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Application of analytical pyrolysis for the molecular fingerprinting of polymers (PE, PET, PP, PS and PVC) within natural organic matter matrices used for rooftop farming

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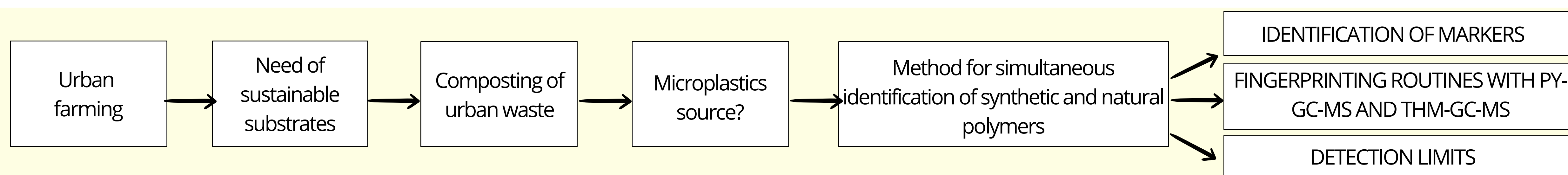
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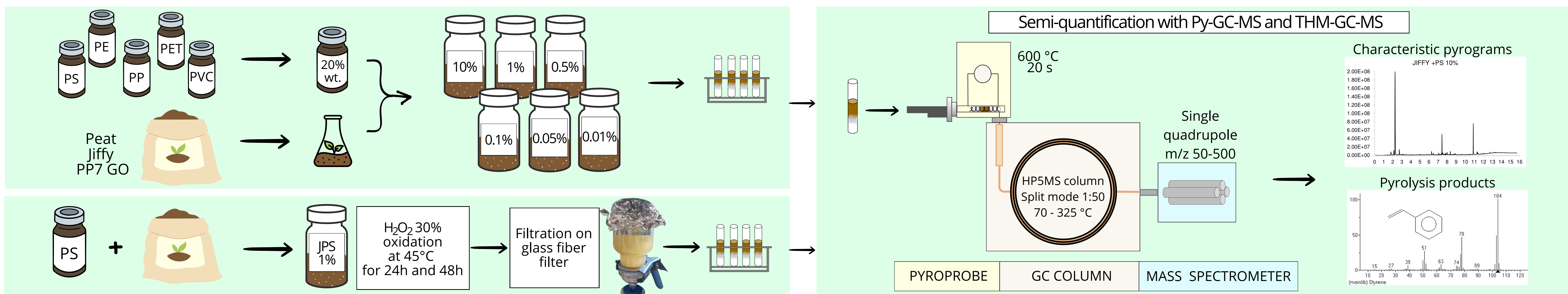
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INTRODUCTION



MATERIALS AND METHODS



RESULTS

Pyrolysis products proportions in mixtures of synthetic polymers and natural organic matter

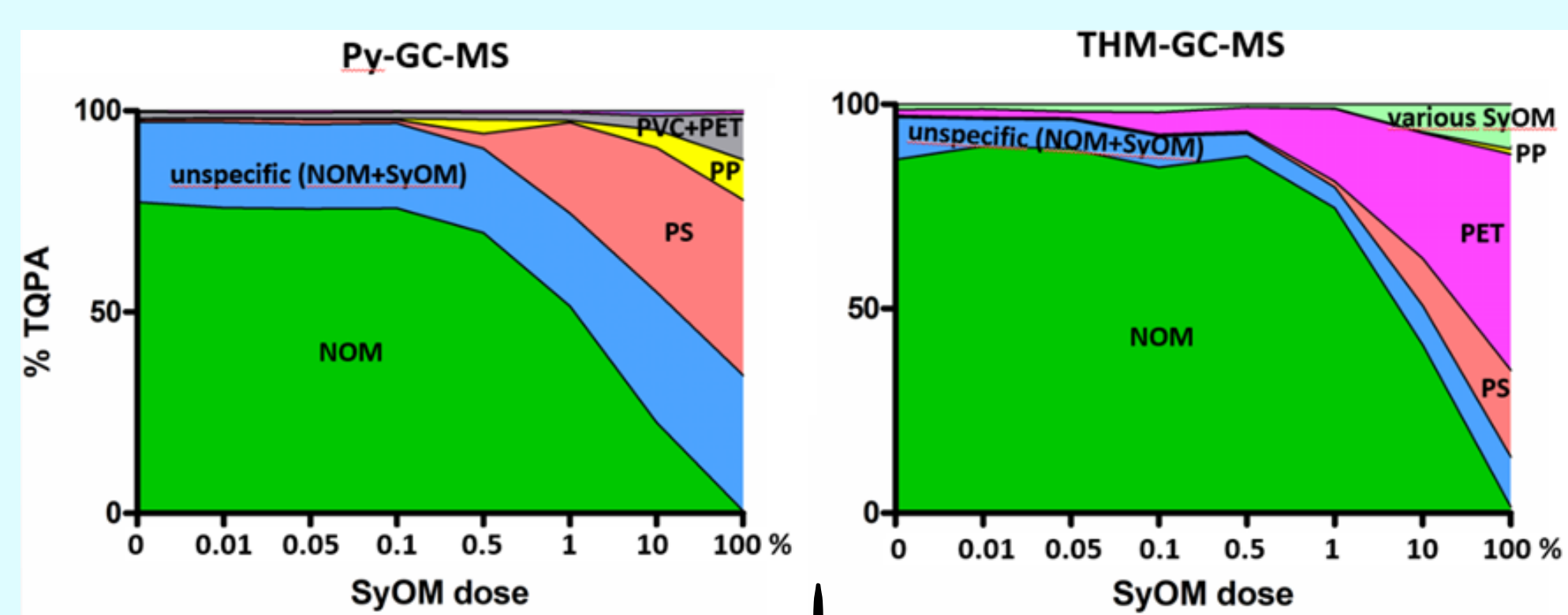


Figure 1. Balance between plastics concentration in the mixtures of synthetic polymers and natural organic matter (x-axis, log scale) and the proportions of the peak areas for Py-GC-MS (left) and THM-GC-MS (right). (Kaal et al. 2023, Under review)

Synthetic polymers Detection Limits with PY-GC-MS and THM-GC-MS

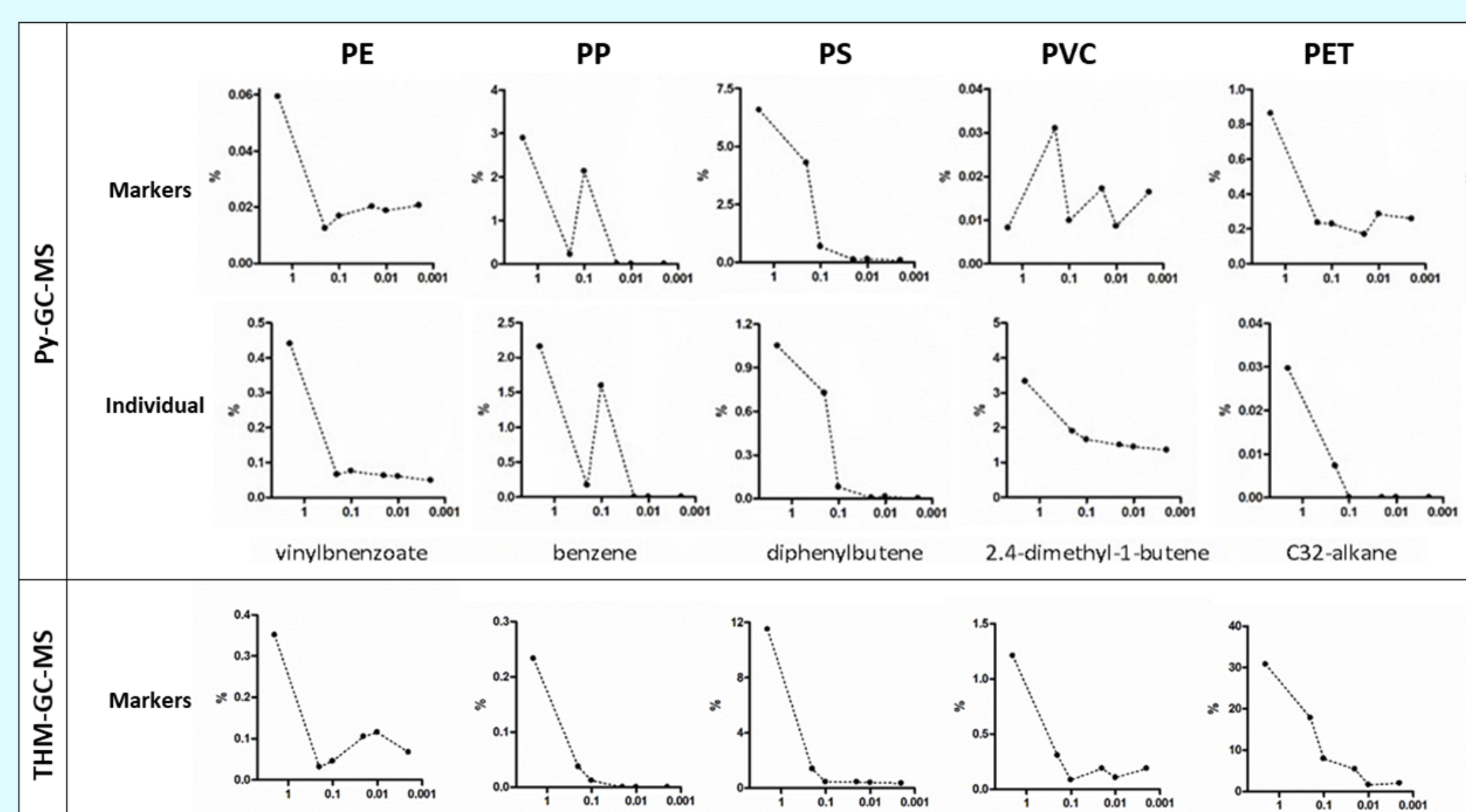


Figure 2. Summary of Py-GC-MS and THM-GC-MS data for the five synthetic polymers in NOM matrix. (Kaal et al. 2023, Under review)

Detection limits for synthetic polymers in peat matrix with

- Py-GC-MS: 0.01% (PS), 0.02% (PET), 2% (PE, PP, PVC)
- THM-GC-MS: 0.02% (PET), 0.2% (PP), 2% (PE, PVC)

NO linear trend with dose rate

H₂O₂ 30% oxidation at 45°C for 24 h and 48 h on Jiffy peat + PS 1% (JPS1)

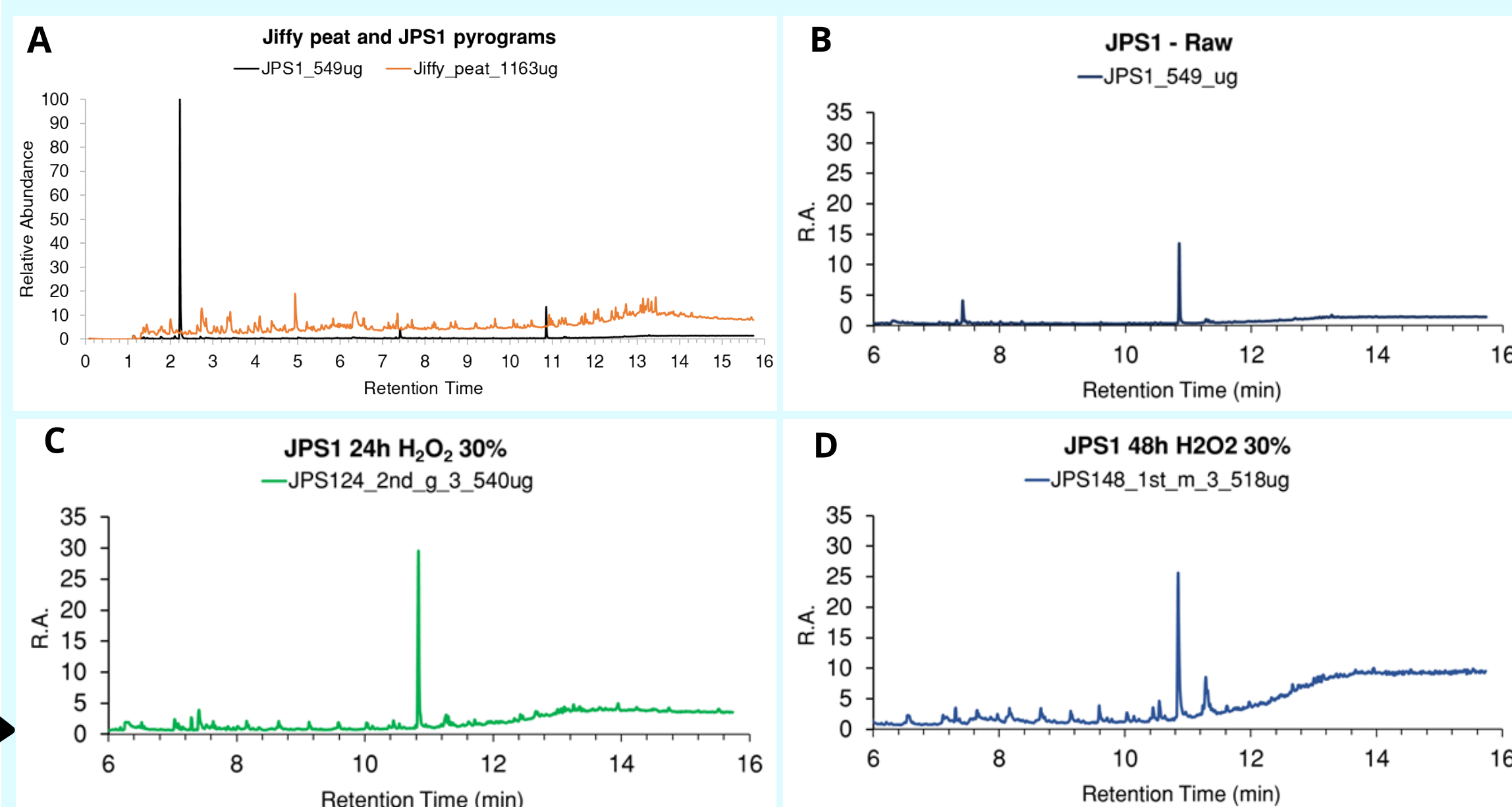


Figure 3. Py-GC-MS pyrograms of pure Jiffy peat (orange) and PS 1% mixture in Jiffy peat (black) (A); pyrograms of styrene trimer peak (10.8 min) in non-treated JPS1 (B) and in JPS1 oxidized for 24 hours (C) and 48 hours (D).

Selected PS characteristic peaks (styrene monomer, dimer and trimer) more abundant after oxidation treatment. Improved detection limits? PS stability was expressed as styrene trimer/dimer ratio: values are comparable before and after oxidation (JPS1: 3.2 ± 0.5; JPS124: 3.5 ± 1.5).

CONCLUSIONS

- OM fingerprinting approach can be used to identify SyOM when present in significant amounts (0.01-2% depending on the polymer)
- Oxidation with H₂O₂ 30% enhances PS molecular fragment peaks in JPS1 pyrograms

PERSPECTIVES

- Detection limits of synthetic polymers in peat samples after H₂O₂ oxidation
- Application of oxidation protocol and Py-GC-MS analysis to composts of urban rooftop

REFERENCES

- Bouzid, N. et al. 2022. Quantification of microplastics by pyrolysis coupled with gas chromatography and mass spectrometry in sediments: Challenges and implications. *Microplastics* 1, 229-239
- Kaal, J., Goñi-Urtiaga, A., Wenig, P., Veliu, M., Moreno-Jiménez, E., Plaza, C., Panettieri, M. 2023. Simultaneous molecular fingerprinting of natural organic matter and synthetic polymers (PE, PET, PP, PS and PVC) using analytical pyrolysis. *Journal of Analytical and Applied Pyrolysis*. UNDER REVIEW
- Fischer, M. et al. 2017. Simultaneous trace identification and quantification of common types of microplastics in environmental samples by pyrolysis-gas chromatography-mass spectrometry. *Environ Sci Technol.*, 51, 5052-5060.
- Pérez-Rodríguez, M. et al. 2023. Explicit microrelief-controlled decoupling of initial aerobic (in hummocks) and anaerobic (in hollows) decay in superficial layers of Sphagnum-dominated peatlands.
- Picca, G. et al. 2023. Suitability of co-composted biochar with spent coffee grounds substrate for tomato (*Solanum lycopersicum*) fruiting stage. *Horticulturae* 9, 89.



Algae-based compost

