Fluorescence Quenching and Inclusion Complex Analysis of Propranolol and β-cyclodextrin

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OBJECTIVES
Propranolol is an amphipathic β-blocker drug used for its regulatory effects over blood pressure and anxiety levels. Recent studies have explored interactions of propranolol in various environments with respect to its pharmaceutical characteristics, i.e., cellular uptake, intracellular location, etc.

We are interested in expanding the knowledge base of data and analysis on the relation between propranolol and β, α-CDs, and γ-cyclodextrins, with respect to solvent accessibility.

The association constant of propranolol and β-cyclodextrin and the Stern-Volmer quenching relationship with iodide were found by fluorescent spectroscopy.

BACKGROUND
Cyclodextrins are used in a variety of ways, more often in industrial and pharmaceutical applications. They are cyclic oligosaccharides that range from 6 to 10+ units in size: β- and γ-cyclodextrins have 6 and 7 units, respectively. They are capable of inclusion complex with various molecules, particularly due to their cone-shaped ring structure. Complexation can aid in a number of functions, such as enhancing fluorescence in the presence of a quencher.

β-Cyclodextrin
C₆H₄O₆
MW of 1134.98
Created by Phosphorylation
+steres inclusion complexes
+helps prevent quenching of included compounds

β-cyclodextrin

METHODS

Fluorimetric Analysis
Fluorescence spectroscopy

RESULTS

Stern-Volmer Plot

Fluorescence Spectra of Propranolol in β-Cyclodextrin Solutions

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CONCLUSIONS

Our observations show that the association constant of β-cyclodextrin and propranolol in the presence of potassium iodide is 152 M⁻¹. Qualitative analysis shows the effects of quenching by potassium iodide, as with many salts. This is seen in the fluorescence spectra at 0.04M KI and the Stern-Volmer plot. The Stern-Volmer plot trendlines show the effects of adding increasingly higher concentrations of β-cyclodextrin in order to enhance fluorescence of propranolol by sheltering it from the surrounding salt anions in solution.

The association constant from a previous study was found to be 195 M⁻¹ by spectroscopic analysis and 239 M⁻¹ by calorimetry. The results confirm that β-cyclodextrin increases fluorescence under quenching conditions.

FUTURE WORK
As this is an ongoing study, more data will be pursued to increase accuracy of the presented analysis, with respect to β-cyclodextrin. Attempts will be made to analyze the association constants and quenching properties of the compounds in question across a variety of pH, temperature, and cyclodextrin derivatives. At the onset of the study, β-cyclodextrin was to be compared with 2-hydroxypropyl-β-cyclodextrin and γ-cyclodextrin inclusion complexes with propranolol. The study will aim to provide the same types of analysis for these two cyclodextrins. 2-hydroxypropyl-β-cyclodextrin is a synthetically derived version of β-cyclodextrin, with increased solubility characteristics because of its added polar substituent.

After this study is completed, it would be beneficial to gain knowledge of the performance and location of the cyclodextrin derivatives in vivo.

REFERENCES


Solubility Behavior of β-cyclodextrin in Water/Concentrated Solutions.