PROJECT OFFER

Enzyme discovery and development for polymer processing

The area Polymer & Environmental Biotechnology focusses on the development of biotechnical and enzymatic strategies related to polymer / material processing and environmental aspects. The expertise ranges from function-based enzyme development, *in silico* screenings and enzyme activation to estimate the biodegradation and fermentation pilots.

BACKGROUND

The diversity of natural environments provides an enormous pool for acquiring novel enzymes with potential for biotechnological applications related to material processing. Identification and improvement of these enzymes using innovative technologies constitute an excellent opportunity to develop novel environmentally friendly processes for a variety of industrial applications.

TECHNOLOGY

Discovery of novel enzymes is still challenging. Functional screening is an important approach to identify new biocatalysts from living cells. Additionally, different methods of functional proteomics are available. However, it is well known that only a very small percentage of the total bacterial diversity can be cultured in the laboratory. Hence, *in-silico* approaches are applied to elucidate promising candidates also from non-culturable sources. In the development of biodegradable materials knowledge about the influence of the chemical structure / composition on biodegradability is essential. Again, *in-silico* strategies towards enzymes for environment of interest, as provided by acib, are useful to predict biodegradation.
In our labs, functional screening and *in-silico* methods are used to identify novel enzymes in especially underexplored environments. In addition, different methods of rational design are applied to tailor the biocatalysts for specific industrial applications. These activities involve the latest tools of biotechnology and sophisticated analytical equipment as well as facilities for scale-up.

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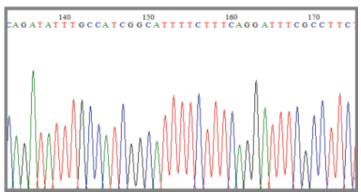
Function-based enzyme development

Depending on the intended application, different (bio)polymers and oligomers as well as labelled model substrates and tailored inhibitors are used for identification of enzymes. A robotic platform for high through-put screenings is available to identify not only novel biocatalysts but also synergistic effects of enzymes and of the producing microorganisms.



In-silico screening for novel biocatalysts

Complementary to functional methods, screening of available genome sequences is used to identify enzymes from non-culturable bacteria and/or to speed up screening procedures. Using this approach, several enzymes were identified and implemented in our enzyme platform.

Novel sources for enzyme screening

Screening of otherwise unexplored sources offers a promising opportunity for discovery of novel enzymes and biocatalytic activities. Hence, aquatic environments, anaerobic habitats and agricultural sources such as rumen are investigated in our labs and succeeded in identification of novel enzymes.

Enzyme activation and improvement

Based on functional and structural data, rational design is applied for improvement of enzymes. In particular, the enhancement of adsorption/desorption properties of enzymes onto insoluble polymers were established including surface engineering, fusion of natural binding modules and activation by truncation for dynamic structural elements.

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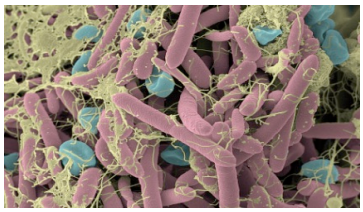
Enzymatic degradation studies for a prediction of biodegradability
Both standardized and novel rapid enzyme-based procedures are established to investigate the biodegradation of synthetic and biopolymer-based materials and have a prediction of it in the range of different environments including composting, as well as aquatic and animal digestion models. Thereby, structurally different model substrates are synthetized and labelled to elucidate the influence of chemical composition onto biodegradation during the development of novel biodegradable materials.



Analytics
State of the art analytical equipment is used both for enzyme identification (e.g., nano **LC MS/MS** for proteomics) and analysis of polymers and small molecules (Mass spectrometry/Chromatography: **LC-Tof-MS**, **MALDI-Tof-MS**; **GPC MALLS**, **HPLC**, **GC**, **GC-MS**; Microscopy: **SEM**, **CLSM**; Spectroscopy: **FT-IR**; Wettability: **Water Contact Angle**).

Fermentation on pilot scale
The facility offers fermentation equipment from lab scale (1 - 60 L) including the required down-stream processing infrastructure. The fermentation pilot plant is configured to produce various cells and the downstream processing is focused on biomass separation and/or concentration (centrifugation and filtration equipment) and drying processes (lyophilization, fluid bed drying).

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DEVELOPMENT STATUS:
TRL 3-5

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