

What is required to provide specialty enzymes?
Spoiler alert: excellence in various technological fields.

Enzymes will play a key role for the transformation towards a sustainable industry. In the food industry, for example, enzymes are already helping to reduce food waste, accelerate the manufacture of food ingredients, increase the digestibility of plant proteins and thereby reduce emissions, energy and water consumption.

'Specialty enzymes' are developed to meet the needs of a particular application. The discovery of enzymes with desired properties is a fundamental step. Mining the enormous diversity of enzymes evolved in nature offers a wealth of fascinating opportunities. Public digital sequence databases provide an important but limited sequence space. To gain a deeper access to the natural sequence space, BRAIN Biotech applies next generation sequencing technologies to digitalize metagenomes for sequence-driven enzyme discovery.

If the discovered enzymes do not ideally match the application, enzyme engineering can provide a perfect fit. Whether it is substrate specificity, stability or solvent resistance, rational design provides opportunities for enzymes to be improved. Current development of machine learning tools is a resource to adapt enzymes faster, easier and with less structural information. However, the most effective way to design enzymes is still to combine several methods: rational design embraced by AI. Methods of enzyme discovery and engineering are equally valuable for providing specialty enzymes. Using these methods individually, simultaneously, or consecutively allows BRAIN Biotech to adapt the process of developing next generation enzymes on a case-by-case basis.

An essential step follows: The production of novel enzymes in microbial strains to analyze their producibility. After the development of a pre-industrial enzyme, it is necessary to ensure that the scale-up of the process meets appropriate commercial parameters. In essence, the final enzyme product needs to be economically viable, regulatory- and quality-compliant, and exceeds the needs and wants of the customers.

This presentation gives insights into how BRAIN Biotech develops specialty enzymes. The focus is on a case study dealing with enzymatic functionalization of a fatty acid, a product requested by different industries including cosmetics. Industrial application requires a production process at elevated temperatures and thus, the goal is to improve the thermal stability of the enzyme. BRAIN Biotech applies techniques of enzyme discovery and engineering simultaneously, giving rise to several new enzymes with improved properties. Now, BRAIN Biotech is one step closer to designing an industrially applicable enzyme, one step closer to a more sustainable future.

Key Messages:

- 1) Tailored project solutions: Enzyme discovery & engineering can be used individually, simultaneously, or consecutively to exploit the full potential of enzyme development.
- 2) The best enzyme is worthless if we cannot produce it. The economically viable production of enzymes is a key factor to bring them to market.