Characterization of the applicative properties of O/W emulsions containing natural polymers associations: rheology and texture analysis

Lucchetti, Silvia1; Tafuro, Giovanni2; Costantini, Alessia2; Busata, Laura2; Baratto, Gianni3; Semenzato, Alessandra1

1 Department of Pharmaceutical and Pharmacological Sciences, University of Padova, Italy; 2 Unired S.r.l., Padova, Italy; 3 Unifarco S.p.A., Santa Giustina (BL), Italy.

*Corresponding author: Silvia Lucchetti, via Marzolo 5, 35131 Padua, Italy, +39 0498275326, silvia.lucchetti@studenti.unipd.it

Introduction:

Polysaccharides in cosmetics are the first choice for replacing the non-biodegradable synthetic polymers, as the attention on environmental issues is increasing.

Since the choice of natural raw materials for cosmetics is wide, manufacturers need to evaluate the potentiality of their use as alternatives to synthetic ones.

AIM of the work: to study by means of rheological and texture analyses the physico-mechanical properties of emulsions, comparing the contribution conferred by natural polymers with that conferred by synthetic ones.

Materials & Methods:

Two emulsifier systems were used:

Y: Gliceryl stearate, Peg-100 stearate
Z: Sucrose stearate, Sucrose tristearate

Emulsions containing Synthetic Polymers were prepared:

<table>
<thead>
<tr>
<th>SP</th>
<th>Sodium Polycrylate</th>
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<tr>
<td>V</td>
<td>Polycrylate Crosspolymer-11</td>
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Emulsions containing Natural Polymers alone and in associations were prepared:

| BLV | Ammonium acryloyldimethyltaurate/beheneth-25 methacrylate crosspolymer |

The oily phase constitutes 20% of the formula and contains four different oils in equal parts: Coco-Caprylate, Coco-Caprate/Caprate, Dicapryli carbonate e Caprylic/capric triglyceride.

Rheological analysis: viscoelastic properties were measured in oscillatory flow conditions, at fixed strain, within the linear viscoelastic region, in function of frequency, using a Rheometer Physica MCR-101 (Anton Paar) at 23 ± 0.50 °C, equipped with a PP500/P sensor (fixed gap of 1.025 mm).

Texture analysis: an immersion/de-immersion test was performed with Texture Analyzer TMS-Pro (Food Technology Corporation) equipped with a 10 N load cell and a nylon spherical probe (2 cm diameter). The probe penetrates the sample at a speed of 80 mm/min to a depth of 10 mm.

The texture analysis (TA) curve and the derived parameters are shown in Fig.1.

![Fig.1: Definition of parameters from a TA curve.](image)

Results & Discussion:

A Principal Component Analysis (PCA), performed using XLSTAT software, was applied to the correlation matrix of the values of the textural parameters (Fig.2). Polysaccharides and synthetic polymers are on opposite sides of the graph. By associating the polysaccharides, it is possible to approach the emulsion YV with balanced texture parameters in the central part of the graph.

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Textural data showed that the AC association had similar characteristics to those of the synthetic polymer V.

Rheological analyses confirmed these similarities, as shown by the comparison between the viscoelastic properties of the emulsified systems Y (Figure 3a) and the system Z (Figure 3b). AC and V showed comparable quantitative response.

![A Principal Component Analysis (PCA), performed using XLSTAT software, was applied to the correlation matrix of the values of the textural parameters (Fig.2). Polysaccharides and synthetic polymers are on opposite sides of the graph. By associating the polysaccharides, it is possible to approach the emulsion YV with balanced texture parameters in the central part of the graph.](image)

Conclusions:

Associations of polysaccharides combined in appropriate ratios can be used in emulsified system to obtain a wide range of different texture profiles as alternatives to synthetic acrylic polymers in the formulation of green products.

The methodological approach based on rheology and texture analysis have proved to be fundamental to study the physico-mechanical properties of cosmetic formulations, overcoming the trial and error formulation design.

References: