

Exploration Of The Nonlinear Viscoelastic Behavior Of Yogurt Using Lissajous Curves

Authors : Hugo Espinosa-Andrews

Abstract : Introduction: Yogurt is widely accepted worldwide due to its high nutritional value, consistency, and texture. Their rheological properties play a significant role in consumer acceptance and are related to the manufacturing process and formulation. Typically, the viscoelastic characteristics of yogurts are studied using the small amplitude oscillatory shear test; however, the initial stages of flow and oral processing are described in the nonlinear zone, in which a large amplitude oscillatory stress test is applied. The objective of this work was to analyze the nonlinear viscoelastic behavior of commercial yogurts using Lissajous curves. Methods: Two commercial yogurts were purchased in a local store in Guadalajara Jalisco Mexico: a natural Greek-style yogurt and a low-fat traditional yogurt. Viscoelastic properties were evaluated using a large amplitude oscillatory stress procedure (LAOS). A crosshatch geometry of 40 mm and a truncation of 1000 μm were used. Stress sweeps were performed at 6.28 rad/s from 1 to 250 Pa at 5°C. The nonlinear viscoelastic properties were analyzed using the Lissajous curves. Results: The yogurts showed strain-viscoelastic behavior related to deformation-dependent materials. In the low-strain region, the elastic modulus predominated over the viscous modulus, showing gel-elastic properties. The sol-gel transitions were observed at approximately 66.5 Pa for the Greek yogurt, double that detected for traditional yogurt. The viscoelastic behavior of the yogurts was characteristic of weak excess deformation: behavior indicating a stable molecular structure at rest, and moderate structure at medium shear-forces. The normalized Lissajous curves characterized viscoelastic transitions of the yogurt as the stress increased. Greater viscoelasticity deformation was observed in Greek yogurt than in traditional yogurt, which is related to the presence of a protein network with a greater degree of crosslinking. Conclusions: The yogurt composition influences the viscoelastic properties of the material. Yogurt with the higher percentage of protein has greater viscoelastic and viscous properties, which describe a product of greater consistency and creaminess.

Keywords : yogurt, viscoelastic properties, LAOS, elastic modulus

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