Spectrophotometric Determination of Ursodeoxycholic acid (UDCA) by ß-Cyclodextrin-Phenolphthalein Inclusion Complex

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An expeditious colorimetric methodology for the determination of the ursodeoxycholic acid (UDCA), bile acid used to dissolve cholesterol gallstones, to treat biliary cirrhosis and colorectal cancer, in pharmaceutical formulations is reported. The method is based on their competitive complexation reaction with a phenolphthalein to form ß-cyclodextrin-inclusion complexes. The objective of this work was the study of the inclusion complex ß-cyclodextrin-phenolphthalein (ß-CD-PHP) with capacity to spectrophotometric determination of the UDCA. UV-visible spectrum was used to determinate the best inclusion complex between phenolphthalein ($1.55x10^{-4}$mol/L) and different concentrations of ß-cyclodextrins ($2.58x10^{-5}$–$9.30x10^{-4}$mol/L). ß-CD-PHP complex was used to measure different concentrations of UDCA ($4.84x10^{-5}$–$3.1x10^{-3}$mol/L). The 2^4 factorial design was performed to evaluate the effect of factors: inclusion complex concentration (ß-CD: $3.10x10^{-4}$–$9.30x10^{-4}$; PHP:$7.75x10^{-5}$–$2.33x10^{-4}$mol/L), pH (10.3–10.7), temperature (20–30°C) and carbonate buffer concentration (50-350mM). The optimal inclusion complex concentration was determined. The best concentration of ß-cyclodextrin to form inclusion complexes with phenolphthalein was $6.2x10^{-4}$mol/L, the absorbance decreased 97% at 553nm. UDCA was determined in the range $6.05x10^{-6}$–$3.88x10^{-4}$mol/L. Statistical analysis of the results showed that only inclusion complex concentration had a negative significant effect on the UDCA determination by ß-CD-PHP complex. In spite of other variables and second order interactions between them were not significant (p=0.05). The optimal ß-CD-PHP concentration was $3.1x10^{-4}$:$7.75x10^{-5}$mol·L^{-1} (increased response of 43.2%) and the detection limit was $4.08x10^{-5}$mol/L. The inclusion complex ß-CD-PHP was efficient and fast to measure the UDCA concentration, what suggests its application in optical biosensors and pharmaceuticals formulations analysis.

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