P-1.37

Real-time Detection of Aggregation in Proteins Using a Novel Technique: Procharts

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Amyloidosis is linked to neurodegenerative (Alzheimer's and Parkinson's) and non-neurodegenerative (Human Lysozyme) diseases, with aggregation mechanisms studied extensively. During aggregation, unfolded monomers self-assemble into oligomers and insoluble fibrils, exhibiting sigmoidal kinetics observed in α-Synuclein, Aβ peptides, and HuL. Conventional aggregation detection methods are expensive, invasive, and focus on later stages. To overcome these limitations, we employ Protein Charge Transfer Spectra (ProCharTS), a cost-effective, non-invasive technique. ProCharTS absorption (250–800 nm) results from photoinduced electron transfer, while luminescence arises from charge recombination. Aggregation enhances ProCharTS signals due to increased charged residue contacts in β-sheets. We study α-Synuclein and HuL aggregation, confirming ProCharTS sensitivity with CD, ANS, and ThT assays. ProCharTS is highly sensitive to early aggregation stages and offers a label-free method for rapid drug screening, providing insights into charged residue interactions within oligomers. Compared to ANS and ThT, ProCharTS exhibits superior sensitivity in detecting initial molecular aggregation events. It operates as an inherent analytical tool for monitoring protein aggregation, offering distinct advantages over traditional methods while enabling rapid and efficient amyloid aggregation studies.