Physics Department
PhD Thesis Defense

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Biophysical Insights into Lipid Oxidation Effects on Membrane Self-Organization and Enzymatic Catalysis Under Extreme Conditions

his thesis comprises two projects. Firstly, it investigates the influence of lipid oxidation on plasma membrane self-organization using phospholipid monolayers as model mem- branes. Lipid oxidation was induced by 2,2'-azobis(2-amidinopropane) dihydrochloride (AAPH), and observations from the Langmuir trough technique revealed a consistent increase in relative molecular area for oxidized unsaturated lipids. Additionally, the sta- bility plots remained unchanged, although shifted towards larger molecular areas, sug- gesting a direct correlation between lipid peroxidation and alterations in the interaction forces between lipid molecules within the monolayer. Furthermore, the study highlights the protective role of antioxidants mainly □-tocopherol (Vitamin E) in mitigating lipid peroxidation-induced damage, as evidenced by a reduction in absorbance in the presence of □-tocopherol, observed through TBARS assay. By integrating these results with the observations from the Langmuir Trough technique, we gain a comprehensive understand- ing of the interplay between lipid oxidation, membrane organization, and the protective role of antioxidants. Secondly, this thesis explores the efficacy of Novozym 435 (NOV (435)), an immobilized form of Candida antarctica Lipase B (CALB), as a catalyst in the transesterification reaction of para-nitrophenyl palmitate (pNPP) and glycerol under extreme temperature conditions. Electrospray Ionization Mass Spectrometry (ESI-MS) and spectrophotometric analyses demonstrated the successful formation of high-value products, namely para-nitrophenol (pNP) and glyceryl palmitate, even at elevated tem- peratures. These findings enhance our understanding of membrane biology dynamics, enzyme functionality, and reaction kinetics, offering insights for industrial applications in sustainable synthesis processes.