Large Amplitude Oscillatory Shear (LAOS) for Protein-Pectin Crosslinking

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Protein-pectin crosslinked biopolymers are promising materials for food, pharmaceutical, and biomedical applications due to their tuneable rheological and structural properties. Large Amplitude Oscillatory Shear (LAOS) rheology provides critical insights into the nonlinear viscoelastic behaviour of these systems under deformation regimes relevant to processing and end-use conditions. In this study, we investigate the LAOS response of protein-pectin complexes formed via enzymatic, chemical, or physical crosslinking, analysing their strain-stiffening, shear-thinning, and network breakdown characteristics through Lissajous plots and Chebyshev harmonic decomposition. By correlating LAOS parameters (e.g., intracycle nonlinearities, harmonic distortions) with crosslinking density and bond type, we will reveal how molecular interactions dictate mechanical performance. Our results will demonstrate that LAOS effectively discriminates between crosslinking mechanisms and identifies optimal formulations for targeted texture or encapsulation properties. This work advances the design of protein-pectin hybrids for applications requiring precise control over nonlinear viscoelasticity.

Keywords: LAOS rheology, protein-pectin crosslinking, nonlinear viscoelasticity, biopolymer design, soft matter, food rheology

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