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

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## Introduction:

Polysaccharides in cosmetics are the first choice for replacing the non-biodegradable synthetic polymers, as the attention on environmental issues is increasing[1].
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[2].
Starting from the results obtained in our previous work[3], we studied the **applicative performance of three polysaccharydes** used **alone and in binary associations** as rheological modifiers **in oil in water emulsions**.

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.

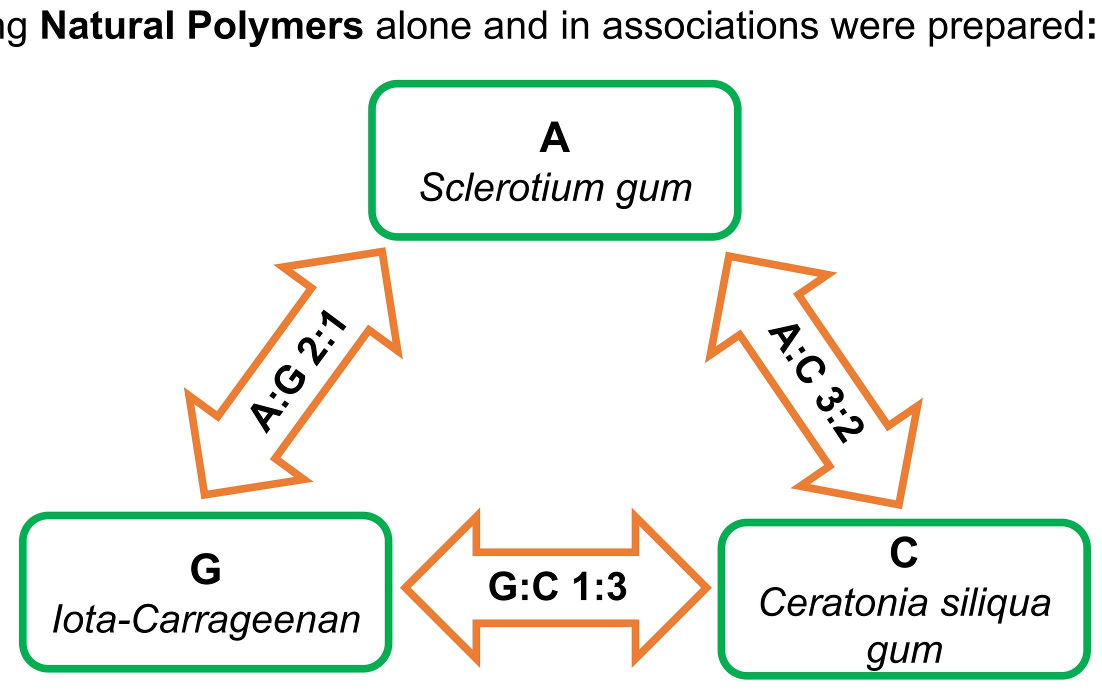
## Materials & Methods:

Two emulsifier systems were used:
**Y:** *Glyceryl stearate, Peg-100 stearate*
**Z:** *Sucrose stearate, Sucrose tristearate*

Emulsions containing **Synthetic Polymers** were prepared**:**

| SP | V | BLV |
|---|---|---|
| Sodium Polyacrylate | Polyacrylate Crosspolymer-11 | Ammonium acryloyldimethyltaurate/beheneth-25 methacrylate crosspolymer |

Emulsions containing **Natural Polymers** alone and in associations were prepared**:**




The oily phase constitutes 20% of the formula and contains four different oils in equal parts: *Coco-Caprylate*, *Coco-Caprylate/Caprate*, *Dicaprylyl 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 ± 0.05 °C, equipped with a PP50/P2 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.

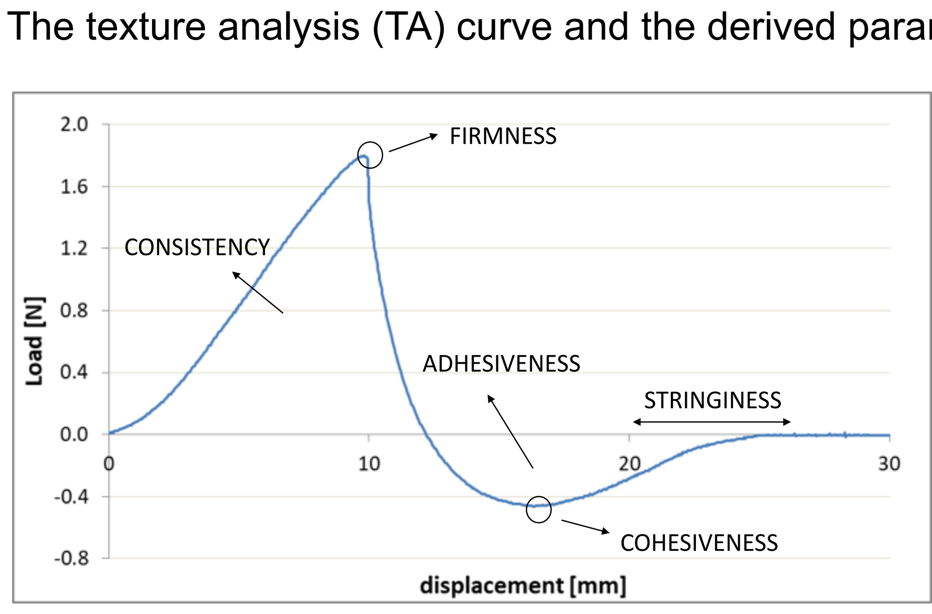



**Fig.1**: *Definition of parameters from a TA curve.*

- ✓ **Firmness:** the force (N) needed to obtain a deformation;
- ✓ **Consistency:** the work (N.mm) the sample opposes against the deformation;
- ✓ **Cohesiveness:** the material intramolecular forces (N);
- ✓ **Adhesiveness:** the work (N.mm) necessary to overcome the forces between two surfaces;
- ✓ **Stringiness:** the distance (mm) the product stretches during the de-immersion phase.

## 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.

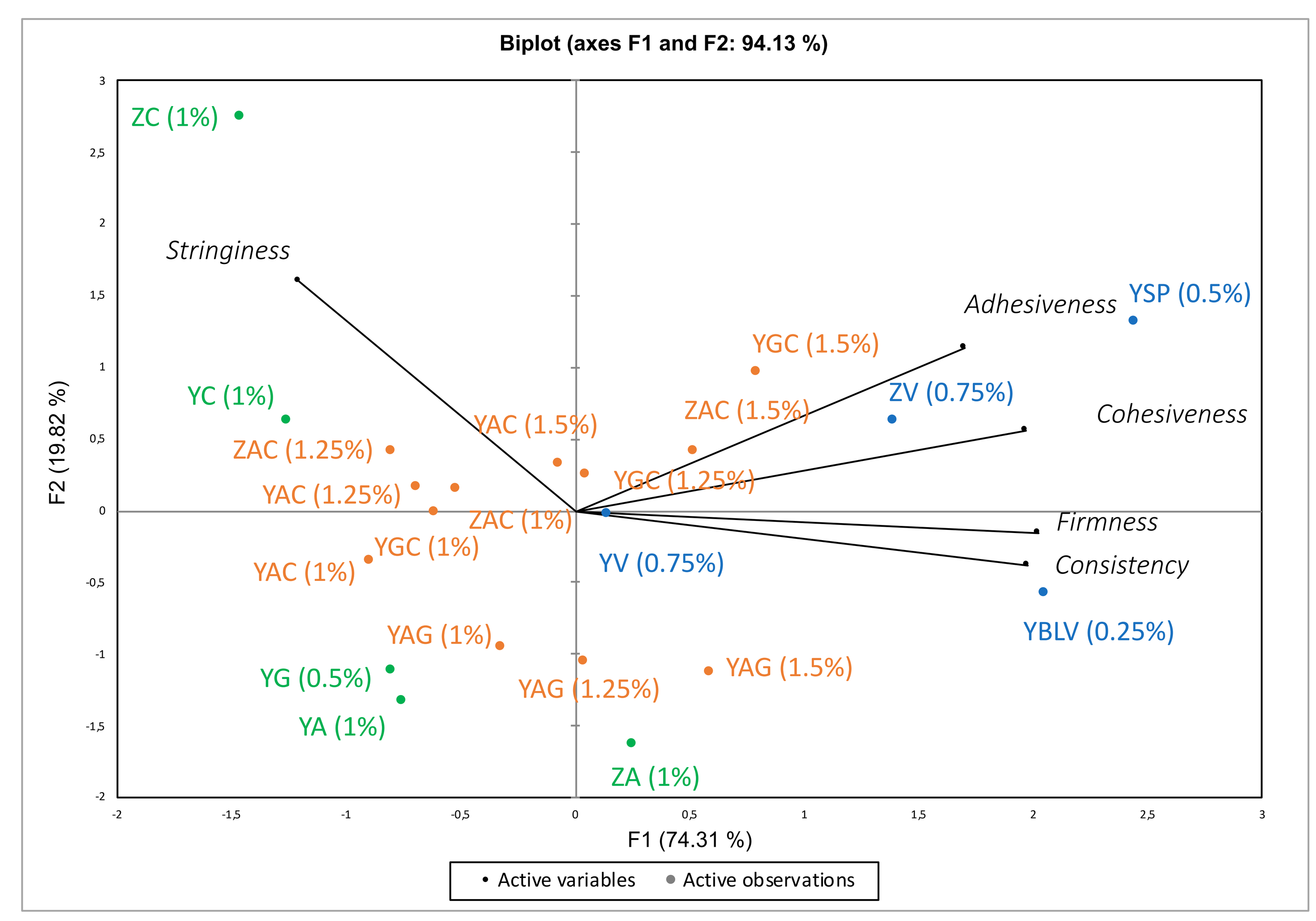



**Fig.2**: *PCA loading biplot with textural parameters (variables in black) of emulsions containing polysaccharides alone (in green), polysaccharides in associations (in orange) and synthetic polymers (in blue).*

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 systems Z (Figure 3b). AC and V showed comparable quantitive response.

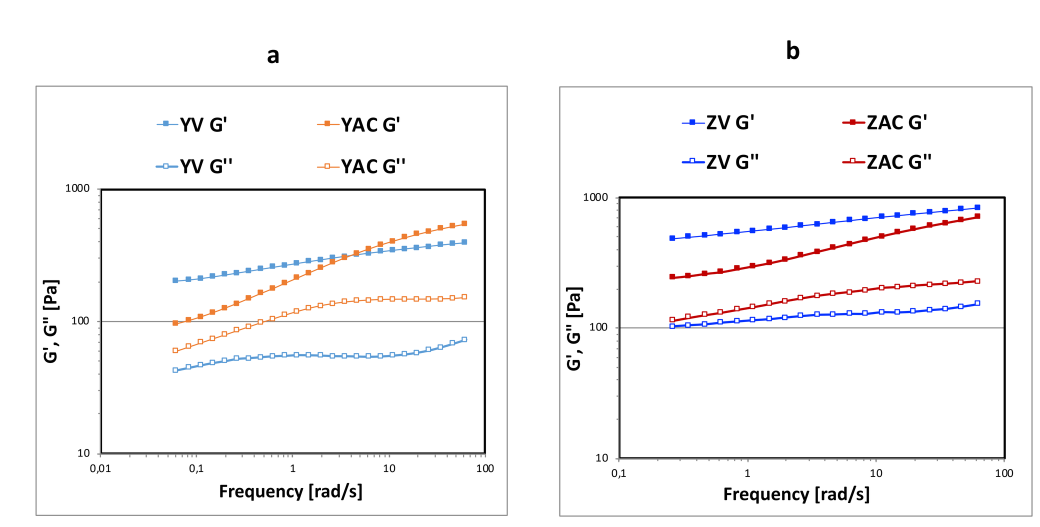



**Fig.3**: *Trend of elastic G' and viscous G'' moduli in function of the frequency for samples (a) YV 0.75% w/w and YAC 1.5% w/w of total polymer concentration, (b) ZV 0.75% w/w and ZAC 1.5% w/w of total polymer concentration.*

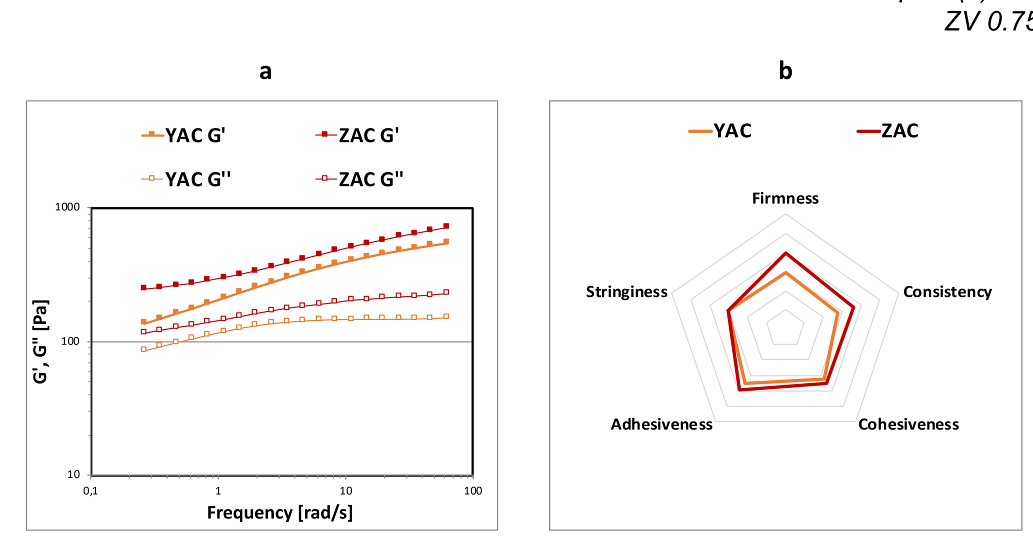



**Fig.4**: *(a) Trend of elastic G' and viscous G'' moduli in function of the frequency, (b) radar of textural parameters for samples YAC and ZAC at 1.5% w/w of total polymer concentration.*

Difference occurred between the two emulsifyng system.

The emulsyfing system Z imparted a more organized structure to the polymer network, leading to an increase of the values of both G' and G'' moduli (Fig.4a) and texture parameters (Fig.4b).

## 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:

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