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Characterization of Linear Viscoelastic Behavior of Foods and Biomaterials at high Frequencies with Mechanical Impedance Measurements

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ABSTRACT

A new instrumental setup, which is based on the oscillatory squeezing flow principle, was developed to characterize the viscoelastic properties of foods and biopolymers. Analysis of the data was performed by two different approaches. The first approach employed principles of vibration to determine viscous damping and elasticity of the sample harmonically compressed between two plates. The second approach involved the use of additional calculations based on the squeezing flow model which were linked to concepts of vibration analysis, such as mechanical impedance, to determine fundamental rheological parameters like complex viscosity and related (elastic and viscous) moduli. The experimental setup for the method is simple to use and could be attached to existing commercial instruments such as Texture Analyzers and Universal Testing Machines. The use the proposed method with this type of instruments would provide them with the additional capability of performing dynamic rheological testing. The dynamic mass of the instrument was significantly low when compared to that of other instruments that use similar principles. This low dynamic mass enabled the use of relatively higher frequencies for the testing of the samples. Comparison of the viscous and elastic moduli obtained with the proposed method and from conventional rheometers for a variety of foods and biopolymers showed good agreements.