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Biosurfactant Formulation Optimization through High-throughput Research

ID 581

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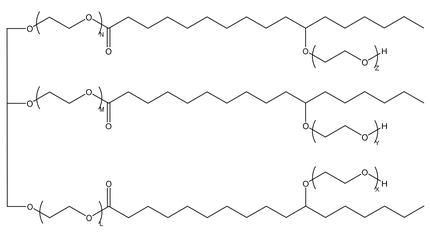
Introduction:

Market trends are moving towards biosurfactants. For widespread adoption, these surfactants must match or improve upon the properties of surfactants derived from petrochemical sources. A key feature of many cosmetic formulations is solubilization of essential oils and fragrances [1,2]. As such, the major thrust of our research was to identify optimal sophorolipid surfactant formulations for solubilization of essential oils. The performance of the sophorolipid surfactants was benchmarked against widely used ethoxylated, hydrogenated castor oil surfactants, which are currently ethoxylated using petrochemically derived ethylene oxide (EO) [3-6]. Below, we present the results of a study that utilized a high-throughput research (HTR) workflow to demonstrate that sophorolipids are promising alternatives to ethoxylated, hydrogenated vegetable oils for solubilization.

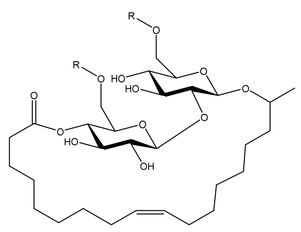
Central Hypothesis : Complex microstructures accessible by sophorolipid surfactants (e.g., rodlike and tubular micelles) would promote increased micellar volume for essential oil solubilization relative to ethoxylated, hydrogenated castor oil surfactants.

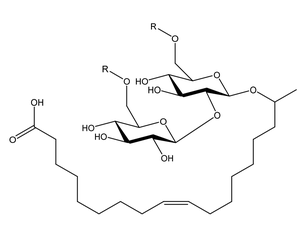
Materials & Methods:

Surfactants Studied



PEG-40 HCO

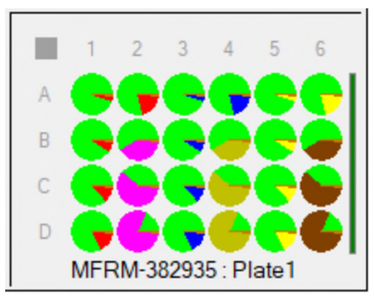




EcoSense™ GL-60 HA Surfactant (≥ 80 % acid; ≤ 20 % lactonic)
EcoSense™ GL-60 HL Surfactant (≤ 47 % acid; ≥ 53% lactonic)

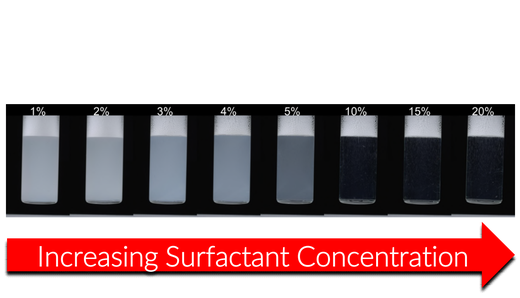
High-throughput Research (HTR) Workflow

Experimental Design

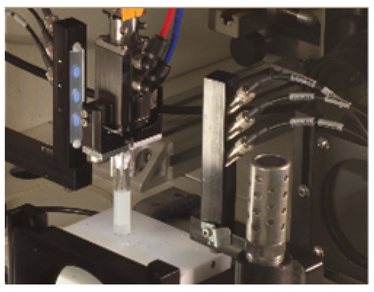


Automated Liquid Hander

Phase Behavior

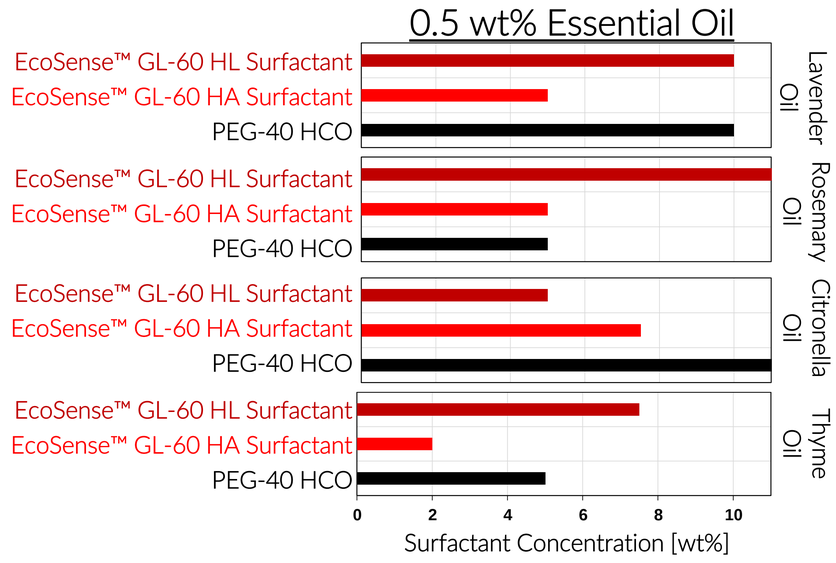


Robotic Image Collection

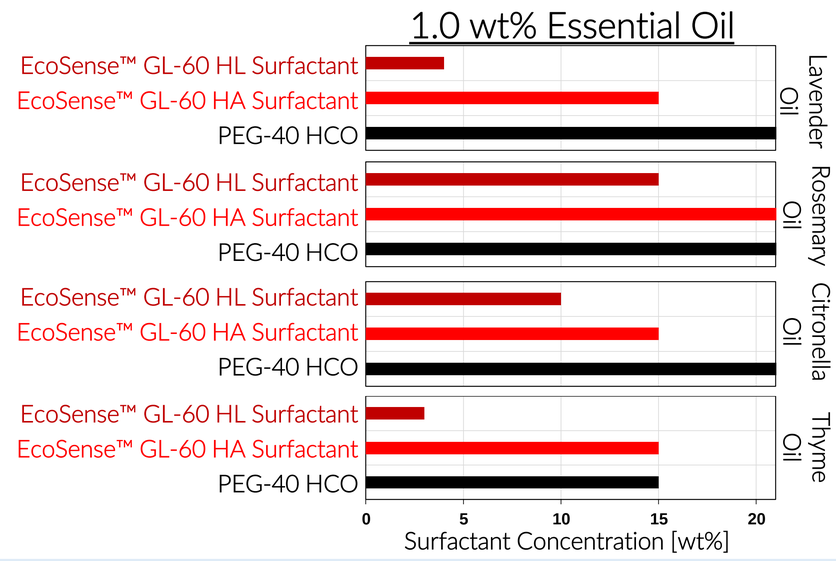


- Order of addition: water, surfactant stock, essential oil (30 minutes of mixing)
- Samples imaged after 24 hours of equilibration
- Surfactant concentration required for solubilization reported

Results & Discussion:



- EcoSense™ GL-60 HA Surfactant had a higher solubilization capacity than PEG-40 HCO surfactant for each of the essential oils studied at 0.5 wt% essential oil
- EcoSense™ GL-60 HL surfactant had a higher solubilization capacity than EcoSense™ GL-60 HA Surfactant for citronellal oil



- At 1 wt% essential oil, the solubilization capacity of the EcoSense™ GL-60 HL was higher than the capacities of both EcoSense™ GL-60 HA and the PEG-40 HCO surfactant for all four essential oils studied

Conclusions:

In this study, an HTR workflow for characterizing essential oil solubilization by surfactants was developed and leveraged to demonstrate that sophorolipid surfactants are more efficient solubilizers than widely used ethoxylated, hydrogenated castor oil surfactants. Thus, sophorolipid surfactants represent a promising class of 100% bio-based, biodegradable alternatives to petrochemical surfactants for solubilization of essential oils and fragrances in cosmetic formulations. The results of this study can be readily applied to design of cosmetic products. For example, the results presented here suggest that access to both acid form-rich and lactone form-rich sophorolipids surfactants will allow cosmetic formulators to develop tailored blends of the forms to optimize solubilization of an essential oil or fragrance of interest.

Acknowledgements:

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References:

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