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Modulation of metal oxide particle behavior in a formulation: physicochemical and sensory properties of emulsion as a tool to identify particles interaction within the matrix

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The aim of this study lays on the fundamental approach in the understanding of the behavior of the systems containing solid particles. Two metallic oxides were selected depending on their different physicochemical properties and introduced in a formulation. Then, stable, homogeneous and totally emulsified systems, never discussed in the literature before, were described through a fundamental, multiscale characterization. Rheological, thermal and sensory behavior, as well as emulsion colloid size and size distribution, were used as a tool to identify the role of the particles on the matrix organization.

Particles covering the water droplets

**Microscopic scale**
- Particles promoted the emulsion formation through the stabilization of the oil/water droplets inside the matrix.
- Droplets visual aspect is influenced by the particle type.

**O/W spherical droplets and distorted droplets**

**Macroscopic scale**
- Oscillatory rheology: Short G' plateau - immediate response of the product to the increasing deformation.
- Flexible structure.

**O/W spherical droplets**

**Emulsification**

**Thermogravimetric analysis**
- O/W TiO₂ emulsion: water free evaporation (continuous phase).
- W/O ZnO emulsion: water retained as internal phase.

**Thermal response**
- W/O ZnO emulsion: oil freeze stage.
- O/W TiO₂ emulsion: W/O internal phase.

**Resistance to the deformation**
- Rapid emulsions destruction.

**Sensory perception**

**Conclusion**

This study showed that emulsions stabilized with solid particles:

- Can be oil on water or water in oil type, depending on the particle properties (hydrophobic or lipophilic);
- Posses specific thermal behavior, due to the particle strong adhesion on the droplet surface;
- Show individual macroscopic response and sensory perception, governed not only by the emulsion type, but also by the particles individual properties.

The chosen particle type clearly impacted the properties of the system at microscopic and macroscopic level. This impact should be taken into account when discussing classical emulsions containing particles in their composition. The next step of this work will be to complete the studied range of particles with other metal oxides to achieve the fundamental understanding of the particles role in the matrix.

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