The role of rheology in product development

Literature

As mentioned earlier, rheology is important for a better understanding of how process variables influence specific textural characteristics, such as pourability and mouthfeel. A food rheologist is an important participant in the development phase of a new product. He/she interacts with the food scientist by providing rheological measurements to quantify the effects of formulation and/or structural manipulations. The interactions with the sensory scientist/marketing researcher occur in relating rheology to sensory perceptions of food texture. In the chain from the food scientist to the consumer, rheology provides a diagnostic tool in understanding consumer perception of texture and elaborates on its relationship to food structure. (Food Texture and Rheology: A tutorial review Rajendra).

In one study, 2 critical parameters were examined for their effect on the initial acid induced gel of cream cheese. Homogenization pressure (HP) of the high-fat cheese milk and fermentation temperature (FT) were also investigated for their effects on rheological properties and textural properties. (Effects of processing conditions on the texture and rheological…) Cream cheese is a soft texture and a creamy, mildly acidic flavor. Cream cheese goes through various steps, slow acidification, acid induced gelation, shearing/heating of the acid gels, whey separation, and curd treatments. It is reported that an increase in the HP of milk increases the firmness of acid induced gels containing fat. The acid gel samples were prepared and when the pH of the gels reached ~4. 7, the gels were stirred. Once the structure was broken, the gels were placed in a water bath while continuously stirring. Then loaded to a controlled stress rheometer. It was noted that gels made at the same FT had a higher consistency with the higher HP treatment. This was

likely due to the increased fat surface area that is covered by protein, which creates more active filler particles that helped to stiffen the gel network. (effects of processing conditions on the texture).

For the cream cheese study, the standardized cheese milks were heated and homogenized. The pressure of the second stage was kept constant. The particle size distribution of cheese milks were measures by laser light scattering. The rheological properties of cream cheeses were determined 4 weeks after manufacture by dynamic small-amplitude oscillatory rheology. For most samples, significant differences were observes between 2 and 4 weeks for G’ and hardness by texture profile analysis, suggesting that changes occurred in the structure/texture of cream cheese during storage. Firmer cream cheese (slow) fat crystallization or structural rearrangements in the cheese network with a longer storage time could be due to ongoing.

The FT used for acid-induced gelation greatly affected the textural and rheological properties of cream cheese, with higher FT causing cream cheese to be less firm, stickier, less cohesive, easier to dissolve, and more spreadable. Many studies have combined rheology and sensory analysis to examine the effects of various factors such as composition on yogurt gel formation and texture (Folkenberg et al. , 2006; Guggisberg et al. , 2009; Ciron et al. , 2012). For example, sweeteners and flavors are generally added to yogurt to make them more palatable. However, the addition of these ingredients may affect the fermentation process of yogurt as well as its physical and sensory characteristics. (Rheological and sensory performances) Therefore, it is important to evaluate the new rapid sensory methods in combination with rheology to assess the viability of developing

sweetened yogurt without the calories of sugar. In one particular experiment, a modified single chain form of the natural sweet protein monellin (MNEI) was used as an alternative to artificial sweeteners. To give a brief summary of the rheological characterization of yogurt, the rheometer was used to monitor the yogurt gel formation of milk mixture. Then during fermentation, the substance was mixed and subjected to a small deformation oscillation with an applied strain. However, the strain did not disrupt the development of the gel network.

After fermenting, oscillation measurement was used during cooling. Then the elastic modulus was measured and the time of gelation was defined as the first point when the elastic modulus was greater than 1 pascal. These measurements are important indicators of texture perception in yogurt. The flash profile was also examined. Flash profile is a rapid, descriptive sensory method based on a combination of free-choice term selection and comparative ranking evaluation (Delarue, 2014). Although the rheological results showed that, when added at typical usage levels, MNEI did not generally affect the yogurt fermentation process or its rheological properties. The sensory results demonstrated that MNEI protein did not sweeten the yogurt when added before fermentation. It is possible MNEI was affected by hydrophobic and coulombic interactions that milk proteins undergo as the casein precipitate, as milk becomes slightly acidic during fermentation. MNEI is still affected by pH changes that can promote unfolding, aggregation, and precipitation with resulting loss of sweetness.