal dispersions are classified on the basis of the dispersed phase and dispersed medium and their interaction. Dialysis, ultra filtration and electro dialysis methods are used to purification of colloids. the colloidal solutions are used in the hydro gels, micelles, micro particle, liposome, and nanoparticle. The main contribution of this work is the study of colloidal dispersions.

KEYWORDS: colloidal dispersion, lyophilic colloids, lyophobic colloids.

INTRODUCTION:

The colloidal dispersions are defined as that polyphasic system where at least one dimension of the dispersed phase measures between one nm and one micrometer. The colloidal system is the dispersion where the internal phase is distributed uniformly in the dispersion medium i.e. external or continuous phase. A colloid is a mixture where one substance consists of microscopically dispersed insoluble particles is suspended in another substance. (1) The particles are dispersed in liquids. The colloidal solution contains the dispersed phase (the suspended particle) and continuous phase (the medium of suspension. In colloidal system particles pass through filter paper but do not pass through semi permeable membrane. The three types of dispersed systems in pharmaceutical sciences: molecular, colloidal, coarse dispersions. The molecular dispersions are homogenous in nature and they are forms true solutions. The coarse dispersions contain the powders and granules. In this review we are discuss about the colloidal dispersions. It is important to know that the difference between the molecular, colloidal and coarse dispersions. When the dispersion medium is gas, the solution is called aerosol and when the dispersion medium is liquid the colloidal dispersion is known as solution.

CLASSIFICATION OF DISPERSED SYSTEM:

The dispersed system is classified on the basic of particle size. The particles in the colloidal size range that posses a surface area that compare with the surface area of equal volume of larger particles. The, molecular dispersion have the size less than 1nm. The colloidal dispersion has the size between 1 nm to 0.5 micrometer. (1)

Class	Particle size	Characteristics	Examples
Molecular dispersion	Less than 1 nm	-Invisible in electron microscope -Pass through ultra filter and semi permeable membrane	-Oxygen molecule -Ordinary ions -glucose

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 1 Jan-Feb 2023, pp: 2471-2480 www.ijprajournal.com ISSN: 2249-7781

		-Undergo rapid diffusion	
Colloidal dispersion	From 1 nm to 0.5 micro.	-Visible in electron microscope -Pass through filter paper -Diffuse slowly	-Colloidal silver solution -Synthetic polymer -Cheese -Jelly -Paint -Milk
Coarse dispersion	Greater than 0.5 micrometer	-Visible under microscope -Do not pass through filter paper -Do not diffuse	-Grains of sand -Emulsion -Suspension -Red bold cells

SHAPE OF COLLOIDAL PARTICLES:

The shape of colloidal particle in dispersion is important because the more extended the particle, the greater its surface area and opportunity for attractive force to develop between the particles of the dispersed phase and the dispersed medium. (2)

The shapes of colloidal particles are: -

- Sphere and globules
- Short rods and ellipsoids
- Oblate ellipsoids
- Long rods and threads
- Loosely coiled threads
- Branched threads

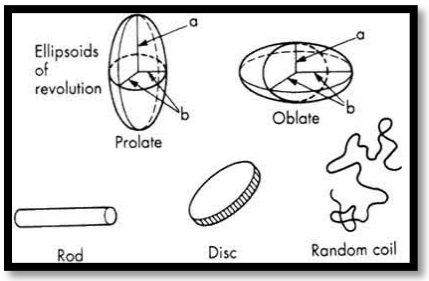

Fig. 1 Shape of colloidal particle

The following properties are affected by changes in the shape of colloidal particles:

- Flow ability
- Osmotic pressure
- Sedimentation
- Pharmacological action.

CLASSIFICATION OF COLLOIDAL DISPERSION:

1) Based on Dispersed phase and Dispersion medium:

On the basis of dispersed phase and dispersed medium the colloids are classified into nine types. The colloidal dispersions are heterogeneous in nature and gas dispersed in another gaseous medium does not form colloidal system.

Dispersed phase	Dispersed medium	Type of dispersion	Examples
Gas	Liquid	Foam	Soap,
Gas	Solid	Solid foam	Pumice

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 1 Jan-Feb 2023, pp: 2471-2480 www.ijprajournal.com ISSN: 2249-7781

Gas	Gas	-	-
Liquid	Gas	aerosol	Fog, dust
Liquid	Liquid	Emulsion	Milk,
Liquid	Solid	Gel	Butter,
Solid	Gas	aerosol	Dust
Solid	Liquid	colloidal suspension	Paste, ink
Solid	Solid	Solid sol(solid suspension)	Pearls, gem stones

2) Based on interaction between dispersed phase and dispersion medium:

a) Lyophilic colloids:

The dispersed phase has a greater affinity for the dispersion medium is called as the lyophilic colloid. The word lyophilic means liquid loving. If the dispersed phase is separated from the dispersion medium, they can readily be reconstituted by simply mixing them. Their affinity for the dispersion medium, the molecules disperse spontaneously to colloidal solution. These colloids are reversible sols. The viscosity of the dispersion medium is increased greatly by the presence of lyophobic colloidal particles. Dispersions are stable generally in the presence of electrolytes; they must be salted out by high concentrations of very soluble electrolytes. Dispersed phase consists generally of large organic molecules such as gelatin, acacia lying within colloidal size range. They are also known as intrinsic colloids.

Preparation: The lyophilic colloids are prepared by the simple dispersion of lyophilic material in the solvent to forms the lyophilic colloids.

b) Lyophobic colloids**:**

If the dispersed phase has little or no affinity for the dispersion medium, the colloid is called lyophobic colloid. The word lyophobic means liquid fearing. They are difficult to prepare because the dispersed phase does not readily form the colloid with the dispersion medium, they require some special methods. They are unstable and require stabilizing agents. These colloids form irreversible sols. Viscosity of the dispersion medium is not greatly increased by the presence of lyophilic colloidal particles. Dispersed phase consists of inorganic particles, such as gold or silver. They are also known as extrinsic colloids.

Preparation: The lyophobic colloids are prepared by the following two methods.

- Dispersion method:

This method contains the breakdown of larger particles into particles of colloidal dimensions. The breakdown of coarse material may affect the use of colloidal mills, ultrasonic treatment in the presence of stabilizing material.

- Condensation method:

The colloidal particles are formed by the aggregation of smaller particles such as molecules. This involves the high degree of super saturation followed by the formation and growth of nuclei. The super saturation is brought by change in solvent and chemical reaction.

c) Association colloids**:**

Some substances are act as strong electrolyte when they are in low concentrations, but they react as colloidal sols when they are in high concentration. These colloids are formed when molecule or soap of other surface active agent substances are associated together to form small aggregates in water. Colloidal aggregates are formed spontaneously when concentration of surface active agents exceeds critical micelles concentration.

PURIFICATION OF COLLOIDS:

When the colloidal solution is prepared then it contains the various types of the electrolytes which destabilize the solution. Then the purification of colloidal solution is important. The following methods are used for purification of colloids. (1)

a) Dialysis:

At the equilibrium condition, the colloidal particles are retained in the compartment A, where the sub colloidal material is distributed in this both sides of the membrane. By the removing the liquid in the compartment B, it is possible to obtain colloidal material in compartment A, it is free from sub-colloidal contaminants. The processor dialysis is

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 1 Jan-Feb 2023, pp: 2471-2480 www.ijprajournal.com ISSN: 2249-7781

occurred by the stirring, so as to maintain a high concentration gradient of diffusible molecules across the membrane and by renewing the outer liquid from time to time.

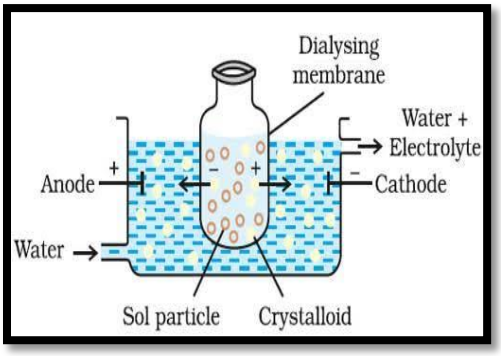

Fig. 2 Dialysis

b) Ultra filtration:

The ultra filtration is defined as the process of separating the colloidal particles from the solvent and soluble solutes present in the colloidal solution by specially designed filters, which are permeable to all substance. If the filter paper is made with colloidal or some regenerated cellulose like cellophane, the size of the pores is decreased. This modified form of the filter paper is called as the ultra filter. It is a slow process. To speed up the process some external gas pressure has to be applied.

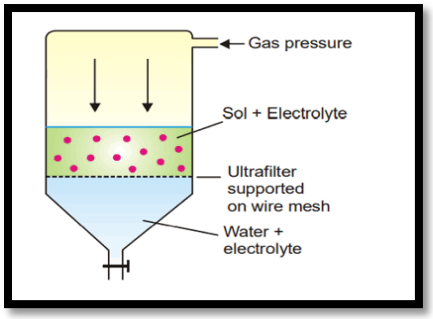

Fig. 3 Ultra filtration

c) Electro dialysis:

In this process of electro dialysis the colloidal solution is carried out under the effect of electric field. Some potential is applied between the metal screens that support the membranes. Due to this potential, the speed of the ions moving direction of opposite electrodes is increased. Thus the rate of dialysis is increased. The dialysis membrane allows the small particles to pass through but the colloidal size particles do not pass through the membrane.

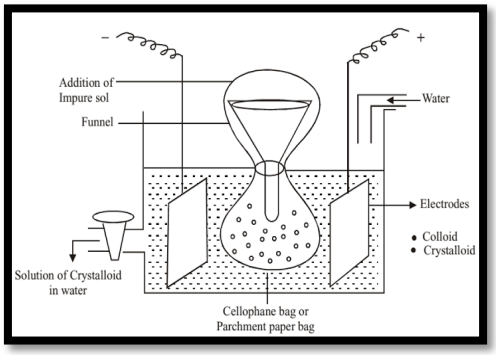

Fig. 4 Electro dialysis

Characteristics of dispersed phase:

➢ Particle size:

The particle size influences the color of the dispersion. The wavelength of light absorbed by particle is approximately related to its radius. The larger the particle, the shorter the wavelength of light transmitted. Violet end of spectrum. For example, colloidal gold has a red colour (650-750 nm), while intermediate size is in violet colour.

➢ Particle shape:

The shape of particle in dispersion depends on method of preparation and affinity of the particle to dispersion medium. The particle shape also influences the colour of the dispersion. Spherical particles of gold are indicated by red colour, while disc like particles of gold gives blue colour. Spherical particle produce dispersion of low viscosity, while linear particle produce more viscous dispersion.

➢ Surface area:

The size of colloidal particles is order of few micrometers, these particles possess enormous the solubility of drug particles. The larger surface area enhances the solubility of drug particle.

➢ Surface charge:

Depending upon the nature of the dispersion medium and ions present in colloidal solutions, colloidal particle acquires a charge on their surface. The surface charge provides valuable information regarding the stability of colloids. Particles move continuously in random manner with collisions with each other. The like charge on the particles creates repulsion forces.

Characteristics of dispersed medium: (2)

➢ Ease of preparation:

The lyophilic solutions can be obtained straight way by mixing the material with the suitable solvent.

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 1 Jan-Feb 2023, pp: 2471-2480 www.ijprajournal.com ISSN: 2249-7781

Lyophobic solutions are not obtained by the simply mixing the solid material with the solvent.

➢ Charge on particle:

The particles of hydrophilic solutions may be little or no charge. The particle of hydrophobic solutions carries positive charge or negative charge which gives them stability.

➢ Salvation:

The hydrophilic sol particles are generally solvated. They are surrounded by an adsorbed layer of the dispersion medium which does not permit them to come together and coagulate.

➢ Precipitation:

The lyophilic solutions are precipitated or coagulated only by high concentration of the electrolytes when solution particles are dissolved. Lyophobic solutions are precipitated even by low concentration of electrolytes.

➢ Viscosity:

The lyophilic sols are viscous as the particle size increases due to salvation, and the proportion of free medium decreases. The viscosity of hydrophobic solutions is almost the same as of the dispersion medium itself.

PROPERTIES OF COLLOIDAL SOLUTIONS:

The colloidal solutions are classified according to the properties of particles in the dispersion medium. (2)

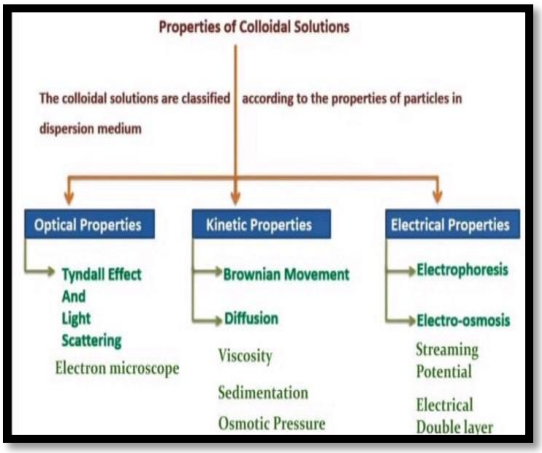

Fig. 5 Properties of colloidal solution

➢ **Optical properties:**

This study helps in obtaining the information of shape, size, structure and molecular weight of colloids. The source of light and resolving power of optical system mainly determine the precision and usefulness of such information. When a beam of light strikes on the particles, it polarizes the atoms and molecules in it and induces dipoles in the particle. The dipole emits weaker light at the same wavelength as that of the incident light. The emitted light propagates in all direction. This phenomenon is called as light scattering.

- Tyndall effect:

The Tyndall effect is the phenomenon in which the particles in a colloid scatter the beams of light that are directed at them. This effect is exhibited by all colloidal solutions and some very fine suspensions. Therefore, it can be used to verify if a given solution is colloid. The intensity of scattered light depends on the density of colloidal particles as well as the frequency of the incident light.

When a beam of light passes through a colloid, the colloidal particles present in the solution do not allow the beam to completely pass through. The light collides with the colloidal particles and is scattered. This scattering makes the path of the light beam visible.

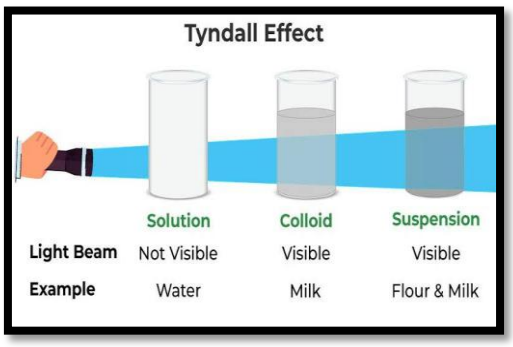

Fig. 6 Tyndall effect

- Light scattering**:**

The light scattering is used to study the proteins, polymers, association colloids and lyophobic solutions. The light scattering property is depends on the faraday Tyndall effect and is widely used for determining the molecular weight of colloids. It can also be used to obtain the information of shape and size of particle. The light scattering is described in the turbidity, the fractional decrease in the intensity due to scattering as the incident light passes through 1 cm of solution. It can be expressed as intensity of light scattered in all direction divided by the intensity of incident light. The turbidity is proportional to the molecular weight of colloids at the given concentration. The low turbidities of the colloids are m ore convenient to the measure scattered light. When the molecule is asymmetric, the intensity of scattered light varies with the angle of observation.

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 1 Jan-Feb 2023, pp: 2471-2480 www.ijprajournal.com ISSN: 2249-7781

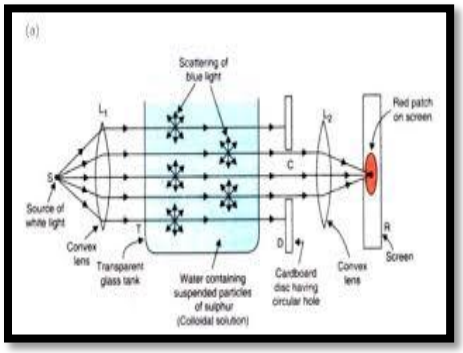

Fig. 7 Light scattering

- Electron microscope:

The particle size, shape and structure can be determined by the electron microscope. The electron microscope gives the picture of particles having molecular dimensions. The microscope have high resolving power which can be defined in term of d, the smallest distance by which two objects are separated and yet remain distinguishable. The smaller wavelength of radiation is used in the microscope. The distance is smaller and the resolving power is greater. The microscope uses visible light as the radiation source and is able to resolve only two particles separated by about 20nm.the turbidity method is used to estimate the concentration of dispersed particles and molecular weight of solute. The spectrophotometer measures the intensity of the transmitted light in the direction of incident light. The relationship between turbidity and relative intensity of the transmitted light.

➢ **Kinetic properties:**

- Brownian movement:

The colloidal particles undergo random collisions with the molecules of the dispersion medium and follow an irregular and complicated path. If the particle up to about 0.5 micrometer in diameter are observed the microscope or light scattered by the particles is viewed using ultra microscope. This movement is referred as Brownian movement. The scientist Robert brown proposed this theory. This motion may exhibited by particles as large as 5 micrometer. The thermal energy keeps particles in the motion. They collide with each other and with the wall of container. These collisions change the direction and velocity of particles. This molecular collision keeps particles in continuous motion. Brownian movement can be viewed by a light microscope and works against gravitational force. This movement can be decreased or stopped by increasing viscosity of medium.

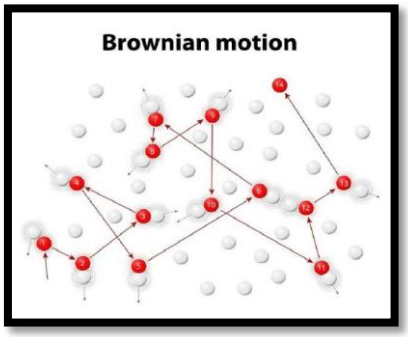

Fig. 8 Brownian movement

- Diffusion :

The Brownian motion colloidal particles spontaneously diffuse from a region of higher concentration to lower concentration. The rate of diffusion is expressed by flick's first law:

$$\frac{DM}{dT} = -D^S \frac{dC}{dx}$$

According to law the amount, dm of substance diffusing in time, dt across a plane of area is directly proportional to the change of concentration, dc, with distance traveled dx. D is diffusion coefficient and has dimension of area per unit time, dc/dx is concentration gradient. The minus sign denotes that the diffusion takes place in the direction of decreasing concentration. The diffusion coefficient of dispersed material is given by Stokes Einstein equation.

$$D = \frac{RT}{6\pi\eta rn}$$

Where N = Avogadro number, r= molar gas constant and r is radius of spherical particle.

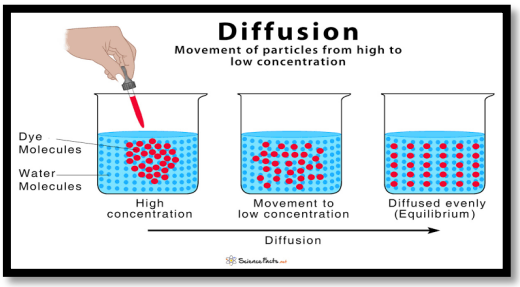

Fig. 9 Diffusion

- Osmotic pressure:

Osmosis is the movement of solvent molecules through semi permeable membrane in to region of higher solute concentration in the direction that tends to equalize the solute concentration on the two sides. The external pressure required to apply that there is no net movement of solvent across the membrane is called osmotic pressure. The osmotic pressure is described by the vant hoff equation.

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 1 Jan-Feb 2023, pp: 2471-2480 www.ijprajournal.com ISSN: 2249-7781

$$\pi = CRT$$

Where, c = molar concentration of solute, this equation is used to calculate molecular weight of the colloid in the dilute solution. Osmotic pressure of colloidal solution is a colligative property useful in determination of molecular weight of dispersed phase.

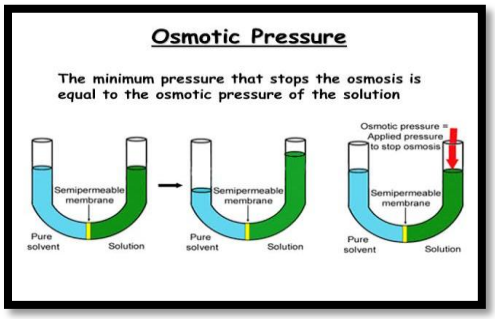

Fig. 10 Osmotic pressure

- Sedimentation:

The velocity of sedimentation is given by the strokes law,

$$v = \frac{2r^2(\rho - p_0)g}{9\eta^0}$$

Where g is acceleration due to gravity. The particles are subjected to the force of gravity, then the lower size limit of particle obeys strokes equation is about 0.5micrometer. this is because Brownian movement becomes significant and tends to offset sedimentation due to gravity and promotes mixing instead. A stronger force must be applied to bring about the sedimentation of colloidal particles. Sedimentation is influenced by the gravitational force. It is not a kinetic property of the colloidal system by itself under normal condition.

- Viscosity:

Viscosity is an expression of the resistance to flow of the system under an applied stress. The flow of dilute colloidal system is expressed by an equation developed by Einstein.

$$\eta = \eta_0(1 + 2 \cdot 5)$$

n0 is the viscosity of dispersion medium. The n is the viscosity of dispersion when volume fraction of colloid particles is fraction. The volume fraction is defined as the volume of the particle divided by the total volume of the dispersion. The more viscous a liquid the greater is the applied force required to make it flow at a particular rate. the shape of particles of the disperse phase affects the viscosity colloidal dispersions. The spherocolloids dispersions of relatively low viscosity where system containing linear particles are more viscous.

➢ **Electrical properties:**

- Electrophoresis:

A charged particle moves through a liquid during electrophoresis while being influenced by an applied potential difference. The dispersion is kept in an electrophoresis cell with two electrodes. (3)

The particles move to the oppositely charged electrode when a voltage is provided across the electrodes. An ultra microscope is used to observe the rate of particle migration, which depends on the charge on the particle.

The zeta potential serves as the rate-determining potential since the particle's shear plane is near the edge of the tightly bonded layer. The sign and magnitude of the zeta potential in a colloidal system can be calculated from the direction and rate of migration. The necessary equation, which generates the zeta potential, in volts, demands on knowledge of the sol migration speed, the medium's viscosity,, in poises (dynes sec/cm2), the medium's dielectric constant,, and the potential gradient, E, in volts/cm in an electrophoresis tube with a known length in cm. The mobility is referred to as the v/E.

$$\xi = \frac{v}{E} \times \frac{4\Pi\eta}{\varepsilon} \times (9 \times 10^4)$$

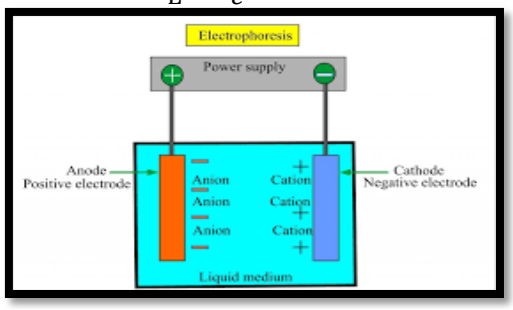

Fig. 11 Electrophoresis

- Electrical double layer: (3)

The theory of the electric double layer addresses this ion distribution and, consequently, the size of the electric potentials that exist in the vicinity of the charged surface. Imagine an electrostatic ally charged solid surface in contact with an electrolyte solution in water. The distribution of all the ions in solution tends to be equalized by these electrical forces as well as the thermal motion. As a result, some of the excess anions move towards the surface, while the remaining anions are dispersed in smaller proportions as one moves away from the charged surface.

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 1 Jan-Feb 2023, pp: 2471-2480 www.ijprajournal.com ISSN: 2249-7781

An electrically neutral area is created when the concentration of anions and cat ions at a specific distance from the surface is equal. Despite some areas with uneven anions and cat ions distributions, the system as a whole has a neutral electrical charge.

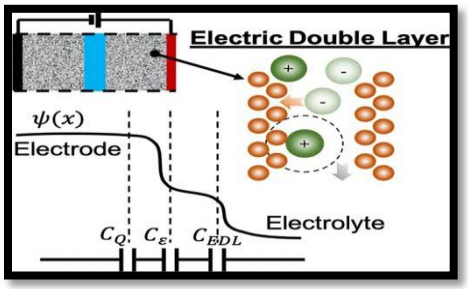

Fig. 12 Electric double layer

PHYSICAL STABILITY OF COLLOIDAL SOLUTIONS:

The stability of colloidal systems depends significantly on the presence, size, or lack of a charge on a colloidal particle. Two main techniques are used to stabilize scattered particles: applying an electric charge to them and enclosing each particle in a solvent sheath that prevents mutual adhesion when the particles contact due to Brownian movement. Only in the case of lyophilic sols does this second impact have any real significance. (1)

- Stability of lyophobic colloids:

Thermodynamic instability characterizes a lyophobic sol. Only the existence of electric charges on the surfaces of the particles in such cols can stabilize them. Similar charges create a force of attraction that repels the particles, preventing coagulation. Hence, adding a little amount of electrolyte to a lyophobic sol by giving the particles a charge tends to stabilize the system. The Brownian mobility of the particles in colloidal dispersions leads to frequent particle interactions. The main cause of colloids' stability is due to such interactions. The two kinds of interactions are electrostatic repulsions and van der Waals attractions. When attractions are more powerful than collisions, the particles stick together, and aggregate is created. The particles rebound after impacts and stay individually scattered when repulsions dominate. Repulsive forces dominate at low electrolyte concentrations, causing the particles to approach, only repellent forces are felt. The particles continue to be separate, and the system is seen as peptized or scattered. The double layer repulsive forces are significantly weaker with high electrolyte concentration, so that the attracting forces of van de Waals are dominant. These net forces of attraction between particles result in the process of coagulation, which results in the production of particle aggregates.

- Stability of lyophilic colloids:

A lyophilic colloid does not coagulate when an electrolyte is added to it in a modest amount, as was the case with lyophobic colloids (3). Nevertheless, agglomeration and sedimentation of the particles may happen if enough salt is introduced. This phenomenon is known as 'salting out'. Since the particles are encased in a solvent, lyophilic colloids are often stable. Ions get hydrated at high electrolyte concentrations, and water is no longer accessible to hydrate particles. As a result, colloidal particles start to flocculate or salt out. An ion's capacity to dissociate colloidal particles from water molecules is known as its coagulating power. Cat ions and anions are ranked in the order of hydrophilic sol coagulation using the Hofmeister or lyotropic series. When compared to less polar solvents like alcohol, acetone has a stronger attraction for water. Particles dehydrate when these are put to hydrophilic colloids. The charge that particles carry now determines how stable they are. When electrolytes are added, even a tiny amount might cause flocculation or easy salting out of the colloid.

- Protective colloid action: (3)

Hydrophobic colloids are protected by an encasing hydrophilic layer that forms when a significant amount of hydrophilic colloids with the opposite charge are added. The precipitating ions are kept from getting to the sol particles by this adsorbed layer. Therefore, the system is stabilized and coagulation is stopped. The entire colloid exhibits hydrophilic behavior. Protective colloid is the term for the colloid that aids in stabilizing the other colloid. The gold number is the most common way to express the protective property. The gold number represents the amount of protective colloid, measured in milligram's (dry weight of dispersed phase), that must be added to 10 mol of a cool sol in order to prevent a colour change from red to violet. Colloid coagulation is seen when an electrolyte such NaCl is added, indicating a violet tint. when defending the addition of colloids stabilizes the gold sol and stops the transition to violet. Greater the protecting action, the lower the gold number.

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 1 Jan-Feb 2023, pp: 2471-2480 www.ijprajournal.com ISSN: 2249-7781

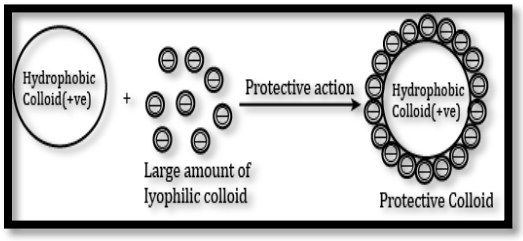

Fig. 13 Protective colloid action

PHARMACEUTICAL APPLICATIONS OF COLLOIDS: (1)

When developed a colloidal condition, some medications have been shown to have unexpected or enhanced therapeutic qualities. Colloidal silver chloride, silver iodide, and silver protein are excellent germicides and do not induce the irritation that is characteristic of ionic silver salts. Powder when taken orally, sulphur is not well absorbed, yet the same quantity of colloidal sulphur may be entirely absorbed, leading to severe effects and even death. Colloidal gold, copper, and mercury have all been employed in the treatment of syphilis, cancer, and paresis, respectively. Several synthetic and natural polymers are crucial to modern pharmaceutical practice. Smaller, non colloidal molecules are polymerized or condensed to produce larger, macromolecules known as polymers.

Proteins are significant natural colloids that make up the body's muscle, bone, and skin. Some drug molecules are bound by plasma proteins in such a way that the drug's pharmacologic effects are impacted. Starch and cellulose, two naturally occurring plant macromolecules that are employed as medicinal additives, are capable of surviving in the colloidal state.

An alternative to plasma is a macromolecule called hydroxy ethyl starch. other artificial polymers include utilized as coatings to solid dosage forms to shield medicines from ambient moisture or deterioration in the stomach's acid environment. In aqueous and oily pharmaceutical preparations, colloidal electrolytes (surface-active substances) are occasionally employed to improve the solubility, stability, and flavor of specific drugs.

➢ Hydro gels:

A hydro gels is a colloidal gel in which water serves as the dispersion medium as opposed to a gel, which is a colloid with a liquid serving as the dispersion medium and a solid serving as the dispersed phase (see Key Concept, Colloidal Systems).

Hydro gels, both natural and synthetic, are now utilized for tissue engineering, wound healing, and as sustained-release delivery systems. Wound gels are great for maintaining or establishing a moist environment. Certain hydro gels have the ability to absorb, deslough, and debride necrotic and fibrotic tissue. Hydro gels may include human cells when employed as scaffolds for tissue engineering to promote tissue repair. The pharmaceutical chemicals that make up hydro gels allow for a sustained release of medication. Hydro gels that are sensitive to the environment have received special consideration. These hydro gels can detect changes in temperature, pH, or the concentration of a particular metabolite and release their load as a response. These hydro gels can be employed as controlled medication delivery systems for specific sites.

Hydro gels that respond to particular molecules, such glucose or antigens, can be employed as both drug delivery systems and biosensors. Hydro gels that are electro sensitive, pressure-responsive, and light-sensitive may potentially be employed for drug administration.

➢ Micro particles:

Micro particles are loaded microspheres of natural or synthetic polymers that are tiny (0.2–5 m).

Vaccines and anti-cancer medications were first delivered via micro particles. Recently, unique micro particle characteristics have been created to enhance medication delivery effectiveness, release patterns, and drug targeting. The development of strategies to lessen the uptake of the nanoparticles by the reticulo endothelial system cells and increase their uptake by the targeted cells has been the focus of numerous studies. For instance, poly(L-lysine)-g-poly(ethylene glycol) (PLL-g-PEG) functional surface coatings of no biodegradable carboxylated polystyrene or biodegradable poly(D,L-lactide-co-glycolide) microspheres were investigated in an effort to protect them from nonspecific phagocytosis and to enable ligand-specific interactions through molecular recognition. Due to their enhanced drug solubilization, lengthy shelf life, and simplicity in preparation and administration, micro emulsions make good candidates for future drug delivery systems. Oil external, water external, and middle phase micro emulsions are three different types that can be employed for medication administration. Micro emulsions are often made of more or less homogeneous particles as opposed to micro particles, which show clear variances between the outer shell and core. Micro emulsions are utilized to deliver various pharmaceutical substances with controlled release and on-target distribution.

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 1 Jan-Feb 2023, pp: 2471-2480 www.ijprajournal.com ISSN: 2249-7781

➢ Liposome's:

Liposomes are made up of an inner liquid core and an exterior unit or multi laminar membrane. Liposomes are often created with phospholipids that are either natural or synthetic and resemble those found in cellular plasma membranes. This commonality makes liposomes simple for cells to utilize. Liposome's can be loaded with pharmaceuticals or other materials in two ways: hydrophilic substances can be dissolved in the inner liquid core of liposomes, and lipophilic chemicals can be linked to the liposomal membrane. The liposome membrane can be altered by polymeric chains, targeting moieties, or antibodies that are specific to the targeted cells in order to reduce their uptake by reticulo endothelia system cells and/or increase it in the targeted cells. Liposome's have several uses as drug delivery vehicles since they are biodegradable, nontoxic, and relatively simple to make.

➢ Micelles:

Liposome-like particles called micelles lack the internal liquid space of liposome's. They can therefore be utilized as water-soluble, biocompatible micro containers for the administration of medications that are hydrophobic and have poor solubility. Like liposome's, micelles can be changed on the surface to engage more specifically with their antigens by adding antibodies or other targeting molecules.

➢ Nanoparticles:

Nanocapsules are submicroscopic colloidal drug carrier systems made up of a thin polymer membrane surrounding an aqueous or oily core. Such nanocapsules can be produced using either interfacial nano deposition of a preexisting polymer or the interfacial polymerization of a monomer. Beginning in the 1990s, solid lipid nanoparticles were created as an alternative to emulsions, liposomes, and polymeric nanoparticles as a carrier system. They were particularly utilized in pharmaceutical and topical cosmetic compositions. Roy et al. have created a brand-new photodynamic treatment medication carrier based on nanoparticles. This carrier can maintain the crucial process of photo generation of singlet oxygen, required for photodynamic action, while yet offering stable aqueous dispersion of hydrophobic photosensitizes. Furthermore, nanoparticles have been used as nonverbal gene delivery techniques.

➢ Nan crystals:

Recent years have seen a surge in interest in biology and medicine for inorganic nanostructures that interact with biological systems. aimed to examine the viability of in vivo targeting utilizing semiconductor quantum dots (qdots), which are tiny (less than 10 nm) inorganic nanocrystals with special luminous properties. Qdots' fluorescence emission is persistent and can be adjusted by changing the particle size or composition. These can be directed exactly to the intended organs and tissues by including a targeting moiety. Particularly, it was shown that ZnS-capped CdSe coated with a lung-targeting peptide to blood arteries or lymphatic vessels in tumors.

REFERENCES:

[1]. Patrick J Sinko, Yashveer Singh. Wolters. Martin's Physical Pharmacy and Pharmaceutical Sciences. 2006.
[2]. Schott, H. Remington's Pharmaceutical Sciences. 16. 1980.
[3]. Hiemenz, P. C. Principles of Colloid and Surface Chemistry. [ed.] marcel dekker. 2. new york : s.n., 1986.
[4]. Overbeek, E. J. W. Verwey and J. Th. G. Theory of the Stability of Lyophobic Colloids. 1948.
[5]. E. J. W. Verwey and J. Th. G. Overbeek, Theory of the Stability of Lyophobic Colloids, Elsevier, Amsterdam, 1948.
[6]. Advances in Pharmaceutical Sciences,. Mulley, B. A. New york : s.n., 1964.
[7]. B Uottger, D. Frenkel, E. van de Riet, R. Zijlstra, Diffusion of Brownian particles in the isotropic phase of a nematic liquid crystal, Mol. Cryst. Liq. Cryst. 2 (1987) 539 –547
[8]. E. Keh, S. Partyka and S. Zaini, J. Colloid Interface Sci. 129,363, 1989
[9]. P. Atkins, J. D. Paula, Physical Chemistry, W. H. Freeman, NY and Company, 7 Ed., 2006