

Correlating Triborheology to the Sensory Profile of Cosmetic Formulations

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Introduction

- The texture or 'feel' of a cosmetic is a key for metric for understanding consumer experience
- The 'feel' of a product can determine the efficacy of a formulation, a way of determining this is to look at the frictional response of the product
- In this study we correlated the data gathered from a limited consumer study with triborheological measurements done on three commercial moisturisers



Figure 1: Image of a person rubbing in a skin cream.

Materials

- Three different commercial moisturiser products were tested and will be referred to as (1), (2) and (3)
- (1) is a daily moisturising product, (2) is a night cream and (3) is a high-end cream with minerals included in the formulation

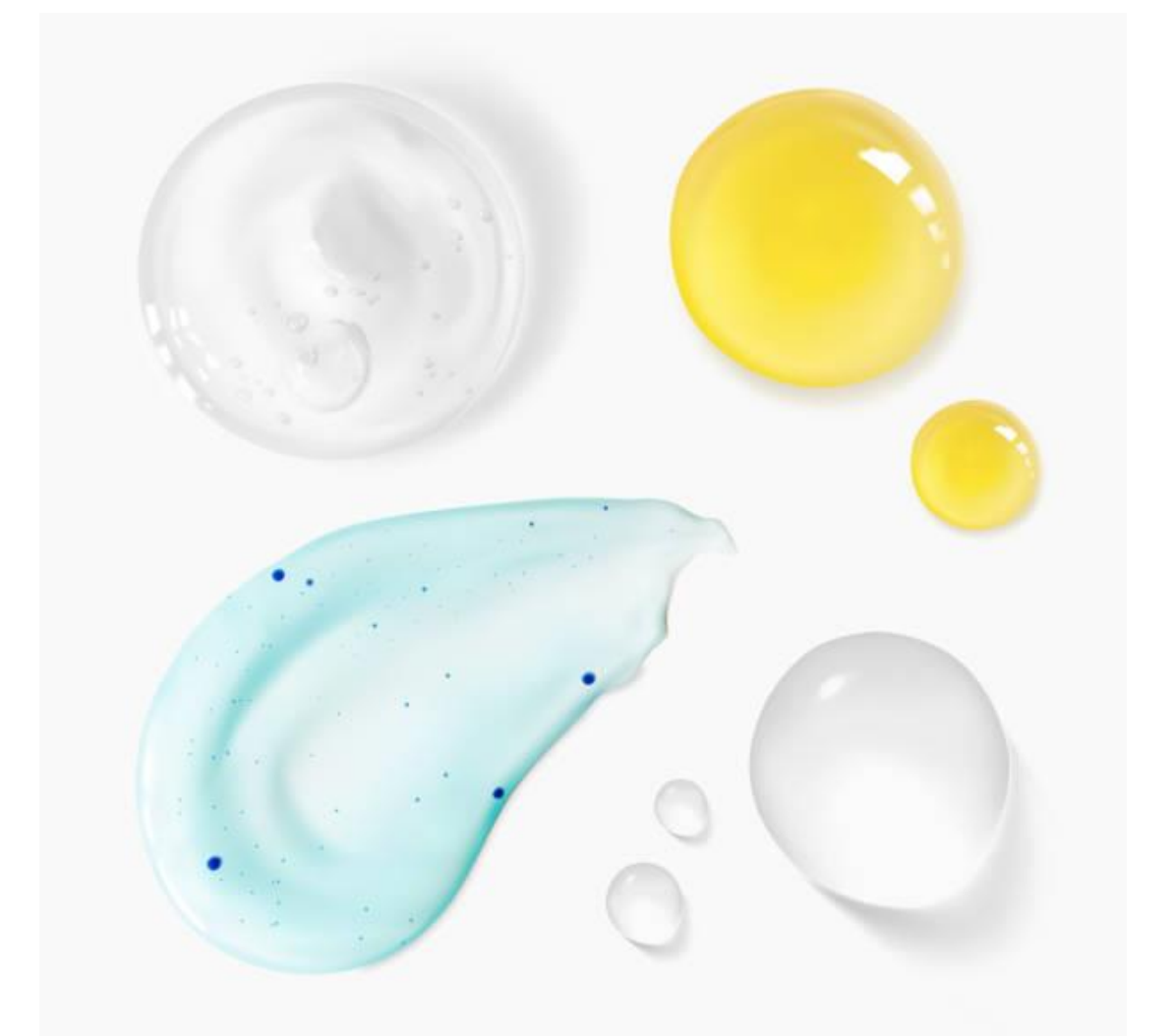


Figure 2: Image different variants of skin creams.

Triborheology Set-Up

- All triborheology measurements were carried out using a KINEXUS Ultra rheometer with a custom-made geometry attached

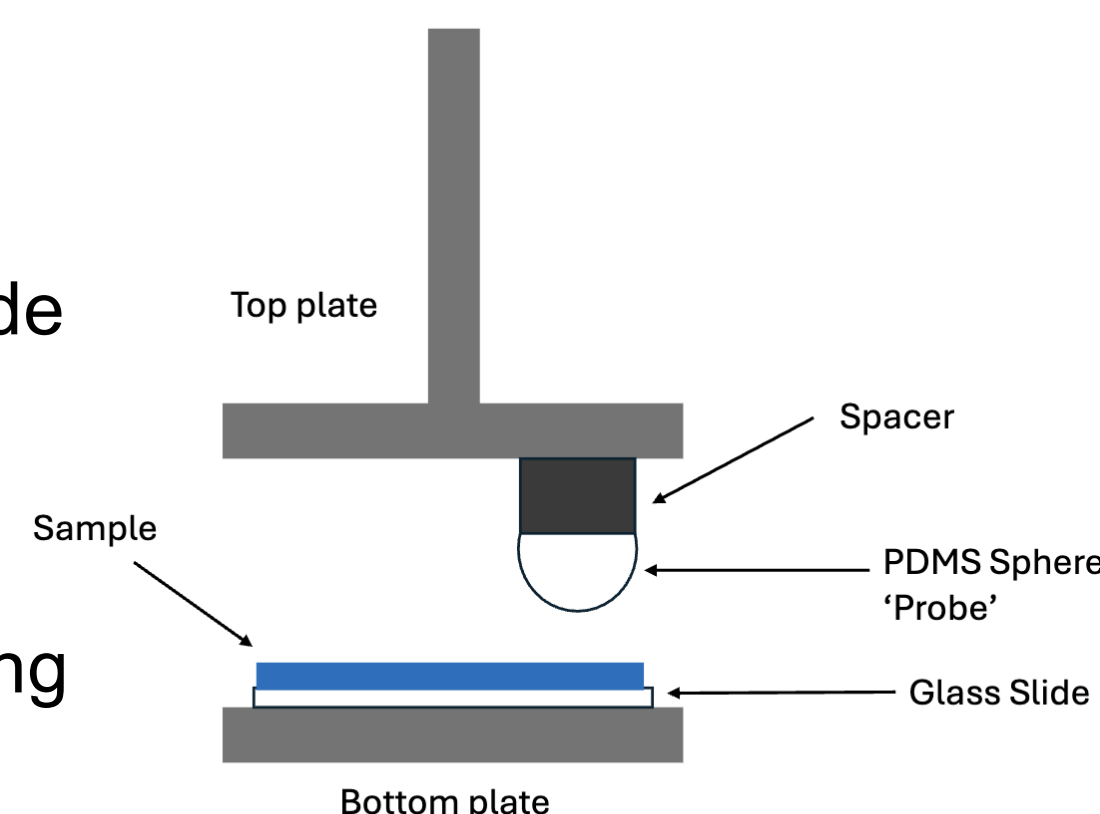


Figure 3: Schematic of the triborheology set up.

- The probe was a PDMS semi-sphere (2.5 cm in radius), which applied a constant load of 0.1 N allowing us to access pressures relevant to those applied by human fingers [1]

- The angular speed was varied from 0.8 mms⁻¹ to 800 mms⁻¹

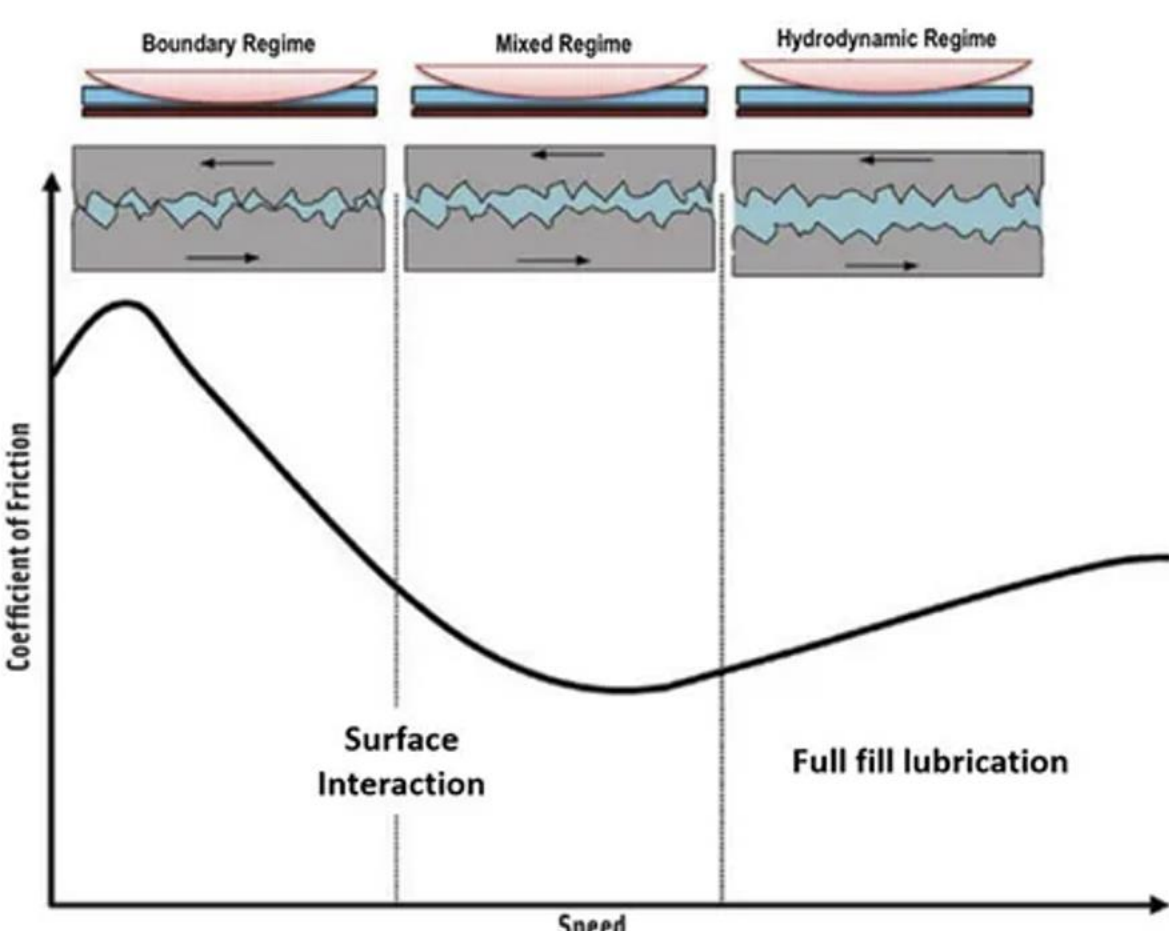


Figure 4: Schematic of an idealised friction curve showing the three lubrication regimes. Taken from [2].

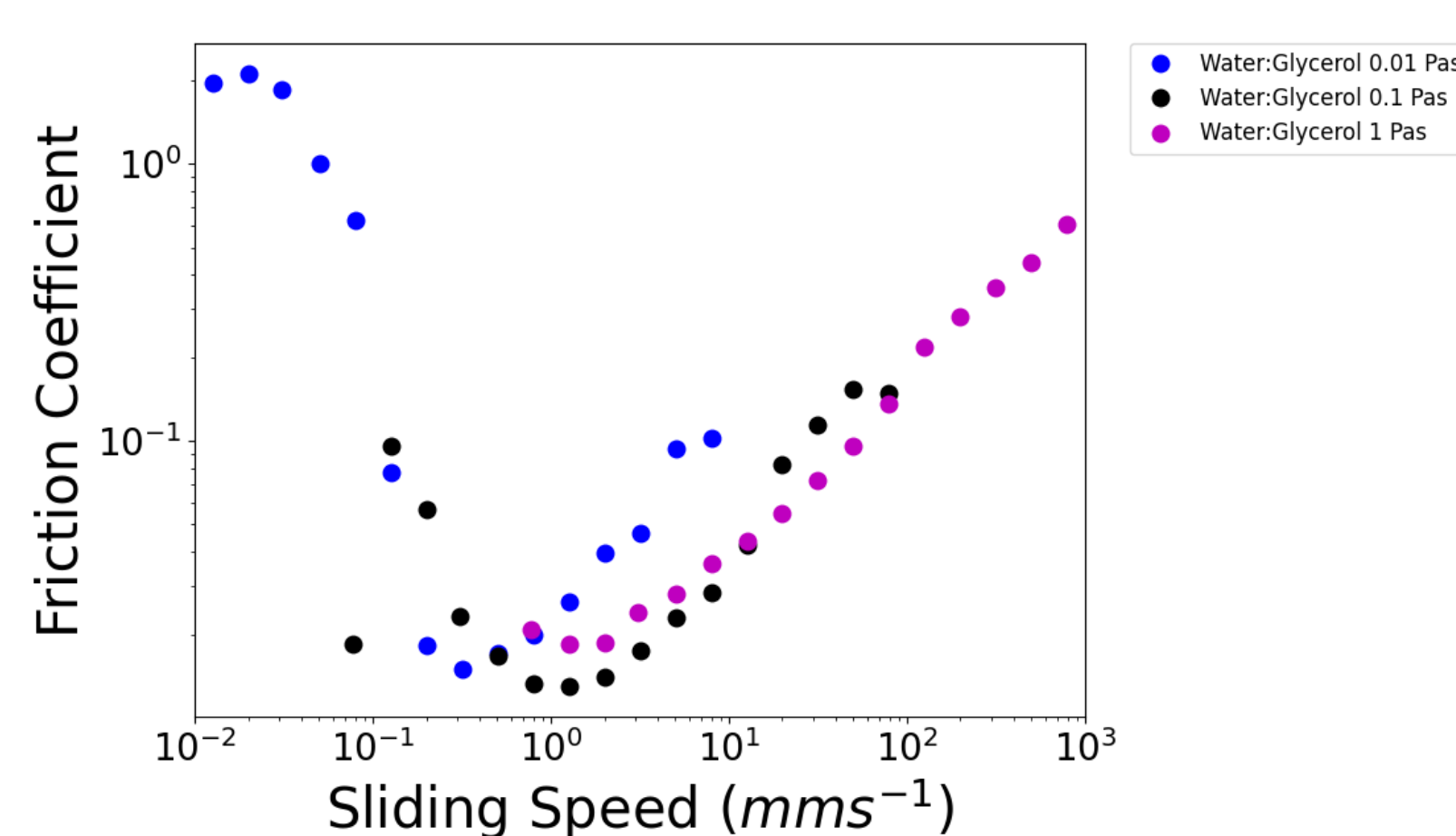


Figure 5: Friction Coefficient plotted as a function of sliding speed for three water/glycerol mixes.

- The set-up was tested using a control which consisted of different mixes of water and glycerol

- By modifying the ratio of water to glycerol we can access different lubrication regimes which allows us to identify the regimes the skin creams exhibit looking at their frictional responses

Consumer Study Parameters

- Nine participants were asked to describe the feel of each of the products using three descriptors: silky, tacky or wet
- A small amount of product was dispensed onto their hand which subjects rubbed into their skin
- Once rubbed in, participants were asked to feel the treated region, and their description of the feeling was noted
- After testing was complete participants were asked to rank the three products based on which product they preferred

Results

- (1) was the least favoured of all the products, incidentally it also had the lowest low shear viscosity
- Wet was the most common descriptor for sample (1)
- (2) and (3) were split between silky and tacky, and had similar low shear viscosities, which are significantly higher than (1)

Sample	Viscosity at 0.01s ⁻¹ (Pa s)	Descriptor	No of responses	1 st Choice	3 rd Choice
1	51	Silky	2	3	5
		Wet	7		
		Tacky	0		
2	506	Silky	4	3	3
		Wet	2		
		Tacky	3		
3	527	Silky	5	3	1
		Wet	0		
		Tacky	4		

Table 1: Summary of results of the consumer study.

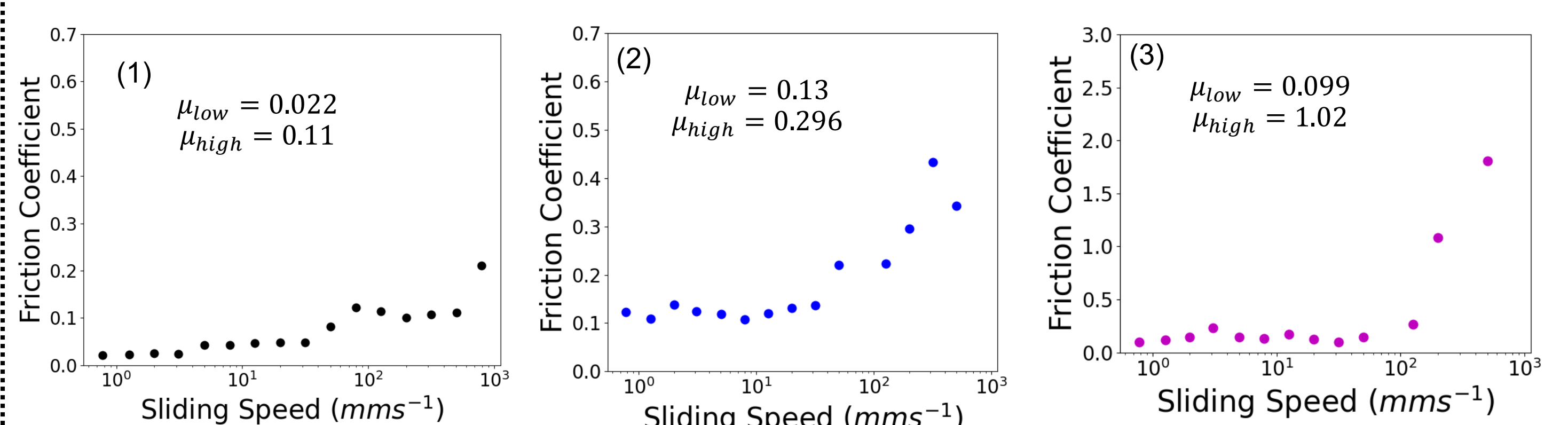


Figure 6: Frictional coefficient plotted as a function of sliding speed for the three commercial samples, from left to right: (1), (2) and (3). μ_{low} and μ_{high} refer to the friction coefficients at 2 mms⁻¹ for low speeds and 200mms⁻¹ for high speeds.

- The frictional response of (1) & (3) are similar at low speeds (< 100 mms⁻¹), (2) was slightly higher whereas the high-speed responses vary between all three samples
- These results seem to indicate that a formulation needs to have a considerable frictional coefficient (approx. > 0.10) for a product to produce a significant 'feel' as (2) and (3) were described as silky or tacky
- The low shear viscosity also seems to be a determining factor as both (2) and (3) were much higher than (1) and neither (2) or (3) was described as wet

Conclusions

- We have demonstrated that triborheology can be used to give meaning to consumer data
- The next steps would be to build a framework for determining the main ingredients which are responsible for a formulation's frictional response
- Another route would be to link the frictional response to the microstructure of a formulation, which is possible using some advanced microscopy techniques

REFERENCES: [1] Bongaerts, J. H. H., K. Fourtouni, and J. R. Stokes. "Soft-tribology: Lubrication in a compliant PDMS-PDMS contact." *Tribology International* 40.10-12 (2007): 1531-1542. [2] Corvera-Paredes, Beatriz, et al. "Soft tribology and its relationship with the sensory perception in dairy products: A review." *Frontiers in Nutrition* 9 (2022): 874763.



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