Soft matter rheology, tribology and biointerface science: from food structure design to plant cell walls

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Multi-scale rheology, soft-tribology, and soft matter physics as well as colloid, surface and biointerface sciences are playing an integral part in the development of measurement capabilities and knowledge for enabling rational food structure design, as well as more generally for defining micromechanical models in soft systems such as plant cell walls.

This presentation considers new approaches to improve quantification of relevant structure-property-processing (SPP) relationships of soft food materials for situations spanning manufacturing processes to oral processing and digestion. This includes highlighting recent progress and new multiscale techniques in rheology and tribology for quantifying how oral processing transforms food during consumption, where the aim is to determine the physical basis for texture and mouthfeel in various multicomponent foods (beverages, semi-fluids/soft solids, solid snacks). A key challenge has been to capture the highly complex interactions that occur with saliva and surfaces. The combination of studies conducted using both model and real food systems are providing superior ability to evaluate new tribological/rheological-based techniques and develop causal SPP relationships. Well-characterised polysaccharides and densely packed microgel suspensions are proving reasonable models for liquid and soft foods, and recent studies indicate an important role of micromechanical and interfacial properties of individual dietary components and whole food systems. The outcomes are being used for the design of next generation foods and beverages that are both nutritionally beneficial and acceptable to consumers.

The presentation also considers the development of new techniques in multiscale rheology, nanoindentation and tribology to study the mechanics of plant cells, microgels, and poroelastic (biphasic) nanocellulose composites, and will highlight how these are informing the development of a new mechanical model of the plant cell wall.