

Phospholipids disrupt the interfacial network of proteins at the oil/water interface

Theresia Heiden-Hecht *a*, Maren Müller *a*, Viktoria Erdmann *a*, Stephan Förster *b*, Henrich Frielinghaus *a* and Olaf Holderer *a*

a Jülich Centre for Neutron Science (JCNS) at Heinz Maier-Leibnitz-Zentrum (MLZ), Forschungszentrum Jülich GmbH, Lichtenbergstr. 1, 85747 Garching, Germany

b Jülich Centre for Neutron Science (JCNS-1), Forschungszentrum Jülich GmbH, 52425 Jülich, Germany

t.heiden-hecht@fz-juelich.de

Oil/water interfaces are found in cosmetics, drug delivery, and food systems. These emulsion systems are often stabilized by proteins and/or low molecular weight emulsifiers such as phospholipids. Research questions about the interfacial structure of mixed interfaces, such as their composition and arrangement, as well as their interfacial rheology and dynamics, remain unanswered.

This study investigated the impact of charge and nature of phospholipid head groups on the interfacial structure, rheology and interfacial dynamics of protein-stabilized emulsions. A combination of conventional methods – such as drop tensiometry and interfacial rheology – and advanced methods – such as small angle neutron scattering and neutron spin echo spectroscopy – helps us to answer research questions about complex interfacial systems.

The head group of phospholipids strongly affects the interfacial structure and rheology of a β -lactoglobulin-stabilized emulsion. The interfacial structure was resolved using small-angle neutron scattering with partial structure factor analysis and coarse-grained modeling. The interfacial dynamics are characterized by 2D diffusion within the interfacial layer of the oil droplet and height fluctuations normal to the interfacial layer. The interfacial dynamics of the protein are inert for changes in interfacial structure, composition, and rheology, although structure and rheology have a strong influence on each other. These results provide guidance for the emulsion characteristics of food, cosmetics, and drug delivery systems (1,2).

Keywords:

Oil/water interfaces, scattering, phospholipids, β -lactoglobulin, emulsion

References:

- 1 Heiden-Hecht, T., Wu, B., Schwärzer, K., Förster, S., Kohlbrecher, J., Holderer O. and Frielinghaus, H. (2024). New insights into protein stabilized emulsions captured via neutron and X-ray scattering: An approach with β -lactoglobulin at triacylglyceride-oil/water interfaces. *Journal of Colloid and Interface Science* 655, 319-326. doi: 10.1016/j.jcis.2023.10.155
- 2 Heiden-Hecht, T., Müller, M., Prevost, S., Chakkel, O., Zolnierczuk, P., Schwärzer, K., Förster, S., Frielinghaus, H., and Holderer, O. (2025). Phospholipids disrupt the interfacial network of proteins at the oil/water interface. *Journal of Colloid and Interface Science*. Accepted