Degradation of synthetic textile microplastic fibers by fungi and photocatalysis

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Numerous studies expose the catastrophic impact of plastic pollution on a daily basis. The research conducted to assess its impact on global ecology and human health suggests an immediate need for action. In particular, aquatic systems are full off toxic chemicals and small man-made organic debris that irreversibly break down into even smaller fragments through biotic or abiotic processes. Among these are microfibers from synthetic textiles.

Within the work, we explored the degradation of polyethylene terephthalate (PET), polypropylene (PP), and polyamide (PA) fibers for the purpose of remediation of wastewater from washing machines. By mimicking natural processes, we investigate the benefits of photodegradation enhanced by the use of a photocatalyst and biodegradation by fungi. In the study, photocatalysis was conducted for 48 hours in a covered quartz beaker. The beaker contained fibers, Milli-Q water, and photocatalyst; we tested TiO_2 and ZnO. Reactor systems were irradiated while stirring using a UV-vis simulated sun spectrum (Ultra Vitalux, 300 W, Osram). Biodegradation was performed by two selected species of fungi, *Pleurostoma richardsiae* and *Coniochaeta hoffmannii.* Sterilized plastic fibers were transferred to tubes with sterile M9 liquid medium. A cell suspension of each selected strain was added to the tube and incubated at 24°C for 2 and 6 months.

Microscopy analysis after the photocatalysis showed that the surface of individual fibers became rough with clear signs of partial degradation, which could not be observed on pristine fibers. We also observed a successful growth of fungi, indicating that their main food source came from fibers. Cross-sectional FIB-SEM analysis revealed details of the damage, and Raman analysis showed structural changes in the plastic material. The kinetics of both degradation processes are relatively slow; however, repetition and proper reactor design could potentially increase the dynamics of microplastics degradation.