Spectroscopic Characterization of Low-Spin Six-Coordinate Thiolate-Ligated Hemes: Relevance to the Biochemistry of Cystathionine β-Synthase

Rachel C. Linck, Judith N. Burstyn

Department of Chemistry, University of Wisconsin-Madison

Cystathionine β-synthase (CBS) is one of a small group of heme proteins whose native iron coordination is 6-coordinate and low spin, with a neutral nitrogen donor (such as histidine) and a cysteine thiolate as ligands. Heme proteins with this coordination environment are easily identified as they exhibit unique spectroscopic properties in the ferric state: thiolate-to-iron charge transfer transitions in the visible spectrum and narrowly dispersed g values near g = 2 in the EPR spectrum. Often two overlapping signals in the EPR spectrum are observed; however, the origin of these multiple signals is unknown. Heme proteins with non-native N-donor/thiolate ligation such as the M80C cyt c variant, myoglobin with an exogenous ethanethiol ligand, and $P450_{cam}$ with an exogenous imidazole ligand have been investigated and compared. The M80C cyt c and the Mb-SEt model systems yield simple EPR spectra; the $P450_{cam}$-imidazole model, in which thiolate is a native ligand, exhibits the familiar overlapping EPR signals observed in the spectra of CBS. The unique coordination environment in CBS is hypothesized to cause novel pH-dependent redox and ligand-switching behaviors. Reinvestigation of the reactivity of CBS and examination of the model systems may help explain the function of the unusual heme coordination environment in CBS.