Norway grants

NCBR
National Centre for Research and Development

Preparation of biopolymer-based coatings and films for use on cellulose substrates

Karolina Tomkowiak

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PARTNERS:

Uniwersytet Przyrodniczy w Poznaniu
Poznań University of Life Sciences

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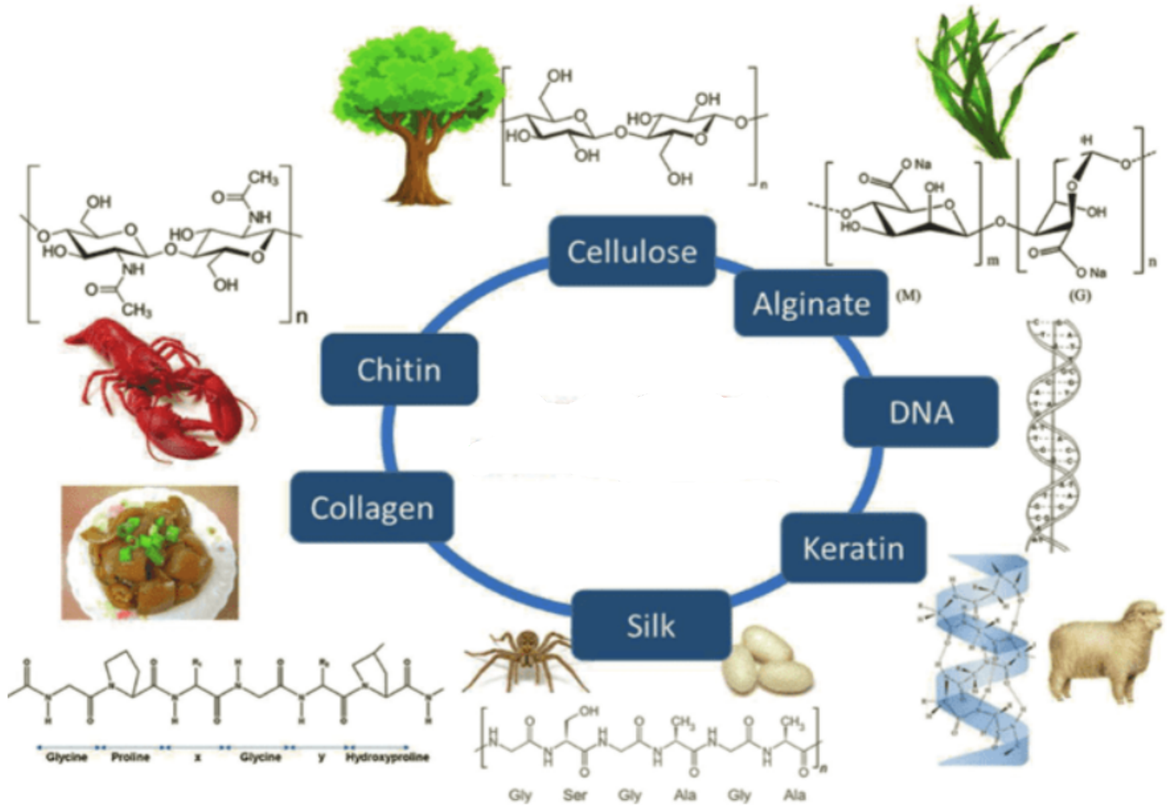
CELLMAT4EVER

Aim of the project and research

The aim of the CellMat4Ever Project: bio-based innovation systems from forestry biomass intended for the production of advanced lignocellulosic materials being resistant to variation in air humidity and temperature and/or fire conditions.

The aim of the research: estimation of the influence of different natural polymers on the barrier and strenght properties of materials

Biopolimers

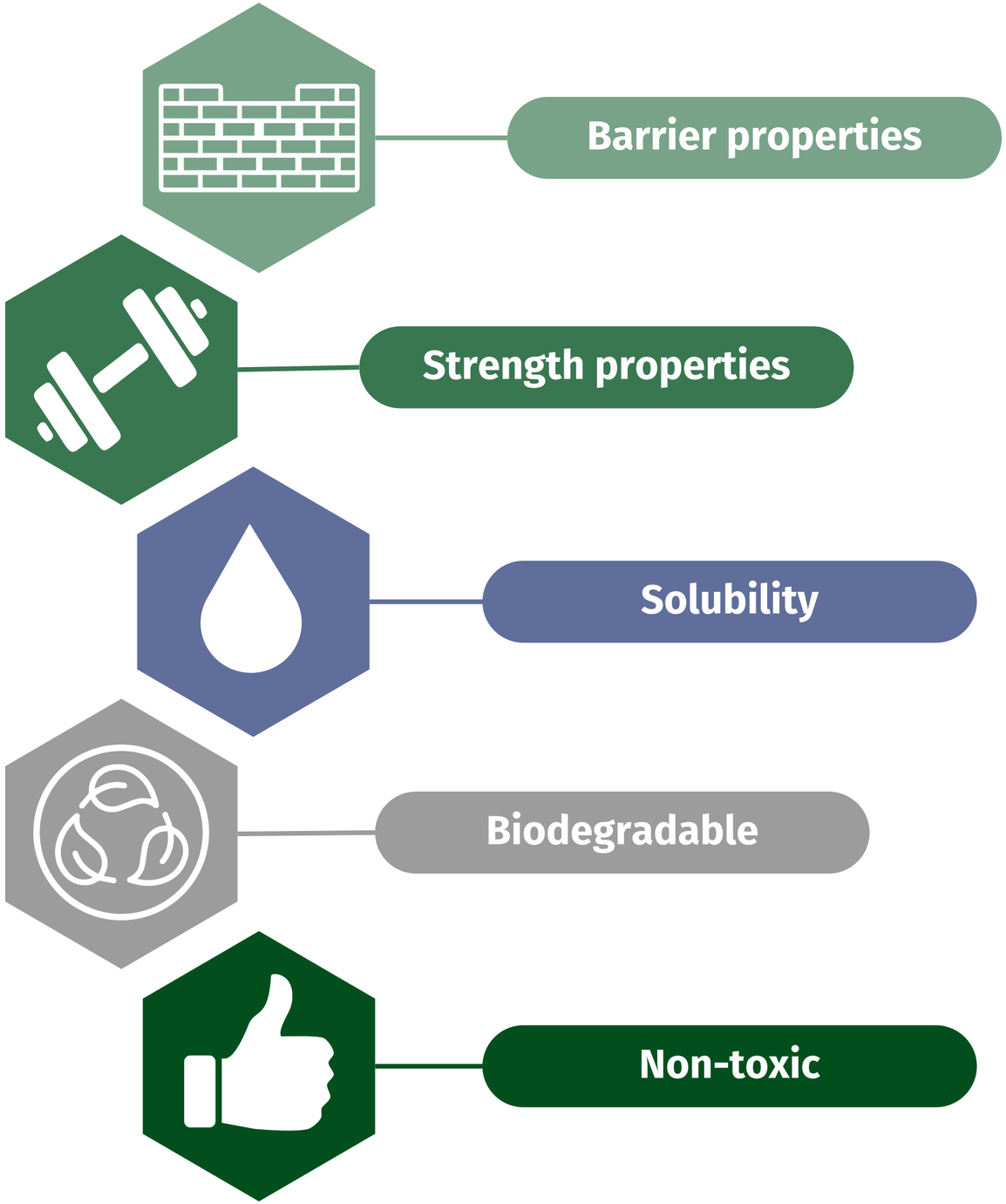


Proteins

Mihalca, V., Kerezsi, A. D., Weber, A., Schmucker, J., Vodnar, D. C., Dulf, F. V., Socaci, S. A., Fărcaș, A., Mureșan, C. I., Suharoschi, R., & Pop, O. L. (2020). Protein-Based Films and Coatings for Food Industry Applications. Polymers, 13(5), 769. https://doi.org/10.3390/polym13050769

Umoren, S. A., & Solomon, M. M. (2021). Biopolymer composites and nanocomposites for corrosion protection of industrial metal substrates. In Corrosion Protection of Metals and Alloys Using Graphene and Biopolymer Based Nanocomposites (pp. 16-31). CRC Press.

Properties of protein coatings and films



Chen, H., Wang, J., Cheng, Y., Wang, C., Liu, H., Bian, H., Pan, Y., Sun, J., & Han, W. (2019). Application of Protein-Based Films and Coatings for Food Packaging: A Review. Polymers, 11(12), 2039. https://doi.org/10.3390/polym11122039

Calva-Estrada, S. J., Jiménez-Fernández, M., & Lugo-Cervantes, E. (2019). Protein-Based Films: Advances in the Development of Biomaterials Applicable to Food Packaging. Food Engineering Reviews, 11(2), Article 2. https://doi.org/10.1007/s12393-019-09189-w

Aristippos Gennadios. (2002). Protein-based films and coatings. CRC Press LLC.

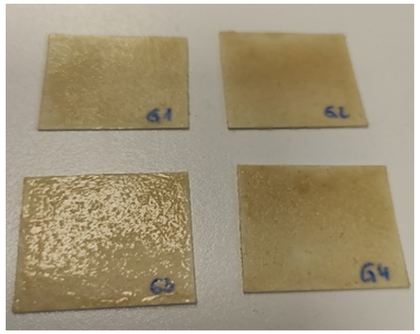
Manufactured variants

Corn zein

Wheat gluten

Hybrid
(Corn zein 1:1 Wheat gluten)

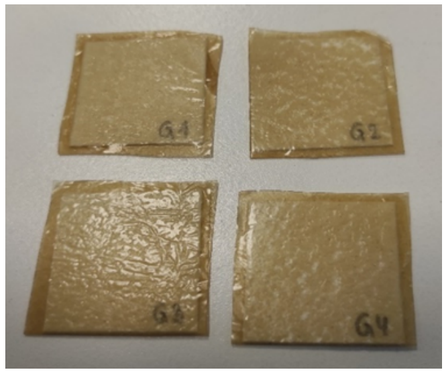
Hen’s egg albumin

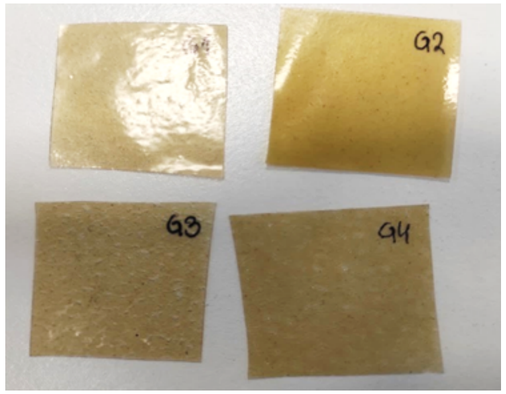


Coating

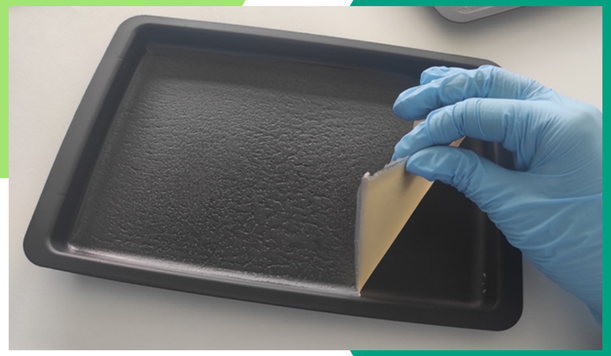
Composite

Film





Course of research

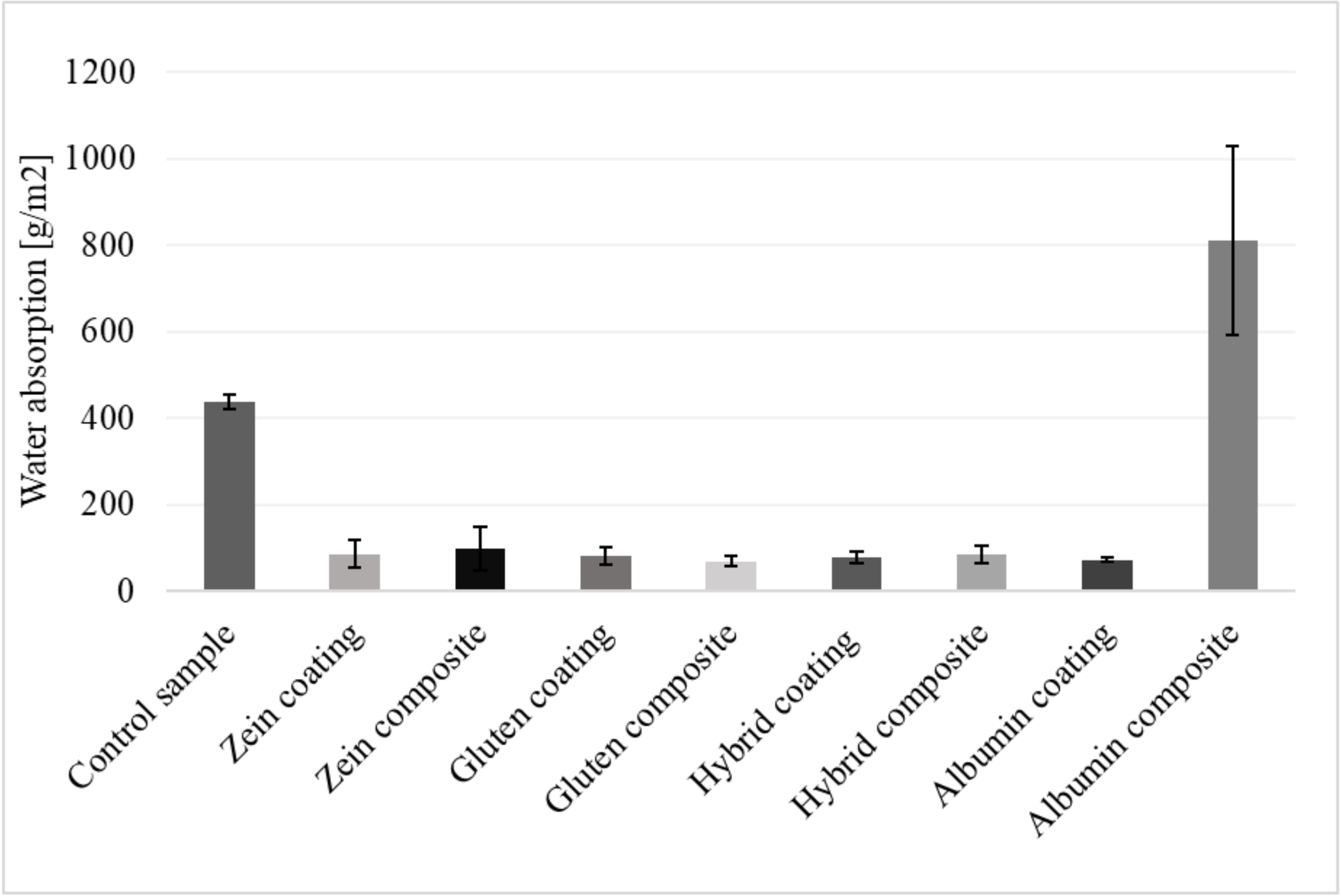


Preparation of the protein solution

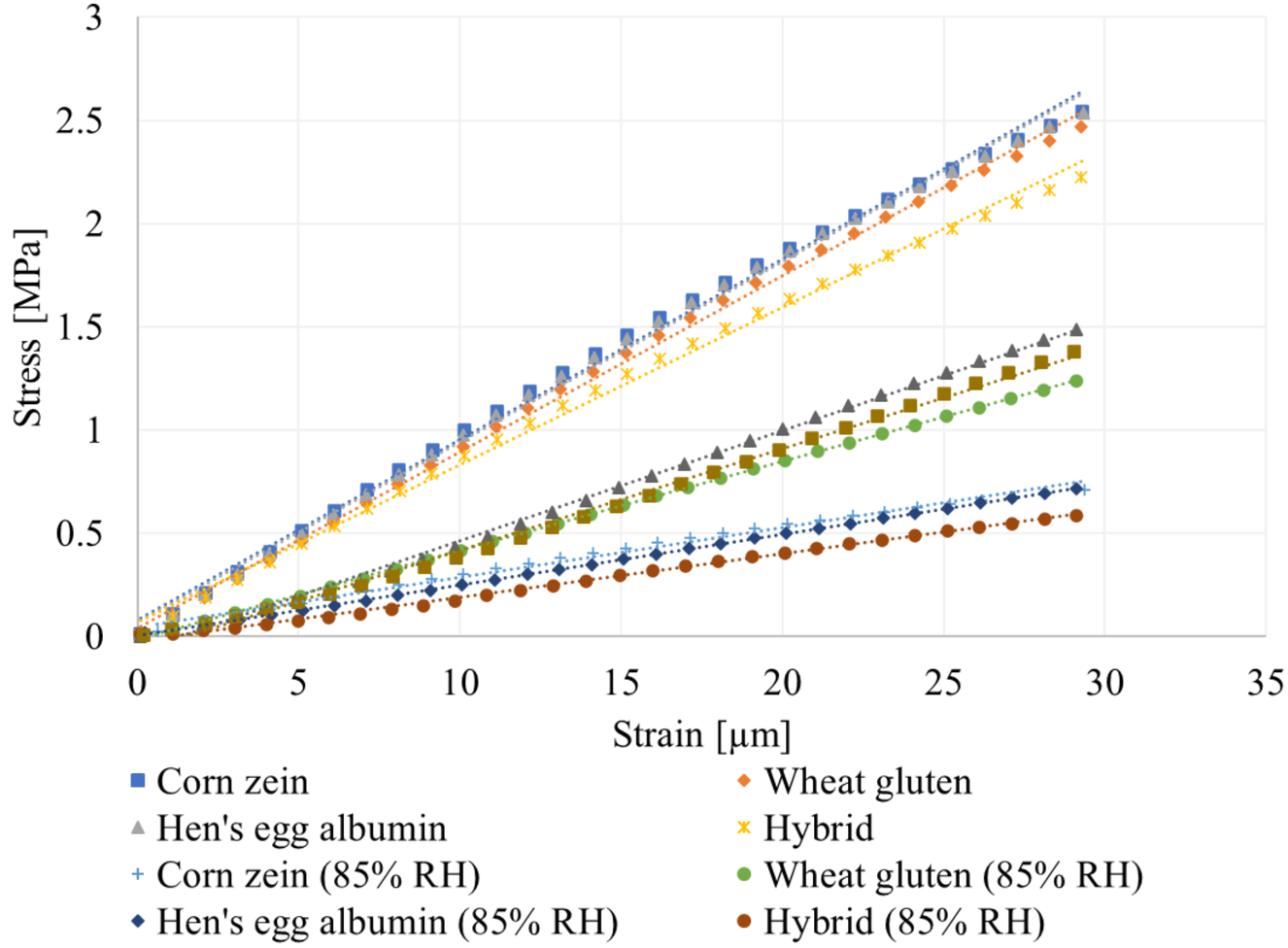
Application on cellulose paper

Testing of selected properties

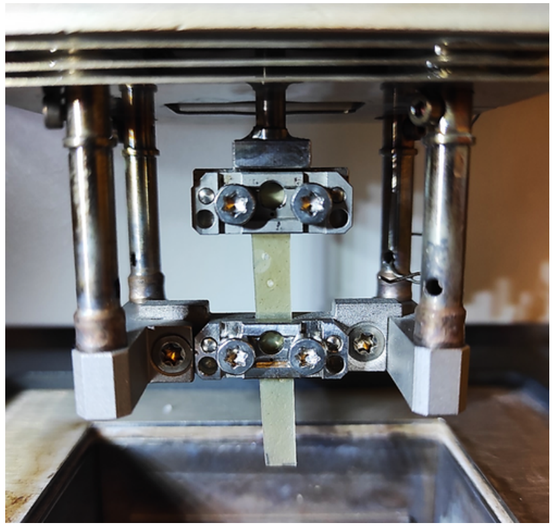
Cobb absorption



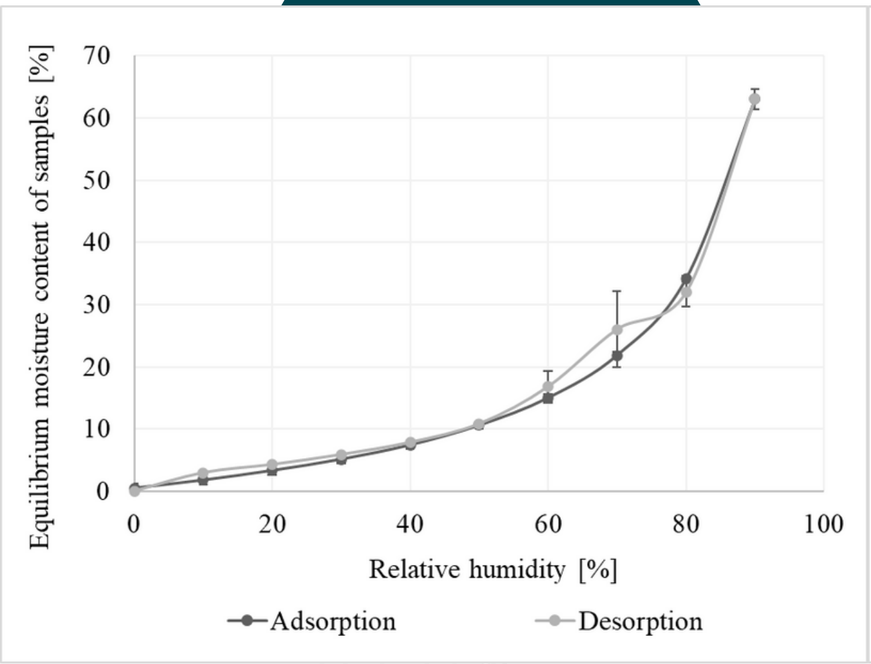
Dynamic mechanical analysis (DMA)



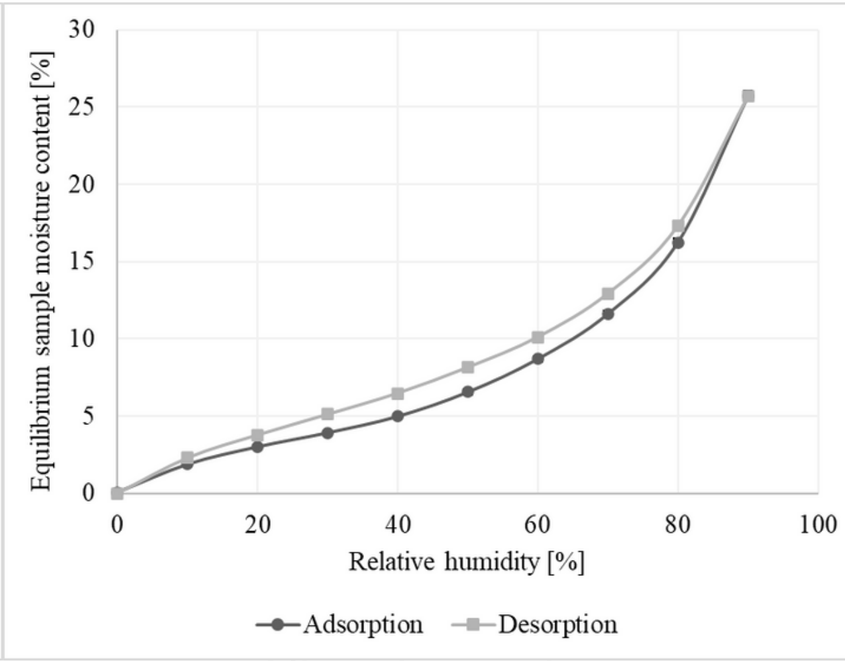
Results of mechanical analysis in the stress-strain relationship of coatings in air-dry conditions and conditions of 85% relative air humidity



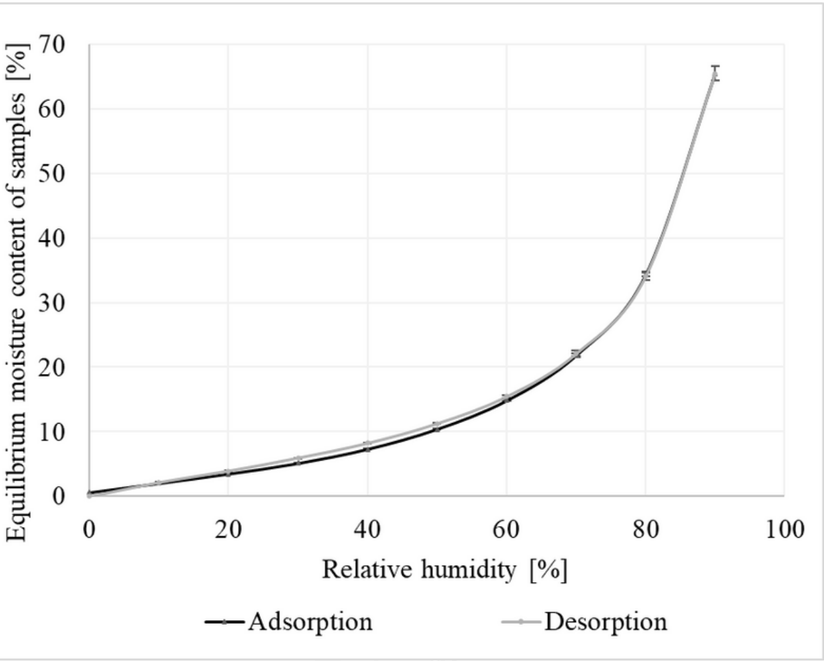
Additional tests...
Dynamic sorption analysis (DVS)



Hybrid film

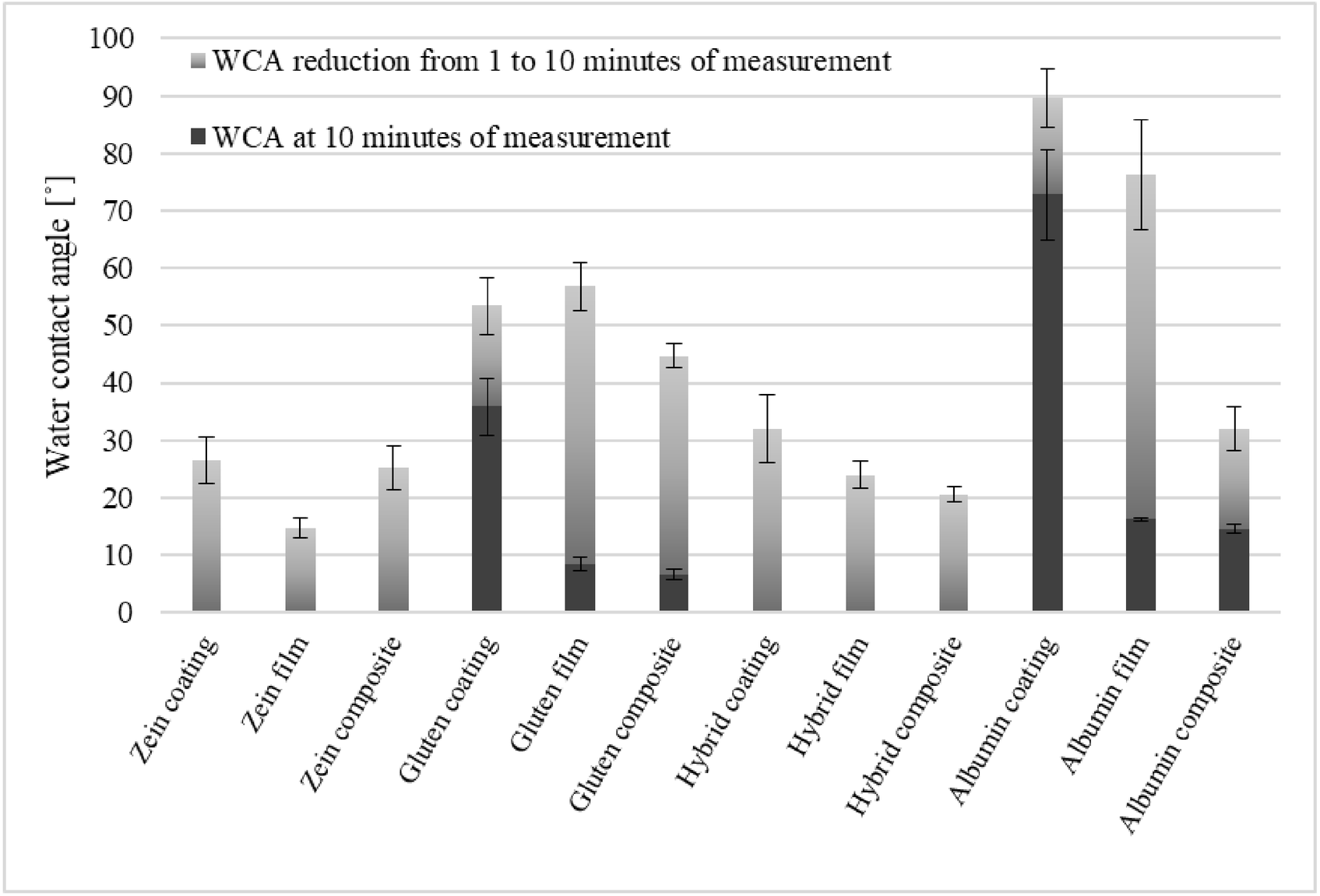


Albumin coating



Zein film

Contact angle test



Conclusion

- Significantly lower tendency to absorb liquid water.
- Less common courses of adsorption, desorption isotherms, and hysteresis (or lack thereof).
- Increased strength properties of samples in air-dry conditions.
- Loss of mechanical properties of all variants in conditions of increased humidity.
- Hydrophilic nature of films, coatings, and protein composites.
- The best barrier against water and water vapor in the DMA test was wheat gluten. In dry conditions, the best strength parameters should be attributed to corn zein.

This proves that proteins have great potential for the future of films and coatings. Further work should focus on the mechanism of protein denaturation and direct assessment of its impact on the functional properties of coatings or films.

Norway grants

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www.**Cellmat**.up.poznan.pl

Acknowledgements.
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