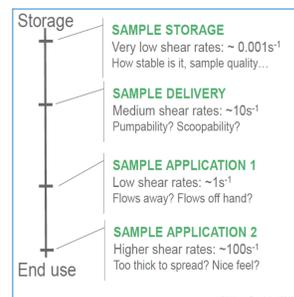


BACKGROUND

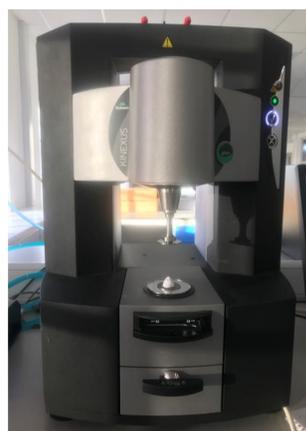
- Rheological characterisation of ingredients and formulations during new product development is largely used to reduce the time and cost of a sensory evaluation^{1,2}.
- Rheological study is also important for improving processing efficiency and assessing product stability².
- There is a need for ingredients substitutions and innovation as differentiator and to satisfy consumers requirements for more natural products produced in a sustainable manner.
- Yield stress provides an indication of the body cream and gels processability, their long-term stability and shelf life, how easy they will be distributed on the skin and the skin feeling after application^{1,2,3}.



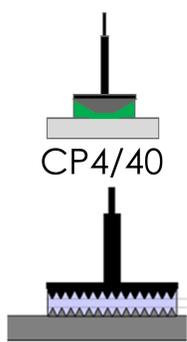
OBJECTIVES

1. Assess any potential presence of wall slip that could affect the accuracy of the results;
2. Determine the best method for assessing the yield stress of skin care products
3. Measure the viscosity and yield stress of novel creams and gels

MATERIALS AND METHODS



Kinexus pro+ rotational rheometer



Serrated plate (PLS40X)

Examples of geometries

Viscometry

- Table shear 0.1 -100 s⁻¹
- Herschel-Bulkley model
 $\sigma = \sigma_0 + K\dot{\gamma}^n$
 $\sigma_0 = \text{Yield stress}$
- Shear stress ramp 0 – 200 Pa

Oscillatory

- Amplitude sweeps were performed from 0.1 % to 1000% strain at 1 Hz
- Cohesive energy $CE (Pa) = \frac{1}{2} G' \dot{\gamma}^2$
Where, G' = The storage modulus value corresponding to the LVER.
- $\dot{\gamma} = \text{The limit value corresponding to the LVER, \%}$

Wall slip?

Stress ramp (0-200 Pa)

Cone and Plate VS Serrated plate

Selection the geometry

Tests

- Viscosity
- Yield stress

RESULTS

1. Measurements are likely to be affected by Wall slip

Table 1. Typical yield stress ramp of a cream A as measured with different 40 mm diameter geometries

Geometry	Yield stress (Pa)	Maximum Viscosity (Pa.s)
Serrated plate	35±2	4185±294
Cone and Plate	17±5	4112±833

Values in parentheses are standard deviations of at least three tests

2. Yield stress (YS) estimation by amplitude sweep (AS)

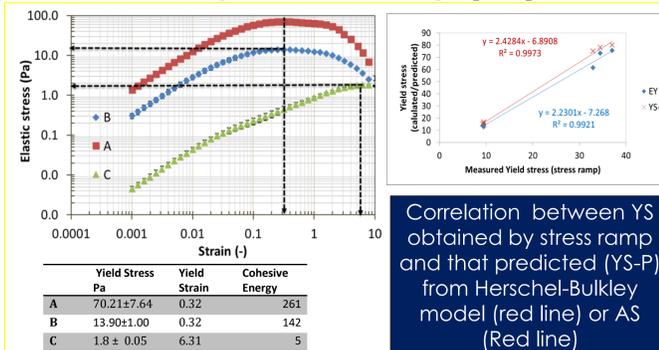


Figure 1. Analysis of amplitude sweep data for yield stress and yield strain calculation. Good correlation was obtained between the two methods

3. Effect of temperature on samples' viscosity

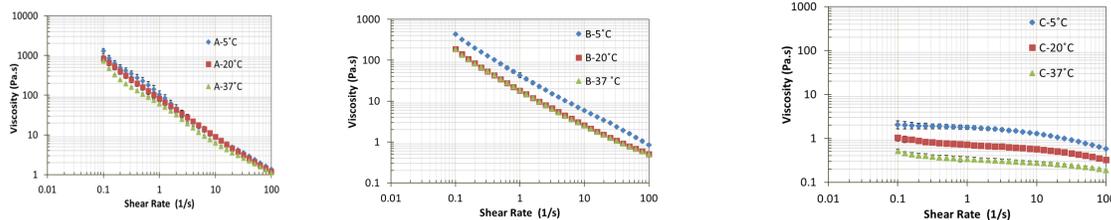


Figure 2. Log-log plot for viscosity against shear rate of different skin care products (creams, A&B, Gel, C) at relevant temperatures (storage, transportation application)

CONCLUSIONS

- ✓ More reproducible data and higher yield stress and viscosity was obtained with a serrated plate, thus it is a better geometry.
- ✓ Amplitude sweep (AS) has proven to be a good method for estimating the yield stress (YS) of product with low viscosity whereas it was not possible to obtain YS by stress ramp for these samples.
- ✓ The yield stress was within the acceptable range for a lotion (yield stress < 10Pa) and a cream (yield stress > 10Pa)⁴.
- ✓ Creams with a relatively higher yield stress & low yield strain generally show good acceptability & performance.
- ✓ Cream A is less sensitive to temperature than the two other products, thus will be more stable to temperature fluctuation during storage/distribution

FUTURE WORK

- ✓ Study the rheological properties of different base formulations of skin care products and the effect of biological active ingredients on their stability
- ✓ Combine the rheological study and other characterization methods such TGA, DSC and microscopy analysis.

REFERENCES

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