Contribution ID: **14** Type: **Poster**

Engineering PET-degrading enzymes –targeting the energy barrier for PET binding

Tuesday 20 February 2024 10:45 (1 hour)

In view of the worsening climate crisis and increasing plastic waste pollution, scientific interest in the development of an environmentally friendly enzymatic degradation mechanism for plastics is growing. However, the bottleneck in the industrial application of enzymes for plastic waste recycling is their insufficient activity and partial lack of stability under industrial conditions.

To this end, we investigated the binding behaviour of highly active PET-degrading enzymes to polyethylene terephthalate (PET). Adsorption to the PET surface could be captured by classical molecular dynamics (MD) simulations. However, the entry of PET into the active site associated with the formation of productive binding poses was presumably hindered by an energy barrier limiting the activity of the enzyme. Using Hamiltonian Replica Exchange MD (HREMD) simulations, we were able to overcome this barrier and unveil entry pathways leading to productive conformations using principle component analyses (PCA).

In addition to hindering intramolecular PET interactions, we identified amino acids that potentially hinder entry into the binding site based on free energy surface (FES) profiles of amino acid-PET interaction and evaluated the PET-degradation activity of respective variants experimentally.

These insights address current research gaps on the mechanism of PET-degrading enzymes through comprehensive computational analyses of the full binding pathway, which highlights the importance to address not only substrate binding, but also the entrance into the active site.

Consent

Yes

Authors

Jäckering, Anna[a][b]; Göttsch, Frederike[c]; Schäffler, Moritz[a][b]; Doerr, Mark[c]; Bornscheuer, Uwe T.[c]; Wei, Ren[c]; Strodel, Birgit[a][b]

Affiliation

[a]Department of Chemistry, Institute of Theoretical and Computational Chemistry, Heinrich-Heine University Düsseldorf, 40225 Düsseldorf, Germany; [b]Computational Biochemistry Group, Institute of Biological Information Processing (IBI-7: Structural Biochemistry), Research Center Jülich, 52425 Jülich, Germany; [c] Department of Biotechnology & Enzyme Catalysis, Institute of Biochemistry, University of Greifswald, 17487 Greifswald, Germany

Primary author: JAECKERING, Anna (Forschungszentrum Jülich)

Co-authors: STRODEL, Birgit (Forschungszentrum Jülich); Ms GÖTTSCH, Frederike (University of Greifswald); Dr DOERR, Mark (University of Greifswald); Mr SCHÄFFLER, Moritz (Forschungszentrum Jülich); Dr WEI, Ren (University of Greifswald); Prof. BORNSCHEUER, Uwe T. (University of Greifswald)

Presenter: JAECKERING, Anna (Forschungszentrum Jülich)

Session Classification: Poster session