

Deciphering Acidulant-Mediated Gelation of Hybrid Systems through Advanced Imaging and Rheology

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Integrating plant proteins via partial substitution of dairy components is a pivotal strategy for enhancing global protein supply and achieving substantial environmental mitigation. However, this substitution introduces complex technological challenges rooted in the microscale physicochemical interactions that ultimately govern the macroscopic functionality of hybrid systems. A critical knowledge gap persists regarding the mechanistic understanding of how diverse ingredients interact with one another. To address this, an integrated approach of synergistically combining Super-Resolution Microscopy and Coherent Anti-Stokes Raman Scattering were employed with quantitative image analysis and dynamic rheology to elucidate the microstructural dynamics of gelation in a hybrid system as influenced by different acidulants. Cross-correlation analysis of the resulting images quantified inter-protein interactions and revealed distinct patterns of structural organization, with rheological properties directly correlated with the high-resolution imaging data. The work unequivocally demonstrated that the synergistic integration of advanced imaging is paramount for overcoming the knowledge gap in complex hybrid systems. The findings generated reveal and exploit the underlying microstructural architectures, directly facilitating the rational engineering of sustainable, next-generation food products with precisely optimized functional performance.

Keywords:

Hybrid Systems; Super-Resolution Microscopy; Coherent Anti-Stokes Raman Scattering; Rheology

References:

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