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Rheology and Structural Arrest of Dense Dairy Suspensions: A Soft Matter Approach

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Abstract : The rheological properties of dairy products critically depend on the underlying organisation of proteins at multiple length scales. When heated and acidified, milk proteins form particle gel that is viscoelastic, solvent rich, 'soft' material. In this work recent developments on the rheology of soft particles suspensions were used to interpret and potentially define the properties of dairy gel structures. It is discovered that at volume fractions below random close packing (RCP), the Maron-Pierce-Quemada (MPQ) model accurately predicts the viscosity of the dairy gel suspensions without fitting parameters; the MPQ model has been shown previously to provide reasonable predictions of the viscosity of hard sphere suspensions from the volume fraction, solvent viscosity and RCP. This surprising finding demonstrates that up to RCP, the dairy gel system behaves as a hard sphere suspension and that the structural aggregates behave as discrete particulates akin to what is observed for microgel suspensions. At effective phase volumes well above RCP, the system is a soft solid. In this region, it is discovered that the storage modulus of the sheared AMG scales with the storage modulus of the set gel. The storage modulus in this regime is reasonably well described as a function of effective phase volume by the Evans and Lips model. Findings of this work has potential to aid in rational design and control of dairy food structure-properties.

Keywords : dairy suspensions, rheology-structure, Maron-Pierce-Quemada Model, Evans and Lips Model
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