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SPECTRAL BEHAVIOR OF AMYLOID – SPECIFIC DYES IN PROTEIN – LIPID SYSTEMS. I. CONGO RED BINDING TO MODEL LIPID MEMBRANES

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The phenomenon of abnormal protein aggregation currently attracts ever growing attention due to its involvement in etiology of a number of so-called conformational diseases, including neurological disorders, type II diabetes, prion diseases, etc. In vivo, transformation of polypeptide chain into partially folded aggregation-prone conformation can be initiated by protein-lipid interactions. Lipid bilayer, a basic structural element of biological membranes, may act as an effective catalyst of fibrillogenesis, providing an environment where protein molecules adopt conformation and orientation promoting their assembly into protofibrillar and fibrillar structures. Identification of amyloid fibrils in protein-lipid systems with widely employed spectroscopic criteria involving amyloid-specific dyes Congo Red (CR) or Thioflavin T (ThT) may be complicated by interferences of spectral responses from protein- and lipid-bound dye species. To circumvent this problem, all optical amyloid markers must be thoroughly characterized with respect of their lipid-associating abilities. In the present study, the interactions between CR and model lipid membranes composed of phosphatidylcholine (PC) and its mixtures with anionic lipid cardiolipin (CL), cationic detergent cetyltrimethylammoniumbromide (CTAB) and cholesterol (Chol) have been examined using absorption spectroscopy technique. It was found that CR can effectively interact with PC, PC:Chol and PC:CTAB bilayers. The observed shifts of absorption maxima suggest that the dye is capable of penetrating into interfacial region of uncharged model membranes, while remaining at the bilayer surface in positively charged membranes. No CR binding to negatively charged bilayers has been detected. Differential absorption spectra of the lipid-bound dye exhibited maximum at 524 nm, the value different from that characteristic of amyloid-bound dye (545 nm). These findings suggest that CR can be used for detection of amyloid growth in protein-lipid systems, especially for identification of amyloid fibrils induced by anionic lipids.

KEY WORDS: Congo Red, liposomes, dye-lipid interactions