9. COLLOIDAL DISPERSIONS

Preparations are prepared by dispersing a solid, liquid or gaseous phase in a liquid phase. They consist of at least two phases. The phases are either the dispersed phase or the inner phase and the other is the continuous phase or outer phase called the dispersion medium or carrier (vehicle). The size of the colloidal particles is generally between 0.001 and 1000 nm. The solutions in which macromolecular substances such as polymers and proteins are dispersed at the molecular level are in the form of colloidal dispersion. Colloidal systems with optical, kinetic and electrical properties are classified into lyophobic, lyophilic and amphiphilic (associate, micellar) colloidal dispersions.

Practice 9.1.

Protargol	0.5 g
Distilled water q.s.	100.0 ml

Preparation:
Protargol is weighed on a watch glass, transferred to a flask with some of the boiled and cooled purified water. The mouth is closed and waited until homogenous dispersion. Dispersion is transferred to the graduated cylinders and desired volume is completed with the remainder of the purified water.

Practice 9.2.

Kollargol	%1 (w/w)
Distilled water	q.s.

Preparation:
Prepared as Protargol preparation. However, the desired weight is completed.

Questions
1. What are content of protargol and Kollargol?
2. What are the uses of protargol and kollargol preparations?
3. Are there any marketed medicinal preparations?

10. SUSPENSIONS

Pharmaceutical suspension; a coarse dispersant formed by dispersing a finely powdered insoluble solid material in a liquid medium. In almost all pharmaceutical suspensions, the particle size is greater than 0.1 μm. In suspensions, heterogeneous dispersing systems homogenous appearance, dispersed phase particles in dispersing medium collapse over time. However, it is desirable that the disintegration of a pharmaceutical suspension is reversible, homogeneously dispersed upon agitation and formulated so as to allow for complete drug dose each time.

In the suspension formulations, in the inner phase active ingredient, wetting agent, protective colloid, flocculation, deflocculation, suspension agents, thickeners; in the external phase carrier (vehicle), pH adjusters (buffers), preservatives, foaming agent, color, odor and flavor may be availible. Well formulated suspensions should have some basic properties. Particle size distribution should be in a narrow range and should not form cakes when precipitating. Viscosity should be easy to flow. Chemical stability must be stable, homogeneous and resistant to microbial contamination.

When the suspension is prepared in a small scale. First, coarse particulate powder (d> 5mm) is made into fine particulate powder (d = 1-5 mm). Powder are added to the mortar according to the geometric dilution method. A portion of the carrier (water) is added to the blend in mortar. Other water-soluble substances are dissolved in some of the remaining water, added to mortar and blend is transferred graduated cylinders. Desired volume is completed with water and filled into the packaging container and labeled. In addition, a sticker bearing the warning "Shake before use" must be affixed.

Pharmaceutical suspensions;
• Orally applied mixtures
• Externally applied lotions
• Injectable (parenteral) suspensions

There are several important parameters, which determine the quality, acceptability and performance of the suspension drug formulation. Among the main parameters considered in the evaluation of suspensions are;

- Appearance, Smell, Color
- Ph
- Density
- Viscosity
- Sedimentation Parameters
- Easy Miscibility
- Particle Size
- Zeta Potential
- Efficacy
- Microbial Content
- Human Safety

10.1. Calculation of Sedimentation Volume

The volume (V_0) or height (h_0) of the prepared suspension is measured immediately after preparation. After the suspension has settled, the volume (Vu) or height (h_u) of the sediment is measured. The value of F is calculated from V_u/V_0 or h_u/h_o. F must be equal to 1 or close to 1. Ideally, F = 1.

10.2. Determinatipn of Flocculation Number

The sedimentation volume (**F_∞**) at which a suspension formulation is prepared is calculated. A flocculation agent is then added to this formulation to form a flocculent suspension. In this case, the F value is calculated. The **F / F_∞** ratio is the degree of flocculation "β".

The β value can also be calculated from the ratio of the final sedimentation volume (V_u) of the flocculated suspension to the final sedimentation volume (V_∞) of the deflocculation suspension ($\beta = V_u/V_\infty$) It is desirable that the β value is high if the flocculation suspension is aimed at the formulation.

10.3. Geometric Dilution Method

It is a method applied when mixing powder with each other. First, the lowest amount of substance in the formulation is added mortar. Then add the other powder in same amount with the lowest powder and mix it. The addition of all the powder is completed by following the order from the least to the greatest and adding up to the quantity in the mortar each time. After each joint, mixing is done.

Practice 10.1.

Determination of sedimentation volume in suspensions

Zinc oxide		5 g
Glycerine		20 g
Purified water	q.s	70 ml

Preparation:
Zinc oxide is thoroughly crushed with glycerin in the mortar. Then, after mixing with some quantity of water, the mixture is taken into a graduated cylinder. The residue in the mortar is then transferred to the remaining water and the suspension is completed in 70 ml.
After the suspension in the graduated cylinder is thoroughly shaken, put it in 10 ml of water in 3 separate test tubes placed next to one tube. Tubes A, B, C are coded as.

Add 10 ml of water to A tube
10 ml of 0.3% to the B-tube
10 ml of 1% to the C-tube carboxymethylcellulose (25 cP) solution

and the tubes are shaken. There are 20 ml suspension in each tubes (V_0) . After agitation, the volume (Vu) or height (hu) of the precipitate formed in each tube at 5, 10, 15, and 20 minutes and then every 20 minutes for 2 hours is measured.

• Display the sediment volumes (V_u, ml) or sediment heights (hu, cm) of suspensions of tubes A, B and C at specific times as a table
(Table10.1).
• Calculate sedimentation volumes ($F= V_u/ V_0$) at specific times for the suspensions in tubes A, B and C and show the data in a table
(Table 10.2).

Tablo 10.1. Sedimentation height (h_u) of suspensions at specific time intervals.

Tube code	Time (minute)									
	5	10	15	20	40	60	80	100	120	140
A										
B										
C										

Tablo 10.2. Sedimentation volumes of suspensions at specific time intervals (F).

Tube code	$F= h_u / h_0$									
	5	10	15	20	40	60	80	100	120	140
A										
B										
C										

1- Show in a table sediment initial height (h_0, cm), sediment height values (h, cm) at specific times (t, minute) and measured sedimentation volume values (F). Show this values in a table for each suspension.

Tablo 10.3. The h_u and F values obtained based on the h_0 and t of the suspensions.

t (minute)	h_0 (cm)	h_u (cm)	$F= h_u/ h_0$
5			
10			
15			
20			
40			
60			
80			
120			
140			

h_0 : Initial height (cm)
t : Time (minutes)
h_u : sediment height at t time (cm)
F : Sedimentation volume

2- Using the Table 10.3, plot the graph time- F values . It will be marked as 1 cm on the graphic paper every 20 minutes
3- Interpret the graph and determine the formula of the suspension giving the optimum F value .

Practice 10.2.

Determination of Flocculation Degree (B) in Suspensions

Bismuth subnitrate	5 g
Methylcellulose solution (1%)	5 ml
Purified water q.s.	25 ml

A graduated bismuth subnitrate and methylcellulose solution is added and completed with 25 ml water to form a deflocculant suspension. Put 5 ml of this suspension into 4 tubes. Add as flocculation agent monobasic potassium phosphate (KH2PO4) solution (0.5% w / v) is added 5 ml of distilled water to 1st tube, 1 ml to 2nd tube, 2 ml to 3rd tube and 3 ml to 4th tube. 2nd, 3rd, and 4th tubes complete till 10 ml with distilled water.

The sedimentation volumes of the defloculated suspension (1st tube) and flocculated suspensions (2nd, 3rd and 4th tubes) are determined and the flocculation degrees (β) are calculated.

$$\beta = F/F_{\infty}$$

F : Sedimentation volume of flocculated suspension
F_{∞} : Sedimentation volume of deflocculation suspension

Questions:
1- Interpret the β values of the suspensions you have prepared. Which is the best one?

Practice 10.3.

Lotion

Precipitated sulfur	10 g
Talk	20 g
Zinc oxide	20 g
Glycerine	20 g
Methylcellulose (25 cP)	1 g
Purified water	100 g

Preparation:
1/3 of the required amount of water is heated to 80-90^0 C. It is mixed by adding methylcellulose. Wait for half an hour. The mixture is cooled to 10 ° C by adding remaining water.
First sulfur is put into glass mortar and crushed thoroughly. Then add the same amount of talc (5g) and mix well. Each time the joints are made up to the total amount of the substance in the mortar, homogeneous mixing of talc and zinc oxide with sulfur is ensured. Glycerine is added dropwise to the mixture and the methylcellulose mucilage is added to the mortar and mixed well. The mixture is then bottled, labeled and delivered.

Questions:
1- What is the purpose of this medicine and how is it used?
2- What label is affixed on the packaging?
1- Write down roles of each item in the formula

Practice 10.5.

Kaolin-Pectin Suspension (NF XIV)

Kaolin		20.000 g
Pectin		1.000 g
Gummi Tragacanthae		0.500 g
Sodium saccharine		0.100 g
Glycerin		2.000 ml
Benzoic acid		0.200 g
Mint essence		0.075 ml
Purified water	q.s.	100.000 ml

Preparation:
Kaolin is mixed with 50 ml of water. Pectin, gum and sodium saccharin are added to the mixture in the mortar and glycerin is added to make it homogeneous. The benzoic acid is dissolved in 30 ml of hot water and the solution is cooled and mixture is added to the mortar. Kaolin dispersion and peppermint essence is added and completed with the desired volume of water in the graduated cylinder.

Questions:
1- What is the purpose of this suspension?
2-Write down roles of each item in the formula