This work focuses on the characterization of a new potential contrast agent consisting of β-cyclodextrin and 1,4,7,10-tetraazacyylododecan-4,7,10-triocta-1-methyl[(4-aminophenyl)methyl]phosphinoic acid, short for DO3AP$^{\mathrm{ABn}}$. Using 2D NMR experiments, the hydrogen and carbon spectrum signals of both molecules were assigned. There was a temperature dependency studied in DO3AP$^{\mathrm{ABn}}$. By evaluating ^{13}C relaxation, relaxation times T_1, T_2 and Nuclear Overhauser effect were determined. Using the isotropic reorientation model, the rotational correlation time was numerically calculated from the measured values of T_1. From the rotational correlation time, the most rigid part of the molecule was found to be the cycle (τ_c = 264–308 ps). The most mobile is the aromatic methyl phosphine arm, whose correlation time is about half that of the cycle (139-156 ps).