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An ibuprofen/hydroxypropyl-β-cyclodextrin hybrid material obtained by spray-drying organic solutions

Rodrigo L. S. R. Santos* and Denise de Oliveira Silva

Instituto de Química, Universidade de São Paulo, São Paulo, Brazil; e-mail: rluis@iq.usp.br.
* Corresponding author.

Abstract – The bioavailability of hydrophobic drugs can be improved by inclusion into cyclodextrins cavities. The present work describes a novel method to promote the inclusion of the antiinflammatory drug ibuprofen into hydroxypropyl-β-cyclodextrin. A hybrid material was isolated with a yield of 84% drug inclusion by spray-drying using a tert-butyl alcohol solution.

Ibuprofen (Hibp) is a known worldwidely used non-steroidal antiinflammatory drug (NSAID). However, several methods have still been proposed to increase biovailability and to reduce side-effects of the drug.

The bioavailability of hydrophobic drugs can be improved by their inclusions into the cavities of cyclodextrins (CDs). Hydroxypropyl-β-cyclodextrin (HPβCD), a hydroxyalkyl derivative with seven glucose units exhibits improved water solubility compared to βCD besides having low toxicity, high biocompatibility and pharmacological inactivity. It is known that the addition of organic co-solvents in aqueous solutions can affect the binding properties of cyclodextrins [1]. On the order hand, when the solvents are evaporated to dryness a true inclusion material between the components has been obtained [2].

The present work describes a novel method to isolate a hybrid material containing the Hibp drug included into HPβCD (Hibp/HPβCD) by spray-drying a solution of components in tert-butyl alcohol (TBA).

The material was prepared starting from a Hibp:HPβCD molar ratio of 1:2. Ibuprofen and HPβCD were separately dissolved in TBA and water, respectively, and then mixed together to give a TBA/water 9:1 (v/v) solution. The system was stirred at room temperature for six days and then spray-dried to removed the solvents. The content of the drug in the product was determined by absorption spectroscopy after washing with hexane. The isolated material was characterized by optical microscopy, FTIR vibrational spectroscopy, X-rays powder diffractommetry and thermal analysis (TGA/DSC).

The yield of inclusion was 84%. Optical microscopy showed that the particles of the new hybrid material have spherical shape. The morphology and size are different from those of particles of HPβCD, Hibp and particles of physical mixture (PM). X-rays diffraction patterns of all these samples have been compared one to each other. Characteristic reflections of the crystalline drug were found for the PM but not for the hybrid material. The latter shows a pattern that is typical of amorphous solid. The FTIR spectrum of Hibp shows ν_s(C=O) at 1720 cm^{-1}. This band appears at the same frequency for the PM; however, it is slightly shifted (1728 cm^{-1}) for the hybrid material suggesting interaction of Hibp with cyclodextrin. The typical endothermic DSC peak that corresponds to the melting point (76 ºC) of Hibp was found for the PM indicating the presence of non-interacting drug crystals. This DSC peak is not observed for the spray-dried solid suggesting that Hibp interacts with HPβCD in the hybrid material.

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References:

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