

Title: Exploration of textured hair characteristics following lipophilic active applications.

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Objective. This project explores leave-on product characteristics and hair tress testing methods of relevance to textured hair.

Materials and methods. Two non-ionic, oil-in-water emulsions were prepared. The Active formulation contained a triglyceride – triolein. The Control formulation contained the emulsification system only. The formulations were characterised via: texture analysis (cohesion and adhesion) using TA.XT Plus Texture Analyser (Stable Microsystems, UK), rotational and oscillatory rheology using Thermo Scientific™ HAAKE™ Mars™ iQ Air rheometer (Cole-Parmer, UK). Ten Type 8 hair tresses were prepared from chemically and thermally untreated hair collected from two donors. The formulations were applied to the tresses following a defined protocol. The tresses were tested before, after one and after four repeated product applications via adaptations of wet combing and dry friction tests using fibre.one (Diastron, UK) and tri-point bending test using TA.XT Plus Texture Analyser (Stable Microsystems, UK).

Results. *Product characterisation.* The addition of triolein to the non-ionic emulsion increased the cohesion and adhesion properties of the emulsion. Both emulsions exhibited non-Newtonian sheer thinning behaviour, however the Active formulation exhibited higher viscosity at all shear rates in line with the increased oil phase. The thixotropic nature of the formulations is desirable for leave-on products expected to maintain high viscosity at rest and break down rapidly under sheer thinning conditions. The Active formulation also exhibited a better balance between structural stability at rest and deformation in response to force, suggesting superior suitability for a leave-on product. *Hair testing.* The tress test data was not symmetrically distributed hence the sign test was applied, testing if the directions of the median paired differences between two conditions are statistically significant. The following statistical directions of change in samples were detected: in the wet state, combing forces reduced in presence of product in comparison to untreated hair, the multiple Active applications causing further reductions from the single Control and single Active formulations. Multiple Active applications also reduced the dry friction of hair in comparison with untreated hair and single Control and Active applications. The Control formulation caused a reduction of hair stiffness in comparison with untreated hair, whilst the application of Active caused an increase in comparison with Control.

Conclusion. Leave-on emulsions for textured hair, reapplied multiple times between washing, have the capacity to reduce wet combing and detangling of hair. Higher quantity of lipophilic phase enhances this effect, which could be attributed to reduced inter fibre cohesion. In dry friction test, the triolein presence and repeated application also caused reduction in friction. This could be attributed to better hair surface coverage by the Active reapplications and the formulation's superior shear thinning property. The increase tress stiffness after multiple Active applications could be due to the higher firmness of the product contributing to the bending resistance of the hair fibres. Thus, this work identifies textured hair characteristics that could be altered via product applications and measured using tests commonly applied to straight hair. Further test adaptations, specifically to the dosing, are desirable to improve the data distribution and the measured magnitude of differences.