PFAS Biodegradation by *Labrys portucalensis* F11: Identification of Metabolites of PFOS, 6:2 FTS, and 5:3 FTCA by Target and Non-Target Analysis

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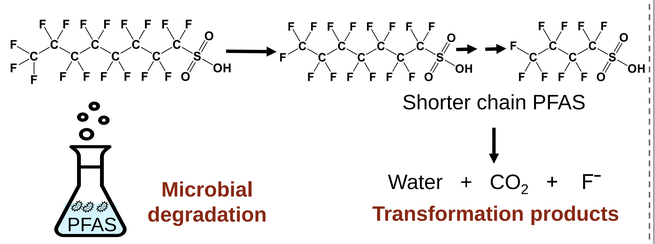
Introduction

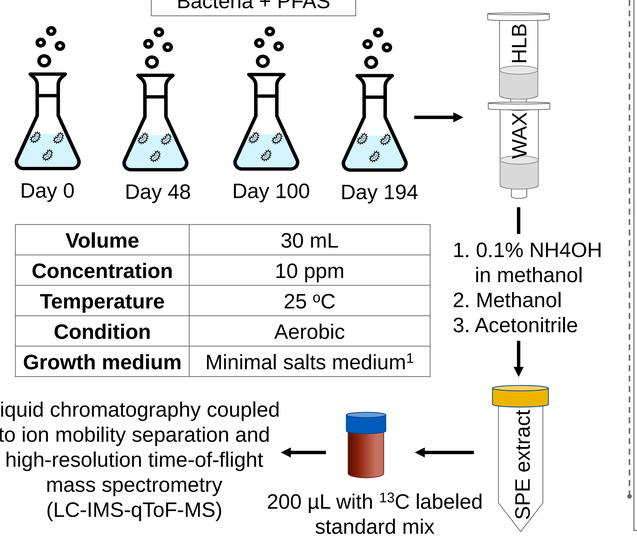
Per- and poly-fluoroalkyl substances (PFAS) are highly fluorinated synthetic chemicals with a wide variety of uses[1,2]. The carbon-fluorine bonds exhibit very high bond dissociation energies: around 536 kJ/mol, making PFAS generally resistant to degradation, which has led to their classification as "forever chemicals"[3]. Strategies to enhance the biodegradation of these compounds are of great interest, such as identifying bacterial species that may be used for bioaugmentation. *Labrys portucalensis* F11 is an aerobic bacterium that has been isolated in Portugal and can degrade fluorinated pharmaceuticals, fluorobenzene, and fluoxetine[4,5]. This F11 strain has the ability to cleave C-F bonds in these fluorinated organic compounds and was therefore tested for its ability to degrade perfluorooctane sulfonic acid (PFOS), 6:2-fluorotelomer sulfonic acid (6:2 FTS), and 5:3-fluorotelomer carboxylic acid (5:3 FTCA).

Objectives

1. To determine whether the F11 bacteria strain can degrade PFOS, 6:2 FTS, and 5:3 FTCA.
2. To identify biodegradation products by non-targeted analysis



Method



Volume	30 mL
Concentration	10 ppm
Temperature	25 °C
Condition	Aerobic
Growth medium	Minimal salts medium[1]

Chemical Analysis

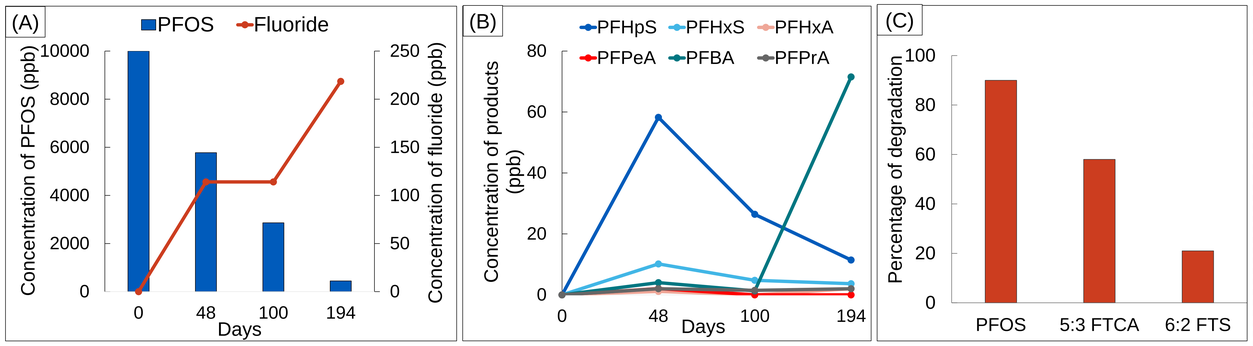
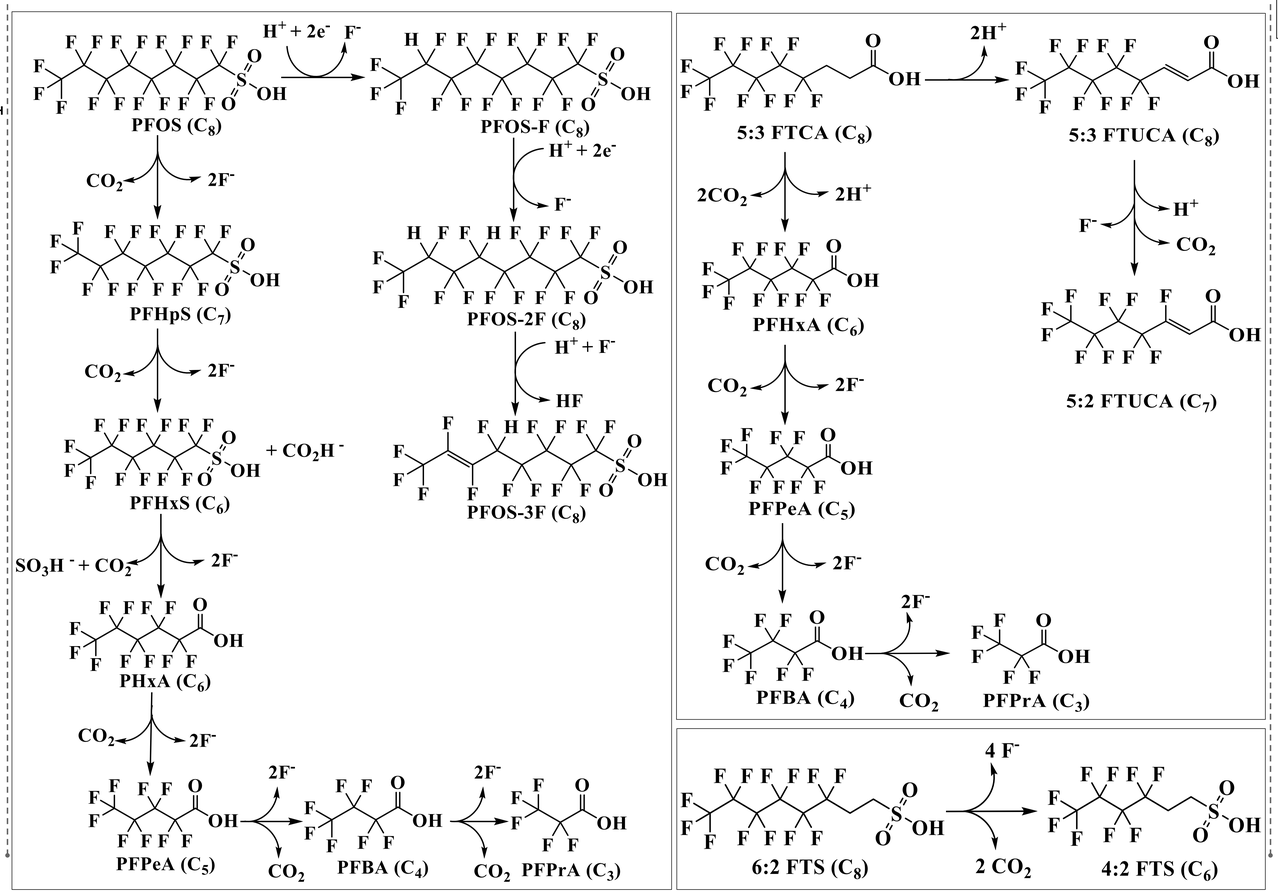


Fig. 1: Plot showing a decrease in PFOS and a corresponding increase in fluoride (A) and targeted metabolites, PFHpS, PFHxS, PFHxA, PFPeA, PFBA and PFPrA (B) detected across 4 time points (0, 48, 100 and 194 days) and the percentage of degradation of PFOS, 5:3 FTCA, and 6:2 FTS in the sample of 100-day incubation (C).

Proposed biotransformation pathway for PFOS, 5:3 FTCA, and 6:2 FTS



Isomer separation

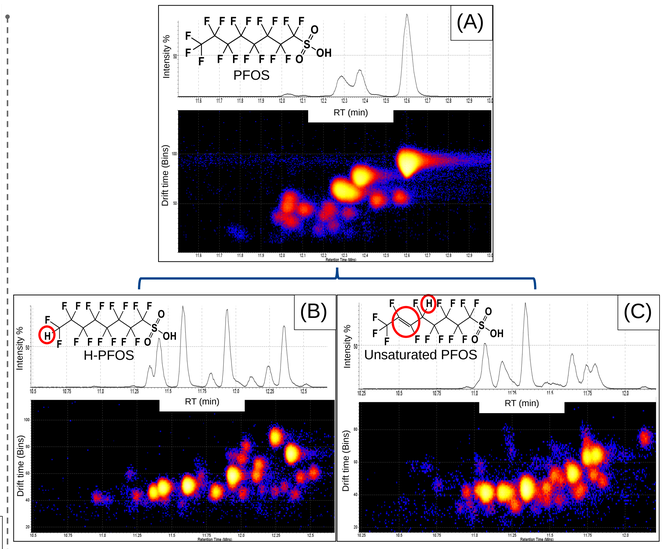


Fig. 2: IMS chromatograms exhibiting isomer separation of (A) PFOS (m/z 498.932); (B) H-PFOS (m/z = 480.940); (C) unsaturated PFOS (m/z = 442.942)

Conclusions

- *Labrys portucalensis* F11 strain degraded PFOS, 6:2 FTS, and 5:3 FTCA.
- Shorter-chain PFAS, from C_7 to C_3 were formed as metabolites.
- Non-target analysis facilitated the identification of the unsaturated and hydrogenated C_8 compounds.
- IMS separation exhibited the separation of isomers of PFOS as well as defluorinated PFOS isomers including isomers of H-PFOS and isomers of unsaturated PFOS.

Acknowledgements

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