Aim: Preformulation Studies and Calibration Curve of Paracetamol and Aspirin

References

1. Skoog, D.A., West, D.M., Holler, F.J., & Crouch, S.R. (2013). Fundamentals of Analytical Chemistry. Cengage Learning.

2. Wilson, C., & Wilson, K. (2007). UV-Vis Spectroscopy: Principles and Practice. John Wiley & Sons.

3. Harris, D.C. (2015). Quantitative Chemical Analysis. W.H. Freeman and Company.

Introduction:

Preformulation studies are essential for understanding the physical and chemical properties of a drug before formulating it into a dosage form. This manual outlines the preformulation studies and the process of creating a calibration curve for Paracetamol and Aspirin, which are commonly used analgesics and antipyretics.

Objective

- To perform preformulation studies on Paracetamol and Aspirin to determine their physical and chemical properties.

- To develop a calibration curve for Paracetamol and Aspirin using UV spectroscopy.

Materials and Equipment

Chemicals:

- Paracetamol (analytical grade)

- Aspirin (analytical grade)

- Solvents (e.g., water, ethanol)

Equipment:

- Analytical balance

- Melting point apparatus

- pH meter

- Bulk density apparatus

- Tapped density apparatus

- Particle size analyzer

- UV spectrophotometer

- Beakers, flasks, and other standard lab glassware

Methodology

Preformulation Studies

Solubility Studies

Procedure:

1. Preparation of Saturated Solutions:

- Weigh 100 mg of Paracetamol and Aspirin separately.

- Dissolve each in 10 mL of distilled water and ethanol (1:1 v/v).

2. Observation:

- Allow the mixtures to equilibrate at room temperature for 24 hours.

- Filter the solutions.

3. Analysis:

- Measure the absorbance of the solutions at appropriate wavelengths using a UV spectrophotometer.

Melting Point Determination

Procedure:

1. Preparation:

- Fill the melting point capillary tubes with finely powdered Paracetamol and Aspirin.

2. Measurement:

- Place the tubes in the melting point apparatus and heat gradually.

3. Observation:

- Record the temperature range over which each substance melts.

pH Measurement

Procedure:

1. Preparation:

- Dissolve 100 mg of Paracetamol and Aspirin in 10 mL of distilled water.

2. Measurement:

- Measure the pH of each solution using a pH meter.

Bulk Density and Tapped Density

Procedure:

1. Bulk Density:

- Weigh 50 g of Paracetamol and Aspirin powder.

- Pour the powder into a graduated cylinder and record the initial volume.

- Calculate the bulk density using:

$$\text{Bulk Density} = \frac{\text{Mass of Powder (g)}}{\text{Volume of Powder (mL)}}$$

2. Tapped Density:

- Tapp the cylinder 100 times and record the final volume.

- Calculate the tapped density:

$$\text{Tapped Density} = \frac{\text{Mass of Powder (g)}}{\text{Tapped Volume (mL)}}$$

Particle Size Analysis

Procedure:

1. Preparation:

- Place 100 mg of finely powdered Paracetamol and Aspirin into a particle size analyzer.

2. Measurement:

- Analyze the particle size distribution and record the results.

Calibration Curve

Preparation of Standard Solutions

For Paracetamol:

1. Stock Solution:

- Prepare a stock solution of Paracetamol by dissolving 100 mg in 100 mL of distilled water to get a concentration of 1 mg/mL.

2. Standard Solutions:

- Prepare the following solutions:

- Solution 1: 1 mL of stock solution + 9 mL distilled water (0.1 mg/mL)

- Solution 2: 2 mL of stock solution + 8 mL distilled water (0.2 mg/mL)

- Solution 3: 4 mL of stock solution + 6 mL distilled water (0.4 mg/mL)

- Solution 4: 6 mL of stock solution + 4 mL distilled water (0.6 mg/mL)

- Solution 5: 8 mL of stock solution + 2 mL distilled water (0.8 mg/mL)

- Solution 6: 10 mL of stock solution + 0 mL distilled water (1 mg/mL)

For Aspirin:

1. Stock Solution:

- Prepare a stock solution of Aspirin by dissolving 100 mg in 100 mL of distilled water to get a concentration of 1 mg/mL.

2. Standard Solutions:

- Prepare the following solutions:

- Solution 1: 1 mL of stock solution + 9 mL distilled water (0.1 mg/mL)

- Solution 2: 2 mL of stock solution + 8 mL distilled water (0.2 mg/mL)

- Solution 3: 4 mL of stock solution + 6 mL distilled water (0.4 mg/mL)

- Solution 4: 6 mL of stock solution + 4 mL distilled water (0.6 mg/mL)

- Solution 5: 8 mL of stock solution + 2 mL distilled water (0.8 mg/mL)

- **Solution 6:** 10 mL of stock solution + 0 mL distilled water (1 mg/mL)

Measurement

1. Blank Preparation:

- Prepare a blank solution using distilled water (or the same solvent) and set it to zero absorbance.

2. Spectrophotometric Analysis:

- Measure the absorbance of each standard solution at the wavelength corresponding to the maximum absorbance (λ_max):

- **Paracetamol:** λ_max = 243 nm

- **Aspirin:** λ_max = 276 nm

Record the absorbance values for each standard solution.

Construction of Calibration Curve

1. Plotting the Data:

- Plot absorbance (y-axis) against concentration (x-axis) for Paracetamol and Aspirin.

2. Drawing the Line:

- Draw the best-fit line through the data points.

3. Equation of the Line:

- The equation of the calibration curve can be determined using linear regression:

$$\text{Absorbance} = m \times \text{Concentration} + c$$

Where:

- m is the slope of the line

- c is the y-intercept

Calculations

Bulk Density Calculation:

For example, if the mass of the powder is 50 g and the initial volume is 40 mL:

$$\text{Bulk Density} = \frac{50\ \text{gm}}{40\ \text{mL}} = 1.25\ \text{g/mL}$$

Tapped Density Calculation:

If the tapped volume after 100 taps is 35 mL:

$$\text{Tapped Density} = \frac{50\ \text{gm}}{35\ \text{mL}} = 1.43\ \text{g/mL}$$

Sample Data Tables

Preformulation Studies Data Table

Property	**Paracetamol**	**Aspirin**
Solubility (mg/mL)	15 (water), 30 (ethanol)	10 (water), 25 (ethanol)
Melting Point (°C)	169-170	135-136
pH	6.5	7.2
Bulk Density (g/mL)	1.25	1.20
Tapped Density (g/mL)	1.43	1.35
Particle Size (µm)	100	150

Calibration Curve Data Table

Concentration (mg/mL)	**Absorbance (Paracetamol)**	**Absorbance (Aspirin)**
0.1	0.150	0.120
0.2	0.300	0.240
0.4	0.600	0.480
0.6	0.900	0.720
0.8	1.200	0.960

1.0	1.500	1.200