STRUCTURE OF NITRIDOTECHENTIUM(V) COMPLEXES WITH CYSTEINE METHYL ESTER AND KYCAR

T. Takayama, S, Sato, T. Sekine, H. Kudo

Department of Chemistry, Graduate School of Science, Tohoku University, Sendai 980-8578, Japan

A novel nitridotechnetium complexes were synthesized by the reaction of a L-cysteine methyl ester (CME) and KYCAR (L-lysyl-L-tyrosyl-L-cystyl-L-alanyl-L-arginine) with [(*n*-$C_4H_9)_4N$][$^{99}TcNCl_4$] in methanol. The nitrido technetium complex with CME as well as KYCAR was found to be diamagnetic, indicating the +5 oxidation state of Tc in the complex. The technetium is reduced from Tc(VI) to Tc(V) during the ligand exchange reaction. The infrared spectra of the complexes showed absorption peaks corresponding to the Tc N stretching frequency at 1069 cm^{-1} for [TcN(CME)$_2$] and at 1080 cm^{-1} for [TcN(KYCAR)$_2$].

Structures of the complexes were investigated by ^{1}H-, ^{13}C- and ^{1}H-^{13}C COSY NMR spectroscopy. The ^{1}H-^{13}C COSY spectrum of [TcN(KYCAR)$_2$] in d_6-DMSO solution is shown in Fig. 1. The arrows in the figure indicate the shift of ^{1}H- and ^{13}C-NMR signals of the technetium complex from the signals of free KYCAR. The ^{1}H-NMR signal of the α proton of cysteine in the complex showed a downfield shift from 4.40 to 4.51 ppm for free KYCAR. The signals of two β protons also showed downfield shifts from 2.68 (2.77) to 3.17 ppm. The signal of amine

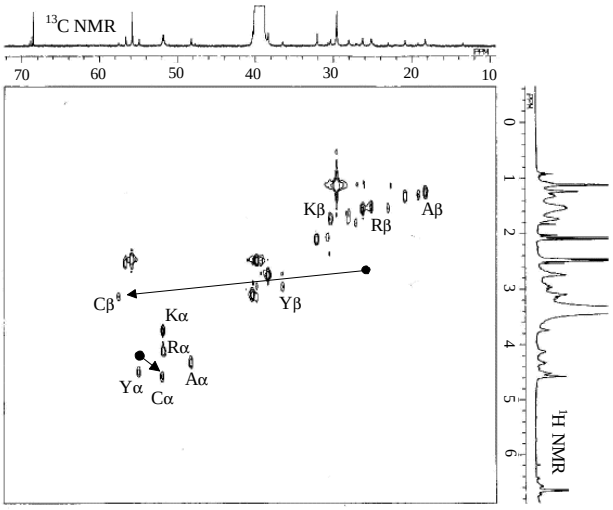

Fig. 1. ^{1}H-^{13}C COSY NMR spectrum of [TcN(KYCAR)$_2$] (400MHz, DMSO -d_6).

protons also showed downfield shifts from 8.38 to 8.83 ppm. The ^{13}C-NMR signal of the α carbon of cysteine in the complex shifted from 54.60 to 51.86 ppm and that of the β carbon from 26.23 to 56.60 ppm. These shifts in the NMR signals indicate that the KYCAR ligand coordinates to the technetium atom through the nitrogen and deprotonated sulfur atoms of the cysteine residue. Two coordinating KYCARs are chemically equivalent. A plausible structure of [TcN(KYCAR)$_2$] is shown in Fig. 2. The complex has a square pyramidal structure with the nitrido ligand at an apical position. The KYCAR coordinates to the nitridotechnetium core in the equatorial plane. Two KYCARs coordinate to the nitridotechnetium core in the *trans* position. The NMR spectroscopic study for [TcN(CME)$_2$] in d_7-DMF solution indicates that the complex have a square pyramidal structure with the nitrido ligand at an apical position similar to [TcN(KYCAR)$_2$].

The [TcN(KYCAR)$_2$] complex would have four structural isomers in which sites of the side chains of cysteine (R_1, COR_2) are *syn* or *anti* for the nitridotechnetium core. From RP-TLC and RP-HPLC analyses, however, [TcN(KYCAR)$_2$] was found to be only one species. No NMR spectroscopy gave information about the favorable structure in the four structural isomers, and theoretical calculations were performed to identify the most stable structure of [TcN(KYCAR)$_2$]. The result of theoretical calculations for model complexes of [TcN(KYCAR)$_2$] indicates that the structure with the R_1 group in *syn* conformation and the COR_2 group in *anti* conformation is the most stable. For the [TcN(CME)$_2$] complex, the result of theoretical calculation indicates that the structure with the COR_2 moiety in *anti* conformation is preferable to the *syn* isomer.

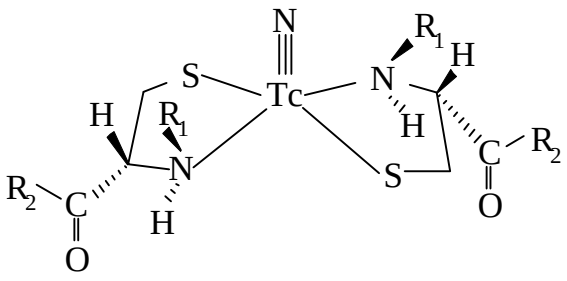

Fig. 2. Plausible structure of [TcN(CME)$_2$] (R_1 = H, R_2 = OCH_3) and [TcN(KYCAR)$_2$] (R_1 = YK, R_2 =AR).