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Improving Bioplastics:
Rapid Assays for Enzymatic Degradability and Toxicity

To mitigate environmental pollution by plastic products, safe alternatives are seeked in biobased and biodegradable plastics. A wide variety of these novel „bioplastics“ have been developed and are constantly being improved. Here, the biodegradability and ecotoxicology of a „bioplastic“ before and after refinement is investigated with two rapid methods.

Test material: BPE-AMF-PLA

PLA/PBAT-blend,

comparison of old and

new formulation

(**Round 1 & 2**)

pH-Stat Titration: Enzymatic Degradability

Suspended microplastics were incubated with hydrolytic enzymes (lipase, esterase, protease)

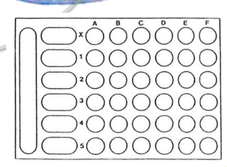
pH decreased during ester bond cleavage

NaOH was added for constant pH (8.2)

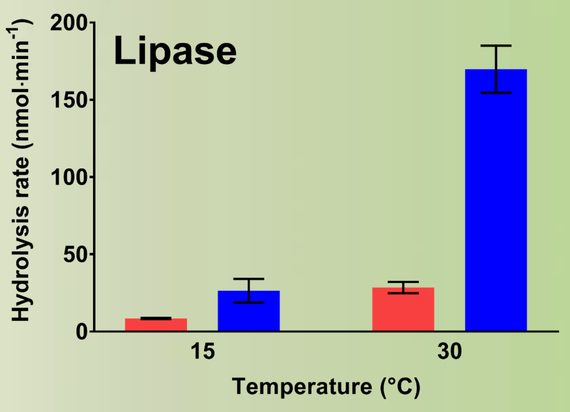
Amount of added NaOH is measure of hydrolysis rate

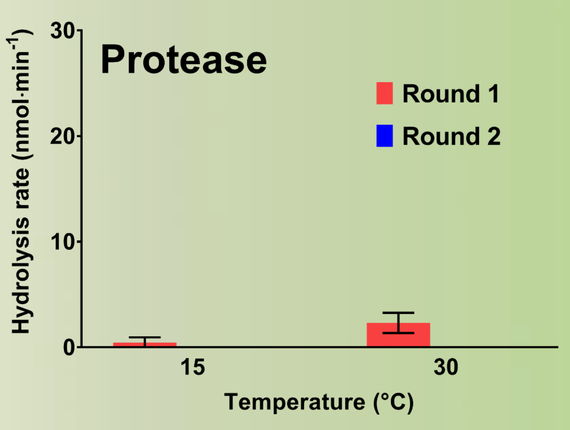
pH-Stat titration system(1)

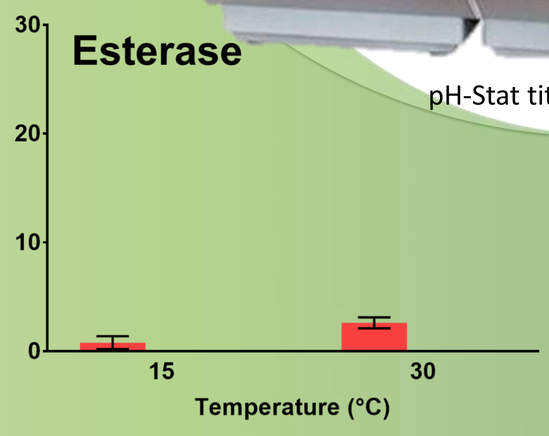
Brachionus plicatilis(2)



Multi-well plate







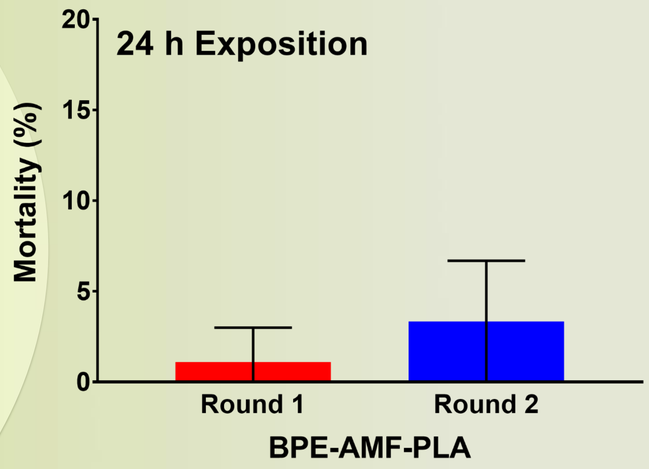
Hydrolysis rates of BPE-AMF-PLA before (Round 1) and after refinement (Round 2) at 15 and 30 °C and constant pH (8.2) when incubated with different enzymes.

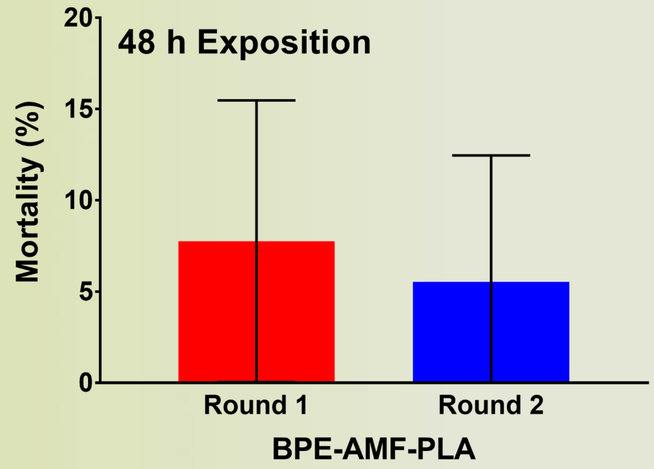
Rotifer Toxicity: *Brachionus plicatilis*

Mortality test after ISO 19820

Incubation of microplastic particles for 24 h

Rotifers were exposed to the leachates for 24 and 48 hours at 25 °C





Mortality of rotifers exposed to leachates from BPE-AMF-PLA before (Round 1) and after refinement (Round 2) for 24 and 48 h.

Summary

- ✚ The test material shows a strongly increased degradability by lipase after refinement
- ✚ Rotifer toxicity after refinement is still very low (mortality below 10 %)
- ▬ Degradability by protease and esterase changed from negligible to zero

Image Sources
(1) Taken from https://www.garnelio.ch/blog/ernaehrung/einzelliges-lebendfutter, visited 05.09.2022
(2) Taken from http://shop.llg.de/info7712_lang_DE.htm, visited 05.09.2022

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