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Formulability of Natural Deep Eutectic Solvents in cosmetics: a joint rheological, calorimetric and sensory analysis

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OBJECTIVES: Natural deep eutectic solvents (NaDES) are a new range of solvents made from biorefinery ingredients. They are currently used in the cosmetic field for their extraction properties, as an eco-friendly alternative to usual organic solvents. Their non volatility implies their inclusion in the final product alongside the molecules of interest. The first objective of this study was to measure the impact of the introduction of hydrophilic NaDES on the properties of a cosmetic gel. The second objective was to evaluate if the physico-chemical and sensory characteristics of the NaDES can help us predict their formulability.
METHODS: Three commonly used hydrophilic NaDES from the main families, organic acid-based, amino-acid based and sugar-based NaDES, where analyzed alone then introduced in a model cosmetic gel (1 and 10% wt.). A blank gel was used as a control. Rheological properties were investigated by flow and viscoelasticity experiments. Thermal behavior was studied by Differential Scanning Calorimetry and Thermogravimetric Analysis. Finally, the impact of NaDES on cosmetic gel sensory properties was evaluated by an expert panel.
RESULTS: The impact of the introduction of NaDES in the gel is different from one family to another. Globally, gels maintain a rheofluidic behavior, i.e. their viscosity decreases when the shear rate increases. The viscosity at low shear rates is dependent on the concentration of NaDES. This is less obvious for high shear rates, which correspond to the spreading, pumping in a vial or spraying. These results are confronted with calorimetric measurements. Finally, sensory analysis allows us to put the physico-chemical results into perspective with the global impact on the consumer's perception. Four descriptors were particularly relevant: odor, visual viscosity, stringyness and stickyness.
CONCLUSION: NaDES could be a major actor in the hands of the cosmetic industry to switch towards more environmentally friendly bio-based ingredients preparation. Nevertheless, our results demonstrate that their use may have an impact on the consumer's experience and that this impact may be partially anticipated thanks to thorough study of the physico-chemical and sensory properties of blank NaDES.

Keywords: Natural deep eutectic solvent; sensory properties; rheology; gels; TGA/DSC

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