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Rheology as an ally in the validation of cosmetic formulations stability

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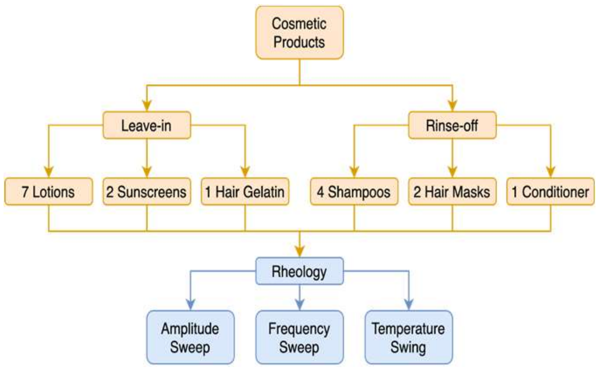
Introduction:

A scientific challenge about cosmetic quality control, nowadays, is the huge number of new products released per year. Cosmetic quality control demands the development of reproducible, predictive and rapid methodologies (GALDORFINI-CHIARI, et al, 2012). The prediction and validation of the product stability, if the product will maintain such standard during the shelf life, is a huge concern of the cosmetics industry, as it is a fundamental requirement for product quality and safety (GALDORFINI-CHIARI, et al, 2012).

As an emergent methodology to evaluate cosmetic instability, rheology could be considered a very powerful technique to predict and ensure the product quality control and shelf life. It is a versatile tool that can be used to predict stability, sensory properties, texture and strength needed to fill and to remove the product from the package (MEZGER, 2014).

Materials & Methods:

Sixteen samples from Boticário Group were selected, which were produced at laboratory scale and analyzed 24 h after production. For amplitude and frequency sweep analysis, the RheoStress 1 rheometer (Thermo Haake) system, geometry of 60mm, 1° Ti, with a gap of 0.105 mm were used.



Amplitude sweep: A tension from 0.01 to 100 Pa was applied, at a frequency of 1 Hz, at 25ºC. Triplicate tests were performed for each sample.

Frequency sweep: Using tensions under the LVR, the samples were evaluated from 100 to 0.01 Hz. All the samples were evaluated under a constant stress of 1 Pa, at 25ºC.

Temperature swing: Cosmetics were analyzed at 10 heating and cooling cycles from 5 to 40°C, at a heating rate of 5°C.min^{-1}, frequency of 1 Hz and 1 Pa. For this analysis, a Discovery HR-1 Rheometer (TA Instruments) using a parallel plate of 40 mm.

Results & Discussion:

The formulations presented a yield stress, except shampoos that behaves as a liquid-like viscoelastic sample. The samples with yield stress behaves as a solid at lower tensions and shearing, limiting phase separation and instability (ABEN, S. et al, 2012).

When analyzing the frequency sweep, for the leave-in formulations, all the lotions and sunscreens presented a solid-like viscoelastic behavior, except for Hair Gelatin. For the wash-off products, the hair mask and conditioner, presented a solid-like viscoelastic behavior, and both shampoos a liquid-like viscoelastic behavior.

The temperature swings allowed the samples to be grouped into three distinct groups. The Group I contain the samples in which G' and G" were not significantly affected by the swing of temperature (**Figure 1A**). The group II was associated to an increase in the G', possibly due to the restructuration of the formulations, increasing the formulations network. In the group III, the cycles of heating and cooling reduced the G' (**Figure 1B)**.

We expected a much more significant variation in G' and G" during the heating and cooling cycles to the sample be reproved in classical methods of analysis (BRUMMER, 2006).

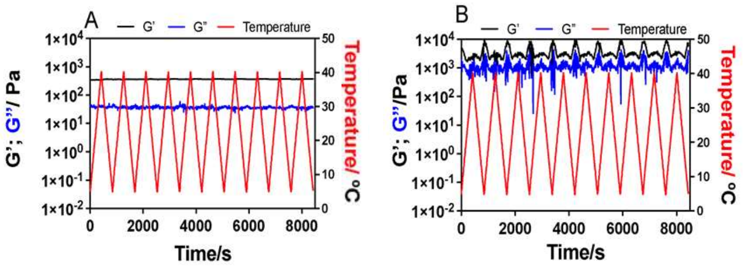


Figure 1. Temperature swing from 5 to 40°C at a heating rate of 5°C.min^{-1} of the samples lotion 2 and conditioner, using an oscillation frequency of 1 Hz at 1 Pa. SOURCE: the Author, (2021).

Conclusions:

Rheology could be an interesting accessory methodology to identify cosmetic sample instability. The swing of temperature could separate the samples in groups, and two of them could be associated to instability. The rheology is much more sensitive to samples instability, compared to classical quality control techniques.

Aknowledgments:

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References:

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