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Enzymatic Degradation of Poly (Butylene Adipate Terephthalate) Copolymer Using Lipase B From Candida Antarctica and Effect of Poly (Butylene Adipate Terephthalate) on Plant Growth

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Abstract : The globe is facing increasing challenges of plastic pollution due to single-use of plastic-based packaging material. The plastic material is continuously being dumped into the natural environment, which causes serious harm to the entire ecosystem. Polymer degradation in nature is very difficult, so the use of biodegradable polymers instead of conventional polymers can mitigate this issue. Due to the good mechanical properties and biodegradability, aliphatic-aromatic polymers are being widely commercialized. Due to the advancement in molecular biology, many studies have reported specific microbes that can effectively degrade PBAT. Aliphatic polyesters undergo hydrolytic cleavage of ester groups, so they can be easily degraded by microorganisms. In this study, we investigated the enzymatic degradation of poly (butylene adipate terephthalate) (PBAT) copolymer using lipase B from Candida Antarctica (CALB). Results of the study displayed approximately 5.16 % loss in PBAT mass after 2 days which significantly increased to approximately 15.7 % at the end of the experiment (12 days) as compared to blank. The pH of the degradation solution also displayed significant reduction and reached the minimum value of 6.85 at the end of the experiment. The structure and morphology of PBAT after degradation were characterized by FTIR, XRD, SEM, and TGA. FTIR analysis showed that after degradation many peaks become weaker and the peak at 2950 cm-1 almost disappeared after 12 days. The XRD results indicated that as the degradation time increases the intensity of diffraction peaks slightly increases as compared to the blank PBAT. TGA analysis also confirmed the successful degradation of PBAT with time. SEM micrographs further confirmed that degradation has occurred. Hence, biodegradable polymers can widely be used. The effect of PBAT biodegradation on plant growth was also studied and it was found that PBAT has no toxic effect on the growth of plants. Hence PBAT can be employed in a wide range of applications.

Keywords : aliphatic-aromatic co-polyesters, polybutylene adipate terephthalate, lipase (CALB), biodegradation, plant growth
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