

# Structural Insights into the Biodegradation Mechanisms of Plasticizers

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Microplastic pollution has emerged as one of the most critical environmental issues. Researchers have detected microplastics in both human and animal bodies, highlighting their toxic potential. These microplastics release harmful chemicals known as plasticizers into the environment, which may expose us to toxic effects. Upon exposure, plasticizers can lead to serious health problems, including respiratory infections, immune system damage, pulmonary bronchitis, nervous system dysfunction, endocrine disruption, developmental disorders, and cancer.

Bioremediation of these plasticizers using potential bacterial enzymes seems to be a promising approach. In-depth structural characterization of these enzymes paves the way to engineer them into high-efficiency enzymes for the development of translational technologies

We have identified enzymes that mediate the degradation pathway of these plasticizers. Using X-ray crystallography, we successfully determined the molecular structures of several key plasticizer-degrading enzymes: Esterases, phthalate dioxygenase, terephthalate dioxygenase, and isophthalate dioxygenase. Exhaustive structural analysis displayed the effective mechanism of catalysis and provided insights that were utilized for engineering these enzymes. The structures show that substrate binding is dependent on the spatial arrangement of residues in the active site. Biochemical studies and enzyme engineering further confirm that these residues are key to the enzymes' substrate specificity and regiospecificity. These discoveries provide a foundation for engineering these enzymes for the biodegradation of microplastics and plasticizers.

**Bell Hall 143**

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**Remote: <https://utep-edu.zoom.us/j/82901391798>**



## **Professor Pravindra Kumar**

He is a renowned academic and researcher at IIT Roorkee, India, currently holding a joint professorship at the Department of Biosciences and Bioengineering and Institute Instrumentation Centre.

He has held various prestigious positions, including Associate Dean (Corporate Interaction), and Head of the Department of Biosciences and Bioengineering (2021-2024). He completed his Ph.D. at AIIMS, Delhi, in 2001, receiving the S.V. Talekar Gold Medal for Best Post-Graduate Degree. Following his doctoral studies, Professor Kumar undertook post-doctoral research in Structural Biology at Purdue University, USA, from 2001 to 2005. His academic journey at IIT Roorkee began in 2005.

Professor Kumar has received numerous national and international awards in recognition of his outstanding contributions to the field of structural biology and biotechnology. He was awarded the ASM-IUSSTF Indo-US Visiting Professorship in 2017 and was honored with the IUSSTF Award for organizing an Indo-US conference in 2014. He is a Fellow of the National Academy of Sciences, India (2024), and holds the Ashok Soota Institute Chair Professorship (2023). Other accolades include the National Bioscience Award (2015) from the Department of Biotechnology, India, and the BOYSCAST award (2008), which facilitated his role as a Visiting Scientist at Purdue University.