Program	B. Pharmacy
Semester	1st semester
Subject /Course	Pharmaceutics-1
Subject/Course ID	BP 103T
Module No.	02
Module Title	Pharmaceutical Calculations, Powders and Liquid Dosage Forms
Course coordinator	Dr. Neelam Sharma

Learning Outcome of Module-2

LO	Particular
103.3	To know the Pharmaceutical Calculations
103.3	To understand the formulation of powders andliquid dosage forms.

Module Content Table

No.	Topic
1.	Pharmaceutical Calculations: Weights and measures – Imperial and Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.
2.	Powders Definition, classification, advantages and disadvantages, Simple and compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions
3.	Liquid Dosage Forms: Advantages and disadvantages of liquid dosage formsExcipients used in formulation of liquid dosage forms, Solubility enhancement techniques.

Pharmaceutical Calculations

The strength of a pharmaceutical preparation may be increased or decreased by changing the proportion of active ingredient to the whole. A preparation may be strengthened or made more concentrated by:

1. The addition of active ingredient,

2. by admixture with a like preparation of greater strength,

3. Or through the evaporation of its vehicle, if liquid. The strength of a preparation may be decreased or diluted by: 1. the addition of diluent or 2. by admixture with a like preparation of lesser strength.

Special Considerations of Altering Product Strength in Pharmaceutical Compounding In the course of pharmacy practice, there are occasions in which the alteration of the strength of a pharmaceutical preparation is either desirable or required.The dilution of a liquid dosage form, as a solution or suspension, may be desired toprovide a product strength more suitable for use by a particular patient (e.g., pediatric,elderly, those in disease states). The diluent is selected based on its compatibility with the vehicle of the originalproduct; that is, aqueous, alcoholic, hydroalcoholic, or other. The dilution of a solid dosage form (as a powder or the contents of a capsule) or asemisolid dosage form (as an ointment or cream) also may be performedto alter thedose or strength of a product. Again, the diluent is selected based on its compatibility with the original formulation

Pharmacists also may find occasion to dilute concentrated acids, alcohol preparations, or very potent therapeutic agents, to meet special compounding requirements. The concentration of a liquid preparation, as through the evaporation of aportion of its solvent or vehicle, rarely is performed nowadays. However, the fortification of a liquid, solid, or semisolid dosage form, bythe addition of a calculated quantity of additional therapeutic agent, remains a viable practice in pharmacy compounding.

Relationship between Strength and Total Quantity

If a mixture of a given percentage or ratio strength is diluted to twice itsoriginal quantity, its active ingredient will be contained in twice as many partsof the whole, and its strength therefore will be reduced by one half. By contrast, if a mixture is concentrated by evaporation to one-half its originalquantity, the active ingredient (assuming that none was lost by evaporation)will be contained in one half as many parts of the whole, and the strength willbe doubled. So, if 50 mL of a solution containing 10 g of active ingredient with a strength of 20%or1:5 w/v are diluted to

100 mL, the original volume is doubled, but the original strengthis now reduced by one half to 10% or 1:10 w/v. If, by evaporation of the solvent, the volume of the solution is reduced to 25 mLoronehalf the original quantity, the 10 g of the active ingredient will indicate a strength of40% or 1:2.5 w/v.

If, then, the amount of active ingredient remains constant, any change in the quantity of a solution or mixture of solids is inversely proportional to the percentage or ratio strength; that is, the percentage or ratio strength decreases as the quantity increases, and conversely. This relationship is generally true for all mixtures except solutions containingcomponents that contract when mixed together.

Problems in this section generally may be solved by any of the following methods:

1. Inverse proportion.

2. The equation:

(1st quantity) X (1st concentration) = (2nd quantity) X (2nd concentration) or Q1 X C1 = Q2 X C2.

3. By determining the quantity of active ingredient (solute) present or required and relating that quantity to the known or desired quantity of the preparation.

How many milliliters of water should be added to a 80 mL of a 20% w/v aqueous solution to prepare 3% w/v solution?

Q1 (quantity) x C1 (concentration) = Q2 (quantity) x C2 (concentration)

80 (mL) x 20 (%) = x (mL) x 3 (%)

X = 533.3 mL – 80 mL = 453.3 mL of water added

OR

80 mL x 20% (or 0.2) g/ mL = 16 g solute

3 g 100 mL

16 g x mL

X = 533.3 mL (quantity of 3% w/v solution that 16 g of solute will appear

X = 533.3 mL – 80 mL = 453.3 mL of water added

If an injection containing a medication, 50 mg/10 mL, is diluted to 1L, calculate percent strength of the resulting solution?

Convert mg to g

50 mg/ 1000 = 0.05 g / 10 mL

Convert 0.05 g/ 10 ml to percentage

0.05 g 10 ml

x 100 ml x= 0.5%

Q1 x C1 = Q2 x C2

10 (mL) x 0.5 (%) = 1000 (mL) x

X (%) X= 0.005%

Dopamine HCl injection is available in 5-mL vials each containing 40 mg of dopamine HCl per milliliter. The injection must be diluted before administration by intravenous infusion. If a pharmacist dilutes the injection by adding the contents of one vial to 250 mL of 5% dextrose injection, calculate the percent concentration of dopamine HCl in the infusion.

Convert mg to g

40/ 1000 = 0.04 g

Calculate the amount of dopamine in each vial

0.04 g 1 mL

X 5 mL x=0.2 g

Calculate the percentage of dopamine in each vial

0.2 g 5 mL

X 100 mL x= 4%

Calculate total infusion volume after addition of dopamine vial

5 mL (dopamine HCl injection) + 250 mL (5% dectrose injection) = 255 Ml

Solving by equation:

Q1 x C1 = Q2 x C2 (5 ml x 4 % = 255 ml x X %)

X=0.078 %

Stock solutions

Stock solutions are concentrated solutions of active (e.g., drug) or inactive (e.g., colorant) substances and are used by pharmacists as a convenience to prepare solutions of lesser concentration.

How many milliliters of a 1:400 w/v stock solution should be used in preparing 1 gallon of a 1:2000 w/v solution?

C1×Q1=C2×Q2

0.05% ×3785 mL= 0.25% × X mL

X= 757 Ml

Some calculations are used in pharmacy practice in which

1. the strength of a diluted portion of a solution is defined,

2. the strength of the concentrated stock solution used to prepare it must be determined.

For example, by the need of a pharmacist to prepare and dispense aconcentrated solution of a drug and direct the patient to use a specifichousehold measure of a solution (e.g., 1 teaspoonful) in a specified volumeof water (e.g., a pint) to make of solution of the desired concentration (e.g., for irrigation or soaking).

This permits:

1. The dispensing of a relatively small volume of liquid,

2. Enabling a patient to prepare relatively large volumes as needed, ratherthan carrying home gallons of a diluted solution from a pharmacy.

How many milliliters of a 17% w/v concentrate of benzalkonium chloride should be used in preparing 100 mL of a stock solution such that 5 mL diluted to 60 mL will yield a 0.13% solution of benzalkonium chloride?

60 mL × 0.13% w/v = 0.078 g of benzalkonium chloride in 60 mL, which is alsothe amount in 5 mL of the stock solution. Thus, the amount of benzalkonium chloride in 100 mL of the stock solution is:

$$0.078g * 100mL/5mL = 1.56g$$

And the amount o the 17% w/v concentrates to use is:

$$1.56g * 100mL/17g = 9.18mL$$

Allegation

Allegation is an arithmetical method of solving problems that involves themixing of solutions or mixtures of solids possessing different percentagestrengths. Alligation medial is a method by which the “weighted average” percentagestrength of a mixture of two or more substances of known quantityandconcentration may be easily calculated.

Example Calculations Using Alligation Medial

What is the percentage strength (v/v) of alcohol in a mixture of 3000 mL of 40% v/valcohol, 1000 mL of 60% v/v alcohol, and 1000 mL of 70% v/v alcohol? Assume nocontraction of volume after mixing

$$0.40 * 3000mL = 1200mL$$

$$0.60 * 1000mL = 600mL$$

$$0.70 * 1000mL = 700mL$$

total= 5000mL, 2500mL

2500(mL) 5000mL=0.50*100=50% answer

Alligation is a rapid arithmetic method used to solve problems that involve mixing two products of different strengths to form a product having a desired intermediate strength. The term alligation has its origin in Latin, alligation which means the art of attaching and therefore refers to lines drawn during calculation to bind quantities together.

Alligation medial is used in calculating the strength of the mixture of two or more components of different strengths. It gives the weighed average percentage strength of a mixture resulting from components of known quantities and concentration.

Alligation method is used to calculate:

(a) The amount of diluent that must be added to a given amount of higher strength preparation to make a desired lower strength.

(a) The amounts of active ingredient that must be added to a given amount of lower strength preparation to make a higher strength.

(a) The amount of higher and lower strength preparations that must be combined to make a desired amount of an intermediate strength.

It is often more practical to dilute a known strength preparation than it would be to compound an entire preparation. Sometimes, a simple calculation using alligation allows us **to calculate the** amount of diluent to be added to an already prepared higher strength preparation to form the strength

Sometimes, it is necessary to increase the strength of a preparation by adding an active ingredient for example if 1% coal tar ointment is available and required strength is 2 %, it can be accomplished by adding an unknown amount of coal tar (100 percent).The unknown amount may be found by using alligation method.

Procedure of Calculation

a) Draw a problem matrix
b) Insert quantities as shown
c) Subtract along the diagonals
d) Read along the horizontals

The desired strength always goes in the center square of the matrix. The desired strength is the strength of the preparation that one wishes to make.

Example

In what proportions should a preparation containing 15% of drug be mixed with one containing 30% of drug to prepare a mixture of 20% strength.

Thus 5 parts of 30% and 10 parts of 15% drug mixed together will give a mixture of 20% drug strength.

Proof of Alligation Method

Suppose a product of X percentage strength is to be prepared by mixing constituents of percentage Y (Higher) and Z (lower).

Hence desired percentage strength of X can be obtained by mixing together (X- Z) parts of Y and (Y-X) parts of Z

$$(X-Z) \times Y + (Y-X) \times Z = [(X-Z) + (Y-X)] \times X$$

Solving the equation

$$XY-ZY +YZ-XZ = [X-Z + Y-X] \times X$$

$$XY – XZ =[Y-Z]xX = XY -XZ$$

This equation proves the line diagram method of alligation is correct and most suitable in such calculation

Example 1

What is the % of alcohol in a mixture obtained by mixing 5 L of 25%, 1L of 50% and 2 L of 95% alcohol?

Solution

(1 Litre = 1000 ml)

5000 mix 25%= 1250

1000 ml x 50% = 500

2000 ml x 95% = 1900

8000 ml

Final mixture concentration = 45.6%

Example 2

What is the strength of zinc oxide in an ointment prepared by mixing 400 g of 10%, 100 g of 20% and 50 g of 5% ointment?

400 g x 10% = 40

100 g x 20% = 20

50 g x 5% = 2.5

550 ml 62.50 62.50 : 550 : : X x 100

Final mixture concentration = 45.6%

Example 3

How many parts of 70%, 60% 40% and 30% alcohol should be mixed to get 50% alcohol. Calculate

20:10:10:20 or 10:20:20:10

Example 4

In what proportion should 12%, 8% and 3% alcohol be mixed to get 5% alcohol"?

Solution

7+3 =10

Pharmaceutical Powders

Powders are solid dosage form containing dry mixtures of finely divided drug substance(s) and excipients intended for internal or external use. Although the use of powders as a dosage form has been replaced largely by the use of tablets and capsules in modern medicine, they represent one of the oldest dosage forms and present certain advantages that have led to their continued use as pharmaceutical dosage forms.

Powders can be classified in various ways and these include

1. Classification based on use
2. Classification based on particle size and
3. Classification based on dispensing/ by the way they are presented to the user.

1. Classification of powders based on use

Based on use, pharmaceutical powders can be classified as powders for internal use or powders for external use. These are briefly described as follows:

a. Pharmaceutical powders for internal use

Pharmaceutical powders for internal use are preparations consisting of solid, loose, dry particles of varying degrees of fine particle size that contain one or more active substances, with or without excipients. Powders for internal use can be taken orally (e.g., Oral powders), administered through the nose as snuffs, or blown into a body cavity as an insufflation.

b. Pharmaceutical powders for external use

Topical powders also known as powders for cutaneous application or powders for external use are preparations consisting of solid, loose, dry particles of varying degrees of fineness. They contain one or more active substances, with or without excipients and, if necessary, appropriate coloring matter.

Powders for external use can be applied to compromised areas of the body. Highly sorptive powders should not be used for topical powders that are to be applied to oozing wounds, as a hard crust may form.

2. Classification of powders based on particle size

After preparation powders are classified according to their particle size. In order to qualify the particle size of a given powder, the USP uses the following descriptive terms:

a. Very coarse (No. 8) powder: All particles pass through a No. 8 sieve (2.38 mm) and not more than 20% pass through a No. 60 sieve.

b. Coarse (No. 20) powder: All particles pass through a No. 20 sieve (0.84 mm) and not more than 40% pass through a No. 60 sieve.

c. Moderately coarse (No. 40) powder: All particles pass through a No. 40 sieve (0.42 mm) and not more than 40 % pass through a No. 80 sieve.

d. Fine (No. 60) powder: All particles pass through a No. 60 sieve (0.25 mm) and not more than 40% pass through a No. 100 sieve.

e. Very fine (No. 80) powder: All particles pass through a No. 80 sieve (0.18 mm). There is no limit to greater fineness.

3. Classification of powders based on dispensing

Pharmaceutical powders are classified based on dispensing or by the way they are presented to the user into bulk or divided powders.

a. Bulk powders

Bulk powders refer to a mixture of all the materials (usually non-potent drugs), packed into a properly designed bulk containers, such as a tight, wide-mouthed glass or plastic bottle, and are intended for either internal or external administration. The major problem of bulk powders is the inaccuracy of dose.

The dose of bulk powders can be affected by many factors, including

Types of powder dosage forms

Powders as dosage forms can be classified based on their usage and/or phys-ical characteristics as detailed in Sections.

1. Oral powders in unit dose sachets

Powders containing drugs intended for children, such as antibiotics, are commonly made available in powder-filled unit-dose sachets. These pow-ders are intended for administration after premixing with a food product, such a yogurt or juice. For example, the antibiotic Augmentin

(amoxicillin in combination with clavulanic acid) and probiotics are available as a sachet. The powder blend is required to have a sweet taste, pleasant fla-vor, appealing color, and an acceptable mouthfeel. Uniform filling of the powder blend in sachets is the only major concern in the dispensing of this dosage form.

2. Powders for oral solution or suspension

Powders for reconstitution into an oral solution or suspension are com-monly dispensed to the patient in multidose bottles. The pharmacist recon-stitutes the powder using water, and the patient is instructed to consume a defined dose, by volume, of the resulting suspension. This mode of drug dispensing is intended to minimize the effects of physical instability of the suspension and/or the chemical instability of the drug compound on storage. This dosage form is exemplified by amoxicillin powder for oral suspension.

The powder blend is required to have a sweet taste, pleasant flavor, appealing color, and an acceptable mouthfeel after reconstitution. Stability of both the dry powder and the reconstituted suspension are important considerations. Also, in addition to the uniform filling of the powder blend in bottles, dose-to-dose uniformity of dispensed solution or suspension after reconstitution of a bottle of powder needs to be established.

3. Bulk powders for oral administration

Herbal medicines, such as laxatives, are commonly dispensed in bulk powder containers for dose dispensing and administration by the patient. The husk of the plant ispaghula as a laxative exemplifies these. These powders must be rel-atively nontoxic with a wide range of well-tolerated doses. These are generally over the counter products that are meant for self-medication by the patient.

4. Effervescent granules

Effervescent granules are sold as bulk powders intended for dispensing of a unit dose and reconstitution with water to form a solution by the patient immediately before administration. Upon contact with water, effervescence is produced by the reaction between an acidic component, such as succinic acid or tartaric acid, and a carbon dioxide-releasing basic component, such as sodium carbonate or bicarbonate. Effervescent granules must be kept in dry state to prevent this reaction before reconstitution by the patient.

5. Dusting powders

Dusting powders are intended for external, local application. The antibiot-ics in powder form for application to open skin wounds exemplify these.

Characteristics of powder blends for their use as dusting powders include low and flexible dose, low and relatively uniform particle size, high density and low aerosolization, and nongrittiness.

6. Dry powder inhalers

Dry powder inhalers (DPIs) are devices that deliver medication to the lungs using an inhalation device in the form of a dry powder. These devices are commonly used for drug delivery for local action, for example, for asthma, bronchitis, and emphysema.

Powder characteristics required for their use in DPIs include good flow, lack of adhesion to the material of package, low and uniform particle size for deposition in the appropriate region of the lung, and an adequate low drug dose.

Advantages of extemporaneous compounding of powders

Compounding of powders for dispensing in pharmacy presents the advan-tages of flexibility in dosing and a relatively good chemical stability. There are, however, disadvantages to extemporaneous compounding of powders as a dosage form. The preparation methods are time consuming and are generally not suitable for drugs that are highly potent, unpleasant tasting, or hygroscopic.

The compounded powders can either be dispensed in unit doses or as bulk powders in a multidose container. The dispensing of bulk powders has a further disadvantage of dosage inaccuracy resulting from several fac-tors such as the BD of powder, consolidation during handling, and the method of measuring the dose by the patient. For these reasons, the dis-pensing of bulk powders is restricted to drugs with some dosage flexibility. These include, for example, herbal and other natural products such as laxa-tives and nutraceuticals and dusting powders intended for external, local application.

Extemporaneous compounding techniques

Extemporaneous compounding of powders as dosage forms in the pharmacy utilizes the same basic pharmaceutical processes, such as weighing, mixing, and sifting—with differences in the equipment used and scale of compounding. For example:

- Efficient mixing by geometric dilution of the component in the least quantity, such as the potent drug, is carried out by mixing it with an equal quantity of the larger component, such as a diluent, followed by repeated mixing with double the quantity of the larger component.Deliquescent substances are solid matter that can get dissolved by absorbing water vapor. The resulting solution is an aqueous solution. This process is known as deliquescence. These deliquescent substances have a high affinity to water.

The atmosphere has 0-4% of water vapor, depending on the location and the time of the day. Since there are many other gases and vapors in the atmosphere, water vapor has a partial pressure. Deliquescence happens when the vapor pressure of the solution that is going to form is less than the partial pressure of water vapor in the air.

Most common examples of deliquescent substances include some salts; for example, sodium hydroxide, potassium hydroxide, ammonium chloride, sodium nitrate, calcium chloride, etc. These substances can be used as desiccants.

Efflorescent substances are solids that can undergo spontaneous loss of water from hydrated salts. Hydrated salts are inorganic salts containing water molecules combined in a definite ratio. These salts can lose these water molecules when kept outside. This process is known as efflorescence.

Efflorescence occurs when the aqueous vapor pressure of the hydrate is greater than the partial pressure of the water vapor in the air. Efflorescent substances include most hydrated salts. Examples include Na_2SO_4, $10H_2O$, Na_2CO_3, $10H_2O$, and $FeSO_4$. A common example of efflorescence is drying of cement.

Hygroscopic substances are solids that can absorb or adsorb water from its surroundings. When water vapor is absorbed by hygroscopic substances, the water molecules are taken into the spaces of the crystal structure. This causes the volume of the substance to increase. Hygroscopy can result in changes in the physical properties of the hygroscopic substances; such properties include color, boiling point, viscosity, etc.

Most examples of hygroscopic substances include salts. Some examples are Zinc chloride ($ZnCl_2$), sodium chloride (NaCl) and sodium hydroxide (NaOH). There are also some other common substances we know as hygroscopic. These compounds include honey, silica gel, germinating seeds, etc.

Deliquescent: Deliquescent substances are solids that absorb moisture from the atmosphere until they dissolve in the absorbed water and form solutions.

Efflorescent: Efflorescent substances are solids that can undergo spontaneous loss of water from hydrated salts.

Hygroscopic: Hygroscopic substances are solids that can absorb or adsorb water from its surroundings.

Monophasic Liquid Dosage Forms - Solutions

Solute + Solvent à Completely soluble

Liquid dosage forms are pourable pharmaceutical preparations which contain a mixture of drug substance and excipients dissolved or suspended in a suitable solvent or mixtures of solvents. They are designed to provide the maximum therapeutic response in patients who have problem of swallowing solid dosage forms and/or to produce rapid therapeutic effects.

Liquids dosage forms can be solutions or dispersions. Pharmaceutical solutions are clear, homogeneous, and single-phase systems containing one or more drug substances dissolved in one or more solvents, while liquid dispersions can be two-phase or multiphase systems, composed of one phase dispersed through another phase(s). The dispersed phase can be composed of solid particles (suspensions), oil droplets (emulsions), micelles (surfactant solutions), and lipid vesicles (liposomes).

Liquid dosage forms can be administered by oral and parenteral (injectable, inhalation, ophthalmic, otic, nasal, and topical) routes.

Advantages of liquid dosage forms

1. Liquid dosage forms (for oral use) are the most suitable dosage form for patients who have difficulty taking tablets or capsules, as might be the case with pediatric or geriatric patients.

2. They are attractive in appearance and gives beneficial psychological effects.

3. Drugs with bitter and unpleasant taste can be given in sweetened, coloured and flavoured vehicles.

4. There is higher flexibility in dosing when compared to solid dosage forms like tablet and capsules. The dose of the drug substance can be easily and conveniently adjusted by measuring a different volume.

5. If given orally, liquid dosage forms are rapidly available for absorption than tablets and capsules.

6. Hygroscopic and deliquescent medicaments which are not suitably dispensed in solid dosage forms can easily be given in liquid dosage form.

7. The products like adsorbents and antacids are more effective in liquid dosage form.

8. The liquid dosage form is expected for certain types of products like cough medicaments

Disadvantages of liquid dosage forms

1. Liquid dosage forms are usually more susceptible to chemical degradation when compared to solid dosage forms.

2. They are bulky and therefore inconvenient to transport and store.

3. Accidental breakage of the container results in loss of whole dosage form.

4. The shelf-life of a liquid dosage form is often much shorter than that of the corresponding solid preparation due to low stability.

5. Solution often provides suitable media for microbial growth and may, therefore, require the incorporation of a preservative.

6. Liquid dosage forms e.g., vaccines may require special storage conditions

7. The taste of a drug which is usually unpleasant is always more prominent when in solution than in a solid form.

8. There is a higher chance of dose variability since the delivery of the dose depends upon the patient measuring the proper volume. This can be significant issue for vision-impaired patients, patients with arthritis, or patients unable to read the numbers on an oral dosing syringe or medicine cup.

Classification of Monophasic Liquid Dosage Forms

1. Internal
2. External
3. Parenteral (Sterile dosage forms)

Internal: Syrup, Elixir, Simple mixture, Draught, Paediatric drops, Linctus

External

Topical use: Liniments, Lotions, Collodions

Used in oral cavity: Gargles, Mouthwashes, Throat paints, Mouth sprays, Throat sprays

Instilled into body cavity: Douches, Enemas, Irrigation solutions, Ear drops, Nasal drops, Nasal sprays

Parenteral (Sterile dosage forms)

Formulation Considerations

Methods of increasing solubility(solubility enhancement techniques)

1. Co-solvency
2. pH adjustment
3. Use of surfactants/ Solubilization
4. Complexation
5. Hydrotropy
6. Chemical modification of drug

1. Co -Solvency

• Co-solvents are used to increase solubility

E.g. of co-solvents are ethanol, sorbitol, glycerin, propylene glycol and PEG

2. pH Adjustment

• Alteration in pH

E.g Buffer systems such as ammonium chloride, diethanolamine, carbonic acid, phosphate buffers, glutamic acid, tartaric acid, citric acid buffer, acetic acid buffer etc.

3. Solubilization/ Use of Surfactants

• Surface active agents

• Surfactants are used

• They have 2 portions

• Head- Polar portion

• Tail- Non- polar portion

• Polar portion is hydrophillic

• Non polar portion is hydrophobic

• When added to water at low concentrations

• Orient at the air-liquid interface

• Additional surfactant is added- the interface becomes fully occupied

• The excess molecules are faced into the bulk of the liquid

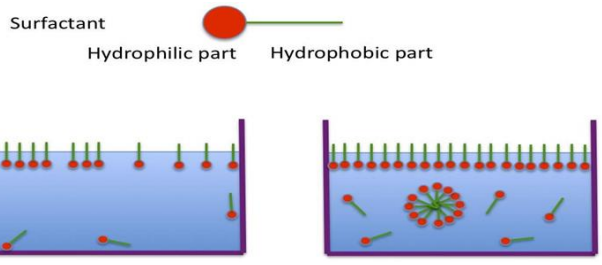
Higher concentrations, the surfactant molecules in the bulk of the liquid - form oriented aggregates or micelles

• The concentration at which micelles from **- Critical Micelle Concentration / CMC**

• Water solubility of the solute increases with the concentration of the micelles

E.g. Tweens, Spans, SLS etc.

To solubilize oil soluble drugs



Preparations made by this technique:

1. Cresol with soap solution

2. Solubilization of oil soluble vitamins like A, D, E and K

4. Complexation

• Solubility is increased by complexing with a complexing agent.

• Insoluble compound + Complexing agent = Complex

• Complex has good solubility in water

Preparations made by this technique:

Aqueous Iodine Solution: Iodine + KI = Poly iodide complex

• Polyiodide complex has good solubility in water

5. Hydrotropy

• Increase in solubility of a drug in water in the presence of large amounts of additives

• Weak interaction between the hydrotropic agent and the solute

E.g of hydrotropic agents are sodium benzoate, urea, sodium acetate, PVP, sodium salicylate etc.

Preparations made by this technique:

1. Increase in solubility of caffeine by adding Sodium Benzoate

2. Increase in solubility of theophylline by adding Sodium Salicylate

6. Chemical modification of the drug

• Enhances the solubility of poorly water soluble drugs

• Modifying them into their water soluble derivatives/ Salt forms E.g. Disodium phosphate ester of betamethasone- Solubility in water is 1000 times greater than its parent compound

Excipients used in formulation of liquid dosage forms

Formulation

1. Drug: Therapeutically active ingredient

2. Vehicles/ Solvents: Aqueous or non- aqueous

- To solubilize the ingredients

E.g. Purified water, Alcohol, Hydroalcoholic mixture, Propylene Glycol, Glycerine, Oils

3. Viscosity enhancers - To increase viscosity E.g. Methyl cellulose, SCMC, HPC, HPMC

4. Buffers: To prevent change in pH E.g. Citrate buffer, Acetate buffer, Phosphate buffer

5. Stabilizers: To protect against oxidation and microbial contamination

- Can be Preservatives and Anti- oxidants
- Preservatives prevent microbial contamination

E.g. Methyl paraben, Propyl paraben, Benzoic acid

- Anti-oxidants prevent oxidation

E.g Ascorbic acid, Tocopherol, BHA, BHT

6. Organoleptic additives- to impart taste, colour and aroma to the preparation

- Sweetening agents
- Flavouring agents
- Colouring agents
- Perfumes

ORGANOLEPTIC ADDITIVES

- Stimulation of sense organs

1. Tongue- Taste - Sweetening &Flavouring agents
2. Eyes- Sight - Colouring agents
3. Nose- Smell - Perfumes

1) Sweetening agents:

- Imparts sweetness E.g. Sucrose, Sorbitol,

2) Flavouring agents: Increases palatability and easy administration

-The four basic taste sensations are salty, bitter, sweet and sour

Taste sensation	**Recommended flavor**
Salty	Butterscotch, maple, apricot, peach, vanilla, mint.
Bitter	Wild cherry, walnut, chocolate, mint combinations, anise
Sweet	Fruit and berry, vanilla
Sour	Citrus flavors, liquorice, raspberry

3) Colouring agents:

- Enhances aesthetic appeal
- FD &C approved colours only
- Should complement flavour

E.g. Amaranth, Tartrazine, Erythrosine

4) Perfumes:

-Imparts an aroma to the preparation

- Used only for External preparations

E.g. Jasmine oil, Lavender oil, Ylang- Ylang, Sandalwood oil

QUESTION BANK

SHORT ANSWER (2 Marks)

Enlist different solubility enhancement techniques.

Names any four solvents used in the preparation of monophasic liquid dosage forms.

Names any two antioxidants used in liquid formulations.

Write any two examples for colouring agents and flavouring agents used in monophasic dosage forms.

Name any two examples of stabilizers used in monophasic liquid dosage forms.

Name any two antioxidants and preservatives used in monophasic liquid dosage forms.

Define antioxidants with examples.

Define preservatives with examples

Define stabilizers with examples.

Give the metric equivalents for the following: (a) one grain, (b) one ounce, (c) one teaspoonful, (d) one tablespoonful.

Give the metric equivalents for the following: (a) one minim, (b) one fluid ounce, (c) one tumblerful, (d) one quart.

Give the metric equivalents for the following: (a) one cup, (b) one pound, (c)one drop, (d) one wineglassful.

How many grams of a drug are required to make 120ml of a 25%w/v solution?

What is the percentage strength (%w/v) of a solution containing 450 mg of medicament dissolved in 90 ml of a solvent?

How much potassium permanganate would be required to prepare 50 ml of potassium permanganate solution of 2.8%w/v strength?

In what ratio 90 % alcohol and 30% be mixed to give 60% alcohol?

How many grams of dextrose are required to prepare 900ml of 10%w/v solution?

How many parts of 15%, 10% and 5% alcohols are mixed to prepare 8% alcohol?

How do you prepare 1 litre of 5% w/v dextrose solution from 50% w/v dextrose solution?

How do you prepare 500 ml of 50% alcohol from 90% alcohol?

How do you prepare of 50% alcohol from 80% alcohol and 30% alcohol?

How many litres of 8% solution can be prepared from 500gm of a solid?

What are isotonic solutions?

Define isotonic and paratonic solutions.

Define 'allegation' and 'proof spirit'.

What is the proof strength of 45% v/v alcohol?

Find the strength of 90% v/v alcohol in terms of proof spirit.

Convert 90% v/v and 40% v/v alcohol in to proof strength.

Convert 40% v/v alcohol in to proof spirit.

How do you prepare 50 litres of proof spirit from 90% v/v alcohol?

What is the proof spirit of an elixir containing 42%.alcohol?

What is the proof spirit of a 1% v/v alcohol?

Define the terms 'proof spirit' and 'isotonicity'.

Calculate the actual strength of 25° O.P. (overproof).

Calculate the actual strength of 45° U.P. (under proof. o.P

What are hypertonic and hypotonic solutions?

Calculate the percentage of sodium chloride required to render a procaine

HCI iso-osmotic with blood plasma. (1% w/v solution of procaine HCl has a freezing- point of 0.122oC and 1% w/v sodium chloride has a freezingpoint of 0.576°C)

38. Define hygroscopic and deliquescent powders.

39. How do you dispense potent powders?

40. Why is a double wrapping of powder required?

41. Classify powders.

42. Define cachets for example.

43. Define powder with an example.

44. Define and classify dusting powders.

45 Define eutectic powders.

46, Define insufflations with examples.

47. Define simple and compound powders.

48. What are the ingredients of dusting powders?

49. Define geometric dilution.

50. Enlist the methods of mixing powders.

LONG QUESTIONS (5 Marks)

1. Discuss briefly solubility enhancement techniques.
2. Define powders. Classify powders.
3. Explain geometric dilution with an example.

4. Discuss the different methods of mixing powders.
5. Explain simple and compound powders with an example.
6. How do you prepare effervescent granules by the fusion method?
7. How do you dispense eutectic powders?
8. Explain insufflations with examples.
9. Write the advantages and disadvantages of powders as the dosage form.
10. Define and classify powders based on the official grades of powders.
11. Explain dusting powders with examples.

VERY LONG QUESTIONS (10MARKS)

1. Define preservatives. Classify with examples.
2. Define stabilizers. Explain with examples.
3. Explain the organoleptic additives used in monophasic liquid dosage forms with examples.
4. Explain in detail the different vehicles used in monophasic dosage forms. Give their advantages and disadvantages.