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Title: Non-contact optical analysis of the viscoelastic properties for food quality using Brillouin spectroscopy

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Body

Brillouin spectroscopy probes the viscoelastic properties of materials by observing the scattered light spectrum from a laser source incident on a given sample. The peak contained in the Brillouin scattering region of the spectrum can be directly correlated to the storage and loss modulus, providing a complex analysis of the physical properties of the study subject (Figure1a) [1].

For the food industry, where the traditional and contact-based rheological measurement techniques dominate the characterization of the physical characteristics of products from raw material to finished foods, Brillouin spectroscopy brings a new and relevant non-contact alternative [2]. Also, this technique is useful for measurement of products inside of sealed packages, allowing the characterization of samples through a transparent window without any violation of the package.

In this study, we explored the potential of the Brillouin spectroscopy to infer changes in viscoelastic properties that occur in different food products when submitted to heating and cooling cycles, freezing and unfreezing cycles, and normal time-based decay [3]. The data was acquired using the setup described in Figure 1b.

Significant changes were already observed in the viscoelastic properties of cow's milk after every day of room temperature and fridge storage, and in cooking oil after consecutive cooling and heating cycles (170 °C). We also obtained spectrums for meat and fish after every day of fridge storage and after freezing and unfreezing cycles. For non-uniform samples, the acquisition location affects the peak obtained, so different approaches to the acquisition method are still being investigated.

These results hint at a future in which we can check if a product was handled with care and transported under the right conditions, if the frozen products have only been frozen once or if meat and fish are really fresh and safe to consume, without ever opening a package or touching/handling the product. This will increase consumer safety and confidence and provide the industry with the necessary tools to ensure and improve the quality of their products without waste.

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Image Legends

Figure 1 - Brillouin scattering: a) typical spectrum; b) optical setup used in the acquisition of the Brillouin scattering spectrum.

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