PP-297

Physicochemical Study on a Host-Guest Interaction between β-Cyclodextrin and Phenylbutazone in Aqueous Solutions

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Aim of the study: The aim of our present study was to determine the formation constant and physic-chemical parameters of the complex formed between nonsteroidal anti-inflammatory drug (phenylobutazone) and β-cyclodextrin using isothermal titration calorimetry. The effect of β-cyclodextrin on the water solubility increase of the mentioned drug was also assessed.

Material and Methods: Phenylobutazone (FBZ), β-cyclodextrin (β-CD) (all Sigma-Aldrich) dried under reduced pressure at 333 K. The water used to prepare all solutions was deionized, twice distilled and degassed. To determine the increase of drug (FBZ) solubility in water caused by the presence of natural cyclodextrin, aqueous solutions ofβ-CD were prepared and the excess of solid FBZ was added to them. The solutions of cyclodextrin with FBZ were filtered and the content of dissolved FBZ was determined by spectrophotometry. The measurements were carried out in a quartz cuvette with an optical path equals to 10 mm. Calorimetric measurements were carried out in an isothermal calorimeter for VP-ITC titrations (MicroCal) at the temperature of 298.15 K. The aqueous solution of phenylobutazone was titrated by aqueous solution of β-cyclodextrin from a syringe. There were taken dilution measurements of aqueous β-cyclodextrin in water, aqueous solution of phenylobutazone were also diluted.

Results: Spectroscopic measurements confirm the effect of natural cyclodextrin (β-CD) on the solubility increase of phenylobutazone in water. Phenylobutazone molecules included inside hydrophobic cavities of β-cyclodextrin macromolecule increases the water solubility couple times. The calorimetric titrations ITC of aqueous solutions of phenylobutazone (FBZ) with the β-cyclodextrin (β-CD) solutions discussed indicate a spontaneous formation of stable inclusion complexes of 1 (FBZ):2 (β-CD).

Keywords: phenylobutazone, β-cyclodextrin, UV spectroscopy, isothermal titration calorimetry (ITC)