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Biodegradation and Carbon Resource Recovery of Poly(butylene adipate-*co*-terephthalate) (PBAT) by Mealworms

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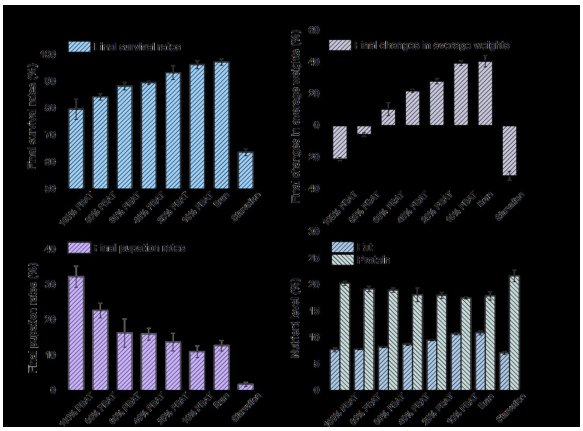

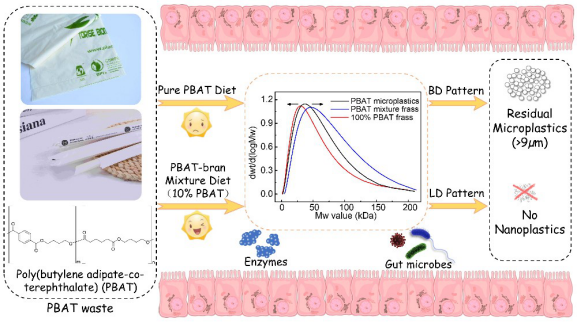

Poly(butylene adipate-co-terephthalate) (PBAT) waste biodegrades slowly in ambient conditions and typically ends up in incineration plants and landfills with great carbon emissions,[1, 2] and little is known about recovering carbon resources from PBAT waste in environmental-friendly ways. Recent studies have found rapid biodegradation of plastics by mealworms, the larvae of *Tenebrio molitor* (Coleoptera: Tenebrionidae), which voluntarily ingest a wide variety of petroleum-based plastic products.[3-6] Here, we tested the biodegradation and carbon resource recovery of PBAT waste by using it as a supplementary feedstock for mealworms. Within about 12 hours of retention time, the PBAT removal achieved 49.2–54.9% in mealworm intestines, depending on the ratio of PBAT in PBAT-containing feedstocks (100%, 80%, 60%, 40%, 20%, and 10% PBAT). Overall, a low ratio of PBAT (10% PBAT content) in the PBAT-bran mixture feedstock was favorable for the growth and development of mealworms (including survival rates, pupation rates, average weights, and fat and protein contents) due to the highest final survival rate (96.3 ± 1.5%) and greatest larval weight growth (39.5 ± 1.5%). The biodegradation and depolymerization of PBAT were confirmed by chemical and thermal modifications as well as changes in molecular weight distribution. Notably, the addition of normal food wheat bran altered the depolymerization pattern of the ingested PBAT in mealworm intestines from broad depolymerization (a decrease in molecular weights) to limited-extent depolymerization (an increase in molecular weights) due to competitive digestion. Digestive biodegradation and removal resulted in a particle size reduction of the ingested PBAT material and generated residual PBAT particles within the range of microplastics (> 9 μm), but no nanoplastics were generated or accumulated. Based on the results, we provide a novel conceptual approach for management and carbon resource recovery from PBAT waste via insect-mediated biodegradation.