

鎔氧環丁基丙烯氨𠵽非鏡像立體異構物在水溶液中之穩定性研究

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摘要

本文主要探討鎔氧環丁基丙烯氨𠵽(TcO-CB-PAO)非鏡像立體異構物在水溶液中之穩定性。首先合成大量環丁基丙烯氨𠵽配位子及其鎔錯合物。並在 25 ± 0.1 °C 與不同的酸鹼條件水溶液下，測定鎔錯合物之分解速率。實驗採用動力學的方法，配製 pH 值介於 4 至 10，濃度約為 5×10^{-7} M 之稀釋水溶液，並利用溶劑萃取法分離水相及有機相，由其分解速率常數數據來判斷 $99+99\text{mTcO-CB-PAO}$ 非鏡像立體異構物體外穩定特性。鎔錯合物之濃度控制在 5×10^{-7} M 左右，主要為模擬臨床核醫藥物配劑情形，且其活度約為 10 mCi 至 20 mCi 使不造成鎔錯合物本身之自分解。根據本文所得結果， $99+99\text{mTcO-d,l-CB-PAO}$ 在 pH 值分別為 4,5,6,8,10 時，其分解速率常數(Kd) 分別為 11.0, 7.1, 0.17, 0.14 及 0.085 hr⁻¹，而 $99+99\text{mTcO-meso-CB-PAO}$ 在 pH 值分別為 4, 5, 6, 8, 10 時，其分解速率常數 (Kd) 分別為 4.9, 0.9, 0.028, 0.0072 及 0.035 hr⁻¹，兩者在鹼性溶液中分解速率常數 (Kd) 變化很小，可評估為鎔錯合物在此條件下較為穩定。由實驗結果得知， $99+99\text{mTcO-d,l-CB-PAO}$ 不論在何 pH 值條件下，其分解速率常數(Kd)都比 $99+99\text{mTcO-meso-CB-PAO}$ 大。在 6 小時內，鎔物種濃度其放射化學純度會隨時間的變化而減小並遵循一級反應。但在酸性條件下兩個鎔錯合物酸分解速率皆比鹼性條件下分解速率快且明顯。

關鍵字：穩定性，分解速率，動力學研究，放射化學純度，鎔氧環丁基丙烯氨𠵽非鏡像立體異構物

Stabilities of $^{99}\text{TcO-CB-PAO}$ Diastereoisomers in Dilute Aqueous Solutions

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Abstract

In an attempt to get a better understanding about the in vitro stability of $^{99}\text{TcO-CB-PAO}$ diastereoisomers in dilute aqueous solution, CB-PAO isomers and $^{99}\text{TcO-CB-PAO}$ diastereoisomers were prepared, and the rate of decomposition of the TcO-CB-PAO diastereoisomers were measured under various pH values at 25 ± 0.1 °C . In order to simulate the clinical situations, all solutions of $^{99+99\text{mTcO-CB-PAO}}$ diastereoisomers were diluted to ca. 5×10^{-7} M. The radioactivity of $^{99\text{mTc}}$ is between 10 to 20 mCi. Kinetic studies were used to evaluate the decomposition in the 5×10^{-7} M aqueous solution of $^{99+99\text{mTcO-d,l-CB-PAO}}$ and $^{99+99\text{mTcO-meso-CB-PAO}}$ at various pH values (4 - 10) by solvent extraction method. The rate constant (K_d) at various pH value , e.g. 4, 5, 6, 8, and 10, were found to be 11.0, 7.1, 0.17, 0.14 and 0.085 hr⁻¹, for $^{99+99\text{mTcO-d,l-CB-PAO}}$, and those for $^{99+99\text{mTcO-meso-CB-PAO}}$ were 4.9, 0.9, 0.028, 0.0072, and 0.035 hr⁻¹, respectively. It is clearly shown that the K_d values of $^{99+99\text{mTcO-d,l-CB-PAO}}$ are larger than those of $^{99+99\text{mTcO-meso-CB-PAO}}$ at pH = 4~10. However, the changing of K_d was not significant when the aqueous solution was adjusted at more basic concentration. The radiochemical purity (%) of TcO-CB-PAO diastereoisomers changed with time elapse under various pH values was also compared duration 6 hours. Kinetic studies on the acid decomposition conditions showed that the first order reaction was obeyed for the decomposition rate of both $^{99}\text{TcO-CB-PAO}$ diastereoisomers. In conclusion, TcO-meso-CB-PAO in a dilute aqueous solution is more stable than that of TcO-d,l-CB-PAO at various pH values tested. It seems that TcO-CB-PAO diastereoisomers are easier to decompose when they were treated by acidic conditions (pH < 8). TcO-CB-PAO diastereoisomers are more stable when they were treated by basic conditions (pH 8-10).

Keyword : stability, rate of decomposition, kinetic study, radiochemical purity, $^{99}\text{TcO-CB-PAO}$ diastereoisomers