

Lecture: Concentration Expressions

Course: Physical Pharmacy

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1. Introduction

In pharmacy and pharmaceutical sciences, the concentration of a solution describes the amount of solute dissolved in a given quantity of solvent or solution. Understanding concentration expressions is essential for drug formulation, dilution calculations, solution preparation, and quality control.

2. Basic Concepts

- 1 Solute: The substance dissolved (e.g., drug, sugar, salt).
- 2 Solvent: The medium that dissolves the solute (e.g., water, alcohol).
- 3 Solution: A homogeneous mixture of solute and solvent.

3. Types of Concentration Expressions

Concentration can be expressed qualitatively or quantitatively. Qualitative expressions describe concentration generally, while quantitative ones provide specific numerical values.

A. Qualitative Expressions

Examples include dilute or concentrated solutions — no exact numerical value is given.

B. Quantitative Expressions

These are used in pharmaceutical calculations:

1. Percent (%)

Expresses the amount of solute in 100 parts of solution or solvent. Common forms include % w/w, % w/v, and % v/v.

2. Parts per Million (ppm) and Parts per Billion (ppb)

Used for very dilute solutions. $\text{ppm} = (\text{mass of solute} / \text{mass of solution}) \times 10^6$. 1 mg solute in 1 L solution = 1 ppm.

3. Molarity (M)

M = moles of solute / liters of solution. Most common unit in lab calculations; temperature-dependent.

4. Molality (m)

m = moles of solute / kilograms of solvent. Independent of temperature, used in colligative property studies.

5. Normality (N)

N = gram equivalents of solute / liters of solution. Used in acid-base and redox reactions. Normality = Molarity $\times$ n-factor.

6. Mole Fraction (X)

X = moles of component A / total moles of all components. Useful in vapor pressure and colligative property calculations.

7. Ratio Strength

Expressed as '1 in N' form, e.g., 1 in 1000 solution = 0.1% w/v.

4. Conversion Between Units

- 1 1% w/v = 1 g in 100 mL = 10 g/L
- 2 1 ppm = 1 mg/L (in dilute aqueous solutions)
- 3 Molarity $\rightarrow$ Normality: multiply by equivalent factor
- 4 Molarity $\leftrightarrow$ Molality: requires density of solution

5. Applications in Pharmacy

- 1 Drug formulation and dilution calculations.
- 2 Quality control and analytical procedures.
- 3 Pharmacokinetic studies (plasma drug concentrations).
- 4 Preparation and reconstitution of pharmaceutical solutions.

6. Summary

Concentration expresses the strength of a solution and can be represented in multiple ways such as % w/v, M, m, N, and ppm. Accurate understanding and calculation of concentration are vital for safe and effective pharmaceutical formulations.