Abstract

Plastic pollution is a pressing environmental challenge, contaminating terrestrial and aquatic ecosystems while threatening both animals and humans. Among various mitigation strategies, biodegradation offers the most sustainable and non-toxic solution. This study assessed the biodegradation potential of locally isolated and well- characterized *Bacillus thuringiensis* strains against different plastics, including polyethylene, polypropylene, polyvinyl chloride, polyurethane, and polystyrene. The bacterial strains were re-characterized to confirm their identity as *B. thuringiensis* and to rule out mixed cultures. Cultures were incubated in minimal salt medium (MSM) containing 30 mg of plastic, alongside control groups, for 120 days. Notable degradation was observed: polyethylene showed 33.3% weight loss by *Bt*.NF13.2, 26.6% by *Bt*.NF02, and 12% by *Bt*.NF7.2. Polypropylene exhibited the highest degradation, with weight loss of 50%, 46%, 26%, and 23% by *Bt*.NF7.2, *Bt*.NF02, *Bt*.NF19A1.1, and *Bt*.NF13.2, respectively. Polyvinyl chloride showed 16.6% degradation by *Bt*.NF19A1.1, while polyurethane showed 16.6% by *Bt*.NF02. None of the tested strains showed significant degradation of polystyrene. Multiple analytical techniques confirmed biodegradation. Scanning electron microscopy revealed surface erosion, FTIR spectroscopy detected chemical alterations, GC-MS identified metabolic intermediates, and SDS–PAGE verified enzyme production involved in the degradation process. These results highlight the promising potential of locally isolated *B. thuringiensis* strains for eco-friendly plastic degradation. Their ability to target common plastics, particularly polyethylene and polypropylene, supports their future use in sustainable bioremediation strategies aimed at reducing environmental plastic waste.