Karlsruher Institut für Technologie

Institut für Bio- und Lebensmitteltechnik,
Teilinstitut I: Lebensmittelverfahrenstechnik
Leiterin: Prof. Dr.-Ing. Heike P. Karbstein

Lebensmittelverfahrenstechnik

Pro3-Scholarship Project

Thema: Analysis of emulsifier interactions at double emulsion interfaces with the Diffusion- and Coalescence Time Analyzer

Untersuchung von Emulgatorwechselwirkungen an Doppelemulsionsgrenzflächen mithilfe des Diffusion- and Coalescence Time Analyzer

Emulsions are systems of two immiscible fluids. Depending on the formulation two common types are build: Water in oil (w/o) and oil in water (o/w) emulsions. Additionally to those types, structures that are more complex can be achieved – the multiple emulsions. The most common multiple emulsion is the water in oil in water ($w_1/o/w_2$) double emulsion. They could be used to produce low-fat salad sauces, by replacing a part of the oil droplets in an emulsion by smaller water droplets. Another field they show great potential is drug delivery in pharmacy and cosmetic, where the active ingredient is encapsulated inside the inner water droplets and then released due to time or to specific environmental changes like temperature or pH. The challenge in producing multiple emulsions is the stabilization of the two different thermodynamically unstable interfaces. For stabilizing the inner interface a lipophilic emulsifier is necessary, in contrast, a hydrophilic emulsifier is needed to stabilize the outer interface. It is known that the interaction between those two emulsifiers can lead to instabilities.

To get a better understanding of those instabilities our institute developed the „Diffusion- and Coalescence Time Analyzer“ – short DCTA (Neumann et al. 2017), which allows to observe coalescence and diffusion of single droplets in different double emulsion formulations. With two different cameras, we can observe the duration between contact of the interfaces and coalescence on one hand, and the coalescence process itself, including daughter droplet formation, on the other hand. This way we can predict the stability of double emulsions. Thus, coalescence behavior itself can give hints about fast processes at the interface, which are dominant during emulsification processes.

In his internship Mr. Gomez will investigate the interaction of different emulsifiers using the DCTA. The first step will be to eliminate influence factors like droplet size, temperature fluctuations and impurities. Therefore Mr. Gomez will selectively change those parameters and measure their influence on the results. With this knowledge, different emulsifier combinations will be compared in their influence on the coalescence of inner water (w1) droplets at the outer o/w_2-interface. Interactions of different emulsifiers have to be described and discussed mechanistically.

Mr. Gomez will present the results of his internship project in the seminar of food process engineering. Three copies of the written project report have to be provided after the project.

Prof. Dr. -Ing. H. P. Karbstein
Begin: (depending on start of scholarship)
Supervisor: Dr.-Ing Ulrike van der Schaaf, M.Sc. Nico Leister

References:

Neumann, S. M., van der Schaaf, U. S., & Schuchmann, H. P. (2017). The Diffusion and Coalescence Time Analyzer (DCTA): A novel experimental setup for investigating instability phenomena in double emulsions. Food Structure, 103–112.