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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**

Medina Veliu, Joeri Kaal, Asier Goñi-Urtiaga, Tiago De Oliveira, Giuseppe Picca, Eduardo Moreno-Jiménez, Johnny Gasperi, Denis Courtier-Murias, Liliane Jean-Soro, Marco Panettieri

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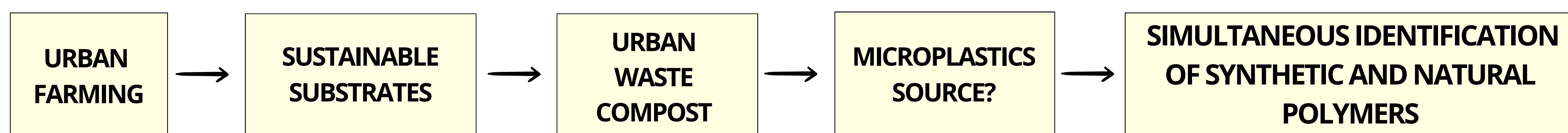


# Application of analytical pyrolysis for the molecular fingerprinting of polymers (PE, PET, PP, PS and PVC) within natural organic matter matrices used for rooftop farming

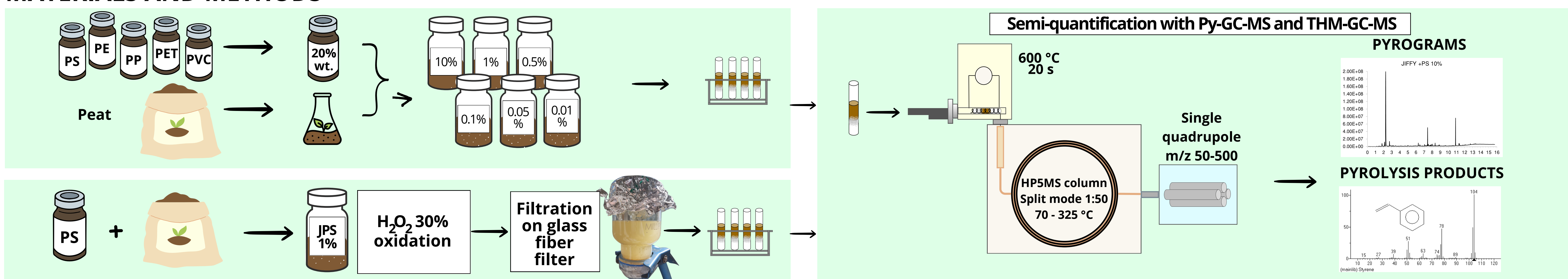
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## INTRODUCTION



## MATERIALS AND METHODS



## RESULTS

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

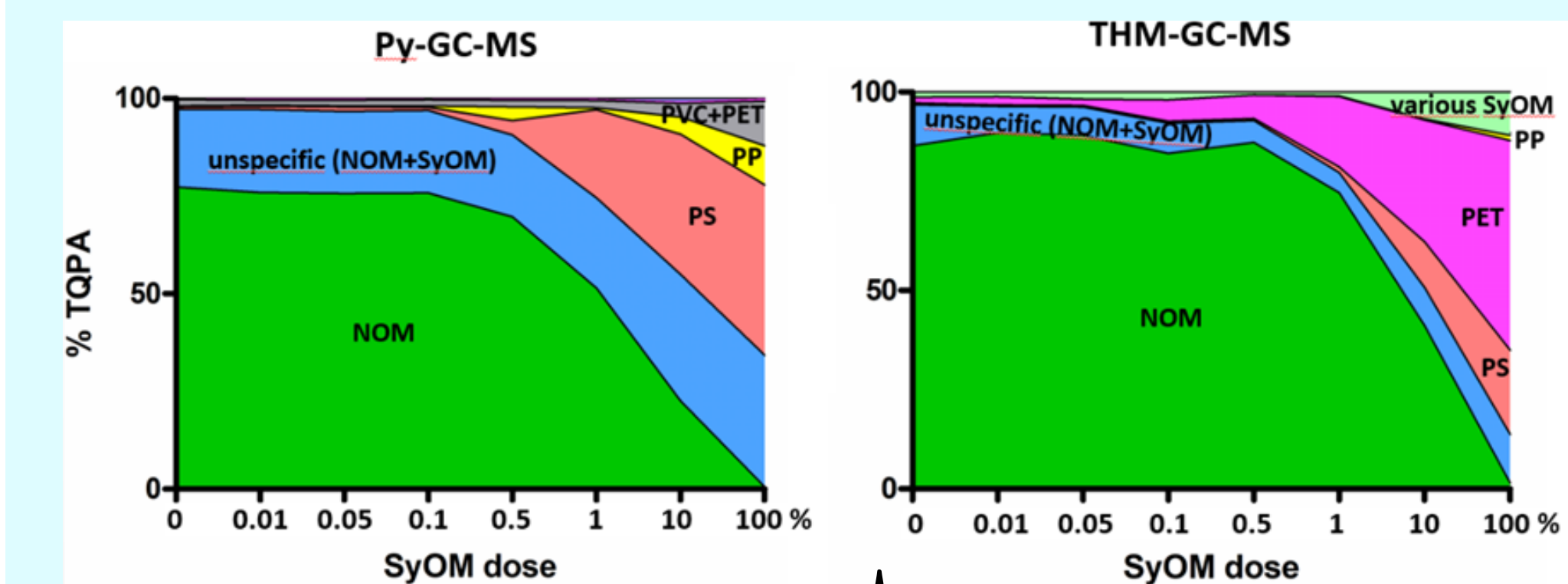


Figure 1. Balance between plastics concentration in the mixtures of synthetic polymers and natural organic matter (x-axis, log scale) and the proportions of the peak areas for Py-GC-MS (left) and THM-GC-MS (right). (Kaal et al. 2023, Under review)

### Synthetic polymers detection Limits with PY-GC-MS and THM-GC-MS

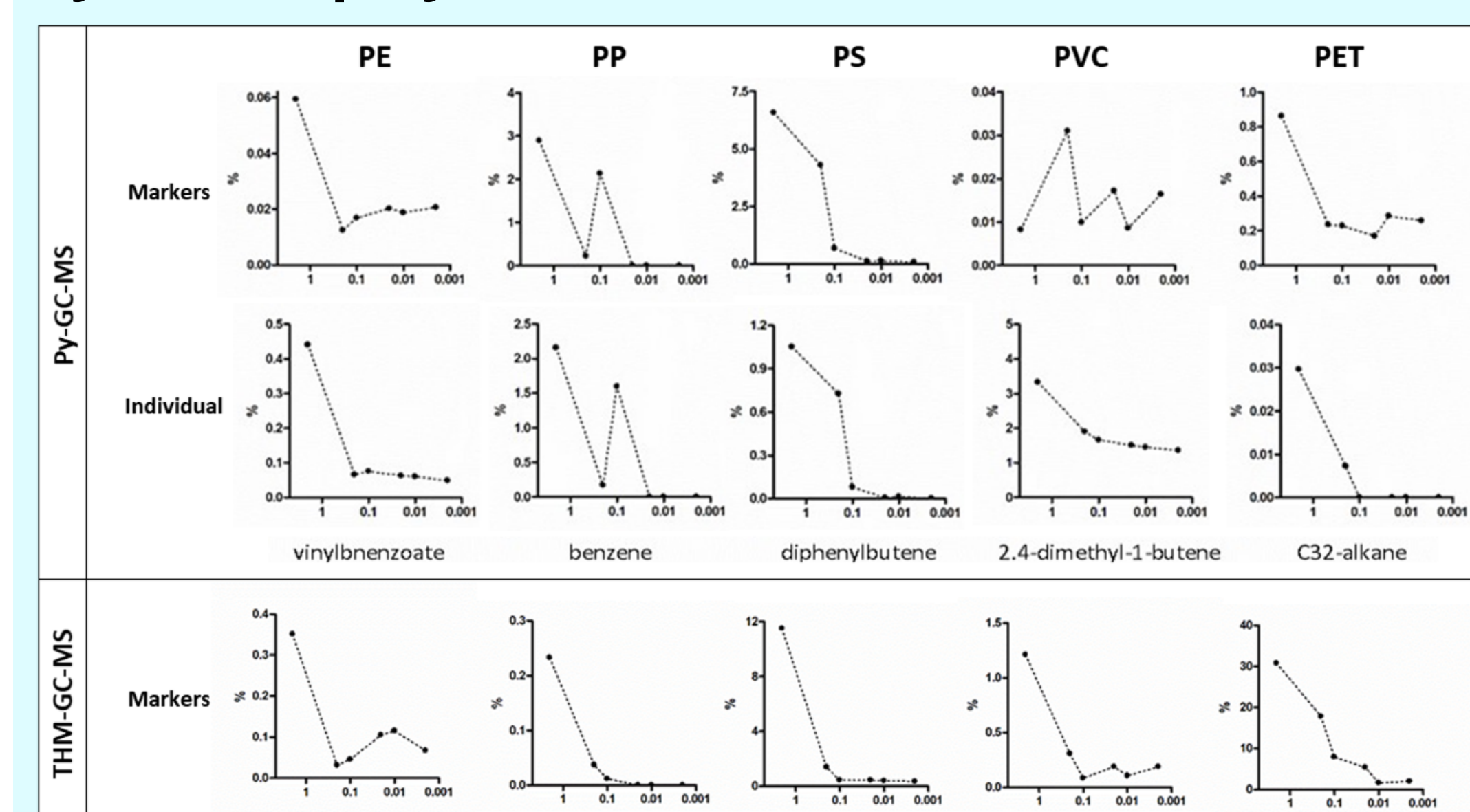


Figure 2. Summary of Py-GC-MS and THM-GC-MS data for the five synthetic polymers in NOM matrix. (Kaal et al. 2023, Under review)

## REFERENCES

- Bouزيد, 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
- 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.
- 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
- Perez, C.N., Carré, F., Hoarau-Belkhir, A., Joris, A., Leonards, P.E.G., Lamoree, M.H., 2022. Innovations in analytical methods to assess the occurrence of microplastics in soil. *J. Environ. Chem. Eng.*, 10 (3)
- Picca, G. et al. 2023. Suitability of co-composted biochar with spent coffee grounds substrate for tomato (*Solanum lycopersicum*) fruiting stage. *Horticulturae* 9, 89.

### H<sub>2</sub>O<sub>2</sub> 30% oxidation at 45°C for 24 h and 48 h on Jiffy peat + PS 1%

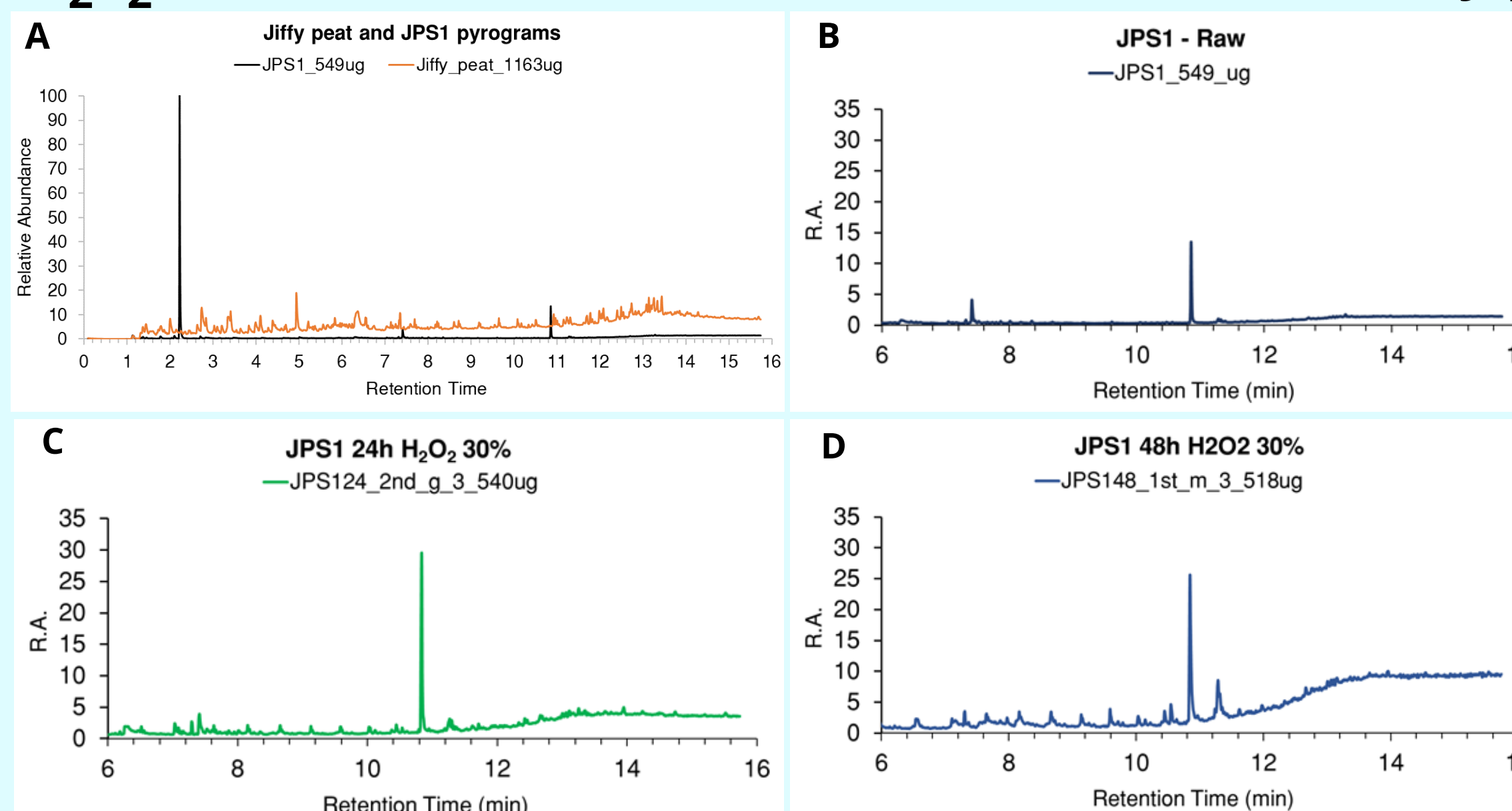


Figure 3. Py-GC-MS pyrograms of pure Jiffy peat (orange) and PS 1% mixture in Jiffy peat (black) (A); pyrograms of styrene trimer peak (10.8 min) in non-treated JPS1 (B) and in JPS1 oxidized for 24 hours (C) and 48 hours (D).

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 synthetic polymers when present in significant amounts (0.01-2% depending on the polymer)
- Oxidation with H<sub>2</sub>O<sub>2</sub> 30% enhances PS molecular fragment peaks in JPS1 pyrograms

## PERSPECTIVES

- Detection limits of synthetic polymers in peat samples after H<sub>2</sub>O<sub>2</sub> oxidation
- Application of oxidation protocol and Py-GC-MS analysis to composts of urban rooftop

Algae-based  
compost

