The Mutarotation of Glucose in Dimethyl Sulphoxide (DMSO)

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Glucose is the most important energy source for many organisms, existing as two isomers, α-glucose and β-glucose. When dissolved in water, these isomers react until an equilibrium mixture forms. This process is called mutarotation and can be observed by polarimetry. The objective of this research was to study the effect of various concentration of dimethyl sulfoxide (DMSO) on the equilibrium constant ($K_{eq}$) and rate constant ($k_{obs}$) of the mutarotation of glucose. Three sets of polarimetry experiments were performed. The first experiment was to develop an experimental method by observing the mutarotation of glucose in distilled water. The $K_{eq}$ was found to be 1.6 and the $k_{obs}$ was found to be 0.033 min$^{-1}$, both agree with the literature. The second experiment was to measure the mutarotation of glucose with varying concentrations of hydrochloric acid (HCl). The purpose of this experiment was to determine the optimal concentration of HCl such that the reaction occurred in a reasonable amount of time. The optimal concentration of HCl was found to be 0.010 M. The mutarotation reaction required between one and three hours to reach equilibrium. The third experiment involved the effect of varying concentrations of DMSO ($X_{DMSO} = 0.027, 0.20, and .83$) with a constant concentration of HCl (0.010 M). The results of these reactions showed a general trend that as the concentration of DMSO increased the $K_{eq}$ increased; however, the values were not significantly different. The rate constant results showed that there was a significant difference for $X_{DMSO} = 0.027$ ($k_{obs} = 0.034$) and $X_{DMSO} = 0.200$ ($k_{obs} = 0.011$). Two main conclusions can be drawn from these data: (1) DMSO slows the mutarotation of glucose and (2) water is necessary to stabilize the transition state of the mutarotation of glucose.
Bibliography


