

Popular summary: Biocatalysis in Pickering emulsions

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The left foot is the mirror image of the right foot. Similar to that the left shoe does not fit on the right foot, the correct mirror image of a pharmaceutical molecule needs to be administered in order to reach the desired effects.

In classical chemical reactions, both mirror images of a molecule are obtained in a 50:50 ratio. Separating these is both costly and causes high amounts of solvent waste.

Enzymes facilitate chemical reactions in biological systems. They are very selective towards reactants, but also in the precision in terms of which mirror image of the product is formed. On top of this, these reactions are carried out at mild conditions. In industrial production, all these properties are very attractive. The successful implementation of enzymes would enable a big economization of steps and solvent use, and thereby a reduction in environmental pollution, usually caused by the energy use that is necessary to reach the high temperatures and pressures used, but also solvents. Economizing energy and solvents is reducing overall process costs. The downside of some enzymes, but especially concerning the ones used in this project, is the susceptibility towards surface contacts which is a problem as the enzymes perform the reaction in an aqueous phase, but the substrate is in the organic, non-polar phase. The presence of this surface will cause enzymatic deactivation.

Here, the employment of an emulsion was investigated. An emulsion is a mixture of two liquids that are immiscible, for example a well-mixed salad dressing made of oil and vinegar. An oil-vinegar dressing is splitting up into an oil and a vinegar phase again if it is not mixed any longer. This can be avoided by adding an emulsion stabilizing agent as it is done in mayonnaise with egg-yolk. Here, instead of egg-yolk, starch particles were used. The particles cover the surface of the non-polar liquid's droplets.

The hypothesis here was that the presence of the emulsion comes with a higher surface and thereby higher rates of substrate leakage into the water phase, but with longer lifetime of the enzymes as the starch particles might form a barrier, meaning surface contact is avoided, and thereby the source of deactivation might be reduced.

In the experiments, it turned out that the form of the vial that was used has a very big impact on the enzyme stability. It could be shown that employing Pickering emulsions might be beneficial, but more research is needed to understand the system better which is crucial for successful application.