Simple Colorimetric Detection of Aromatic Amino Acids via Charge-Transfer Complex Formation Within Cucurbit[8]uril Cavities

Lee, Seungju (School: Korea Science Academy of KAIST)
Kang, Jaemin (School: Korea Science Academy of KAIST)
Myoung, Seohyun (School: Korea Science Academy of KAIST)

Aromatic amino acids phenylalanine (Phe), tryptophan (Trp), and tyrosine (Tyr) show increased plasma concentrations in cases of phenylketonuria, tryptophanemia, and tyrosinemia type I that occur when their metabolism is abnormal. Because delayed treatment causes neurodevelopmental delay and organ damage, a rapid and simple analytical method for plasma aromatic amino acid concentration is required. In this study, a colorimetric sensor was developed using the coloration through formation of a charge-transfer complex between methyl viologen (MV2+) and aromatic amino acids inside the cavity of CB[8]. After formation of the charge-transfer complex, Trp and Tyr changed from colorless to orange-red and pale yellow, respectively (?max = 442 nm, 412 nm), and Phe showed an absorbance change in the ultraviolet region. Under the condition of CB[8]·MV2+ 1 mM, absorbance according to Phe, Trp, and Tyr concentration increased linearly in the ranges of 0-0.40 mM, 0-0.40 mM, and 0-0.35 mM, respectively, and this was visually confirmed for Trp and Tyr. Finally, using a computational chemistry program, it was confirmed that electron transfer from the pi orbital of Tyr to the pi* orbital of MV2+ inside the charge-transfer complex produces color. The CB[8]-based colorimetric sensor reduces pretreatment processes and instrument dependency, allowing results to be easily and rapidly confirmed with the naked eye.

Awards Won: