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Research Article

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Semiquantitative Solubility Determination for Selected Substances from BCS Class 1

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Abstract
This research focuses on analyzing the biopharmaceutical characteristics of pharmaceutical substances with the aim of understanding their solubility and permeability through biological membranes and the impact of these characteristics on bioavailability and therapeutic effectiveness. Through practical examples, two substances from BCS class 1, caffeine and pyridoxine hydrochloride, were analyzed using the pH solubility profile. The research results emphasize the importance of understanding these characteristics for optimizing pharmaceutical formulations and therapeutic regimens and highlight the potential application of BCS for classifying pharmaceutical substances and qualifying drugs for exemption from bio-testing through biowaivers [1].

Keywords: biopharmaceutical classification system, solubility, permeability, BCS classification, biowaivers, caffeine, pyridoxine hydrochloride

1. Introduction

The Biopharmaceutics Classification System (BCS) is a scientific framework for classifying drug substances based on their aqueous solubility and intestinal permeability. When combined with the dissolution of the drug product, the BCS considers three major factors that govern the rate and extent of drug absorption from immediate release (IR) solid oral dosage forms: dissolution, solubility and intestinal permeability. According to the BCS, drug substances are classified as follows: Class 1: High Solubility – High Permeability; Class 2: Low Solubility – High Permeability; Class 3: High Solubility – Low Permeability and Class 4: Low Solubility – Low Permeability [1]. The aim of this work is to demonstrate solubility for two different active substances, caffeine and pyridoxine hydrochloride, but bouth from same BCS class 1, with an increase in pH.

2. Materials and Methods

Instruments

Instrumentation Spectrophotometer (Shimadzu) was employed for analysis. Spectrophotometric data was acquired using class VP software. pH meter was from Eutech and ultrasonic bath from Sonis.

Reagents and materials

Caffeine and pyridoxine hydrochloride were supplied by Sigma-Aldrich. Hydrochloric acid, sodium hydroxide, potassium chloride and potassium dihydrogen phosphate were from Semikem. Buffer solutions were prepared as is in USP described (pH 1.2; 4.5; 6.8 and 7.4) [2, 3, 6].

Preparation of pyridoxine hydrochloride solutions

Standard solution in distilled water: For the semiquantitative determination of the solubility profile for pyridoxine hydrochloride, it is necessary to weigh about 500 mg of substance in a 50 mL flask. Then, using a pipette, add 0.5 mL of distilled water, shake and observe whether the sample has dissolved. If not, add again 0.5 mL same solvent, again shake gently. This procedure is repeated until the moment when the sample substance is completely dissolved.
Sample solutions are prepared separated in buffer solutions pH 1.2; 4.5 and 6.8.

Preparation of caffeine solutions

Standard solution in distilled water: For the semiquantitative determination of the solubility profile for caffeine, it is necessary to weigh about 200 mg of substance in a 50 mL flask. Then, using a pipette, add 0.5 mL of distilled water, shake and observe whether the sample has dissolved. If not, add again 0.5 mL same solvent, again shake gently. This procedure is repeated until the moment when the sample substance is completely dissolved.
Sample solutions are prepared separated in buffer solutions pH 1.2; 4.5 and 6.8.

3. Results

According to EP monograph, pyridoxine hydrochloride is freely soluble in water, slightly soluble in ethanol (96 per cent). Based on our research, pyridoxine hydrochloride is freely soluble in all solvents [4].
According to EP monograph, caffeine is sparingly soluble in water, freely soluble in boiling water, slightly soluble in ethanol (96%). It dissolves in concentrated solutions of alkali benzoates or salicylates. Based on our research, caffeine is sparingly soluble to soluble in water, and soluble in all other solvents [5].
Our results are presnted in Table 1 and Table 2.

Table 1: Semiquantitative solubility data for pyridoxine hydrochloride

Solvent	mL	Category
Distilled water	3	freely soluble
pH 1.2	3.5	freely soluble
pH 4.5	4	freely soluble
pH 6.8	3	freely soluble

Table 2: Semiquantitative solubility data for caffeine

Solvent	mL	Category
Distilled water	11	soluble to sparingly soluble
pH 1.2	12	soluble
pH 4.5	15	soluble
pH 6.8	14	soluble

4. Conclusion

This paper gives specific examples and descriptions of physicochemical properties of two substances from same biopharmaceutical classes (BCS), caffeine and pyridoxine hydrochloride. From our experiment we confirmed for both substance solubility as is defined in monograph in EP. Conclusion of this research emphasizes the importance of understanding the BCS characteristics of pharmaceutical substances, especially their solubility and permeability.

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