A COMPARISON OF RHEOLOGICAL AND TEXTURE ANALYSIS
METHODS FOR THE ASSESSMENT OF VISCOELASTICITY

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All semisolid cosmetic products belong to the group of viscoelastic materials, having both liquid-like (viscous) and solid-like (elastic) characteristics. It is of practical, as well as theoretical interest, to determine the position of a particular product on the viscoelastic scale. Standard method used to assess viscoelasticity is dynamic (oscillatory) rheology, with two principal approaches – stress sweep and frequency sweep. Within this method, there exists a number of parameters used to describe certain aspects of viscoelastic behaviour, for example: elastic modulus \(G'\) (the measure of energy stored and recovered), viscous modulus \(G''\) (the measure of energy lost as flow), phase angle \(\delta\) (how much the resulting deformation lags behind the applied stress) and complex modulus \(G^*\) (the measure of rigidity). In addition to rheological methods, texture analysis (TA) presents a useful approach to assessing many aspects of semisolid behaviour, with well-established parameters, e.g. firmness (maximum on the positive curve), consistency (area under the positive curve), cohesiveness (maximum on the negative curve) and work of cohesion (area under the negative curve). This study was particularly interested in assessing the two novel parameters: stringiness (the distance at which the sample ruptures when the probe rises over the surface) and resilience (the ratio between two areas that make the positive curve).

The purpose of this work was to analyse and compare dynamic (oscillatory) rheological methods with a novel texture analysis method for the assessment of viscoelastic properties of cosmetic semisolids.

The instruments used in this study were an air-bearing controlled-stress rheometer (RheoStress RS75, Haake, Germany) and a texture analyser (TA.XT Plus, Stable Micro Systems, UK). Two commonly used, but chemically different rheological modifiers, xanthan gum and carbomer, were incorporated in a standard emulsion base at five increasing concentrations, respectively, and used as model semisolid systems. Rheological measurements were carried out using a 35 mm serrated parallel plate, with the gap of 0.5 mm. The methods used were stress sweep (0.5-500 Pa at 1 Hz) and frequency sweep (0.01-10 Hz at 10 Pa). The texture analysis method used was a repeated immersion/de-immersion test, using a one-inch diameter cylindrical probe made of perspex.

The results were analysed for their consistency with theoretical predictions and any correlations between the methods and/or concentration ranges. The analysis revealed consistent trends related to two novel TA parameters, stringiness (which decreased with the increase in thickener concentration) and resilience (which has shown a mild increasing trend). Elastic modulus \(G'\) was negatively correlated to stringiness, indicating that some TA parameters do reflect viscoelasticity of the sample.

In conclusion, a comparison of oscillatory rheology and texture analysis has revealed some practically useful correlations between their respective parameters. If carefully interpreted, TA parameters stringiness and resilience could be used to assess the level of viscoelasticity of cosmetic semisolids.