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Relating acoustic tribology to in vitro tribology, oral coating and sensory perception

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The application of tribology in food research has revealed important correlations between lubrication properties and perception of foods. Tribology, also called "thin-film rheology", is the study of friction, lubrication and wear of interacting surfaces in relative motion. In relation to sensory perception and oral processing of foods, the tongue and palate represent two interacting surfaces. These two surfaces are lubricated by the adhered mucous layer, saliva and food. The majority of the tribology studies to date has been carried out ex vivo using tribometers. In the current study we present the results of in vivo measurement using acoustic tribology.

In a full factorial design the 8 milk-based products varying in pH (4.2 and 6.8), sugar content (3% and 8%) and fat content (1% and 3%) were studied. The sensory assessment of the samples was done with a QDA panel. The oral coating was determined by FTIR analysis of tongue scrapings. The ex vivo lubrication behaviour of the milk samples was determined by a pin on disc tribometer. The in vivo acoustic tribology was determined by measuring the sound spectra while rubbing the tongue along the palate after swallowing the sample.

Effects of stimulus (8 different) and stimulus factors fat, pH and sugar (2 values each, full factorial) were found, sometimes as main effect, sometimes only in interactions. An increased amount of sugar in the samples tested affected significantly the acoustic measure that was recorded by rubbing the tongue. Most remarkably, it can be noted that High Frequency (2250-4250 Hz) Power Spectral Densities are most sensitive for such effects, whereas HF/LF ratios are entirely insensitive for stimulus composition effects. This leads us to conclude that stimulus effects are mostly found on absolute acoustic volume (no HF/LF effects) and less on shifts in frequency dominance. HF measures appear to be the most sensitive.