**Multiphase systems – new challenges for the stability and stabilizers evaluation**

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Most food products can be considered as a complex colloidal system. For the final consumer, properties such as visual aspects, shape, texture, smell as well as the most important factor which is taste are the most important. However, in point of manufacturing, transportation, and long-term stability play a crucial role. The same aspects are important in the case of cosmetics, and biomedical applications (i.e. wound healing systems). One of the most frequently investigated systems is based on emulsion systems. Due to the low costs of oil in water systems are preferable. In our previous work, we reported that some of the artificial surfactants can be successfully substituted with natural ones [1]. Here, stabilizers based on saponins showed desirable properties. Soap nuts or Aesculus hippocastanum L. extracts [2], [3] showed a high stability effect in water in oil emulsion systems. The reduction of droplet size using a two-step homogenization process decreases the particle size into nanorange, which increases the system stability.

Typical stability tests apply dynamic light scattering techniques, and various microscopic, and spectrophotometric analytical tests, which are supported by rheology, and storage condition evaluations.

Fig. 1 Idea of the multiphase system

Here, we present the concept of a multiphase stable system. This solution might be interesting in case of preventing the degradation of bioactive compounds such as vitamins and their active release in selected conditions. In the proposed multiphase system the O/W emulsion systems might be beneficial, due to final composition stability. As a final matrix of the emulsions with vitamines hydrogels will be applied.

Our goal in this presentation is to open a discussion for:

- which factors/interactions should be considered in stability evaluation,

- what kind of stability tests/desirable properties tests should be applied for multiphase colloidal systems evaluations,

- how the natural stabilizers affect each phase in the complex/multiphase system.

During the presentation, some examples of testing techniques, such as microscopy (with digital microscopy support), DLS, and rheology will be discussed.

*References:*

[1] M. Jarzębski *et al.*, “Characterization of hemp seed oil emulsion stabilized by soap nuts (Sapindus mukorossi) extract,” *Food Hydrocoll.*, vol. 156, p. 110352, Nov. 2024, doi: 10.1016/j.foodhyd.2024.110352.

[2] W. Smułek and M. Jarzębski, “Hemp seed oil nanoemulsion with Sapindus saponins as a potential carrier for iron supplement and vitamin D,” *Rev. Adv. Mater. Sci.*, vol. 62, p. 20220317, 2023, doi: https://doi.org/10.1515/rams-2022-0317.

[3] M. Jarzębski *et al.*, “Aesculus hippocastanum L. extract as a potential emulsion stabilizer,” *Food Hydrocoll.*, vol. 97, no. May, 2019, doi: 10.1016/j.foodhyd.2019.105237.