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السملاية - مراكش
FACULTÉ DES SCIENCES
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Assessment of lignin compounds during composting of sewage sludge using Pyrolysis-GC/MS

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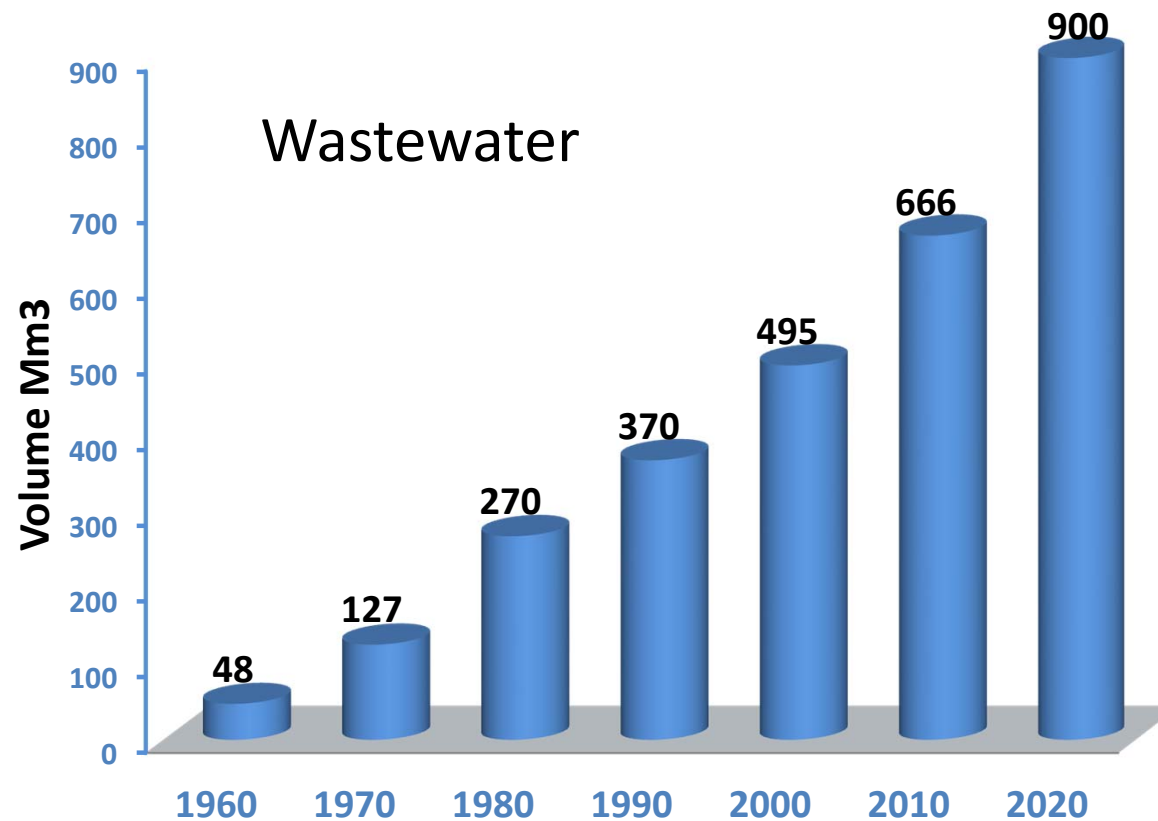


6th International Conference on Sustainable Solid Waste Management, 13-16 June 2018

Wastewater in Morocco

Untreated wastewater is one of the main sources of environmental pollution in Morocco

Important cause of diseases and epidemics



Moroccan Ministry of Agriculture, Rural Engineering Administration, 2002

National Sanitation Program

Aims at solving wastewater issue in Morocco with the

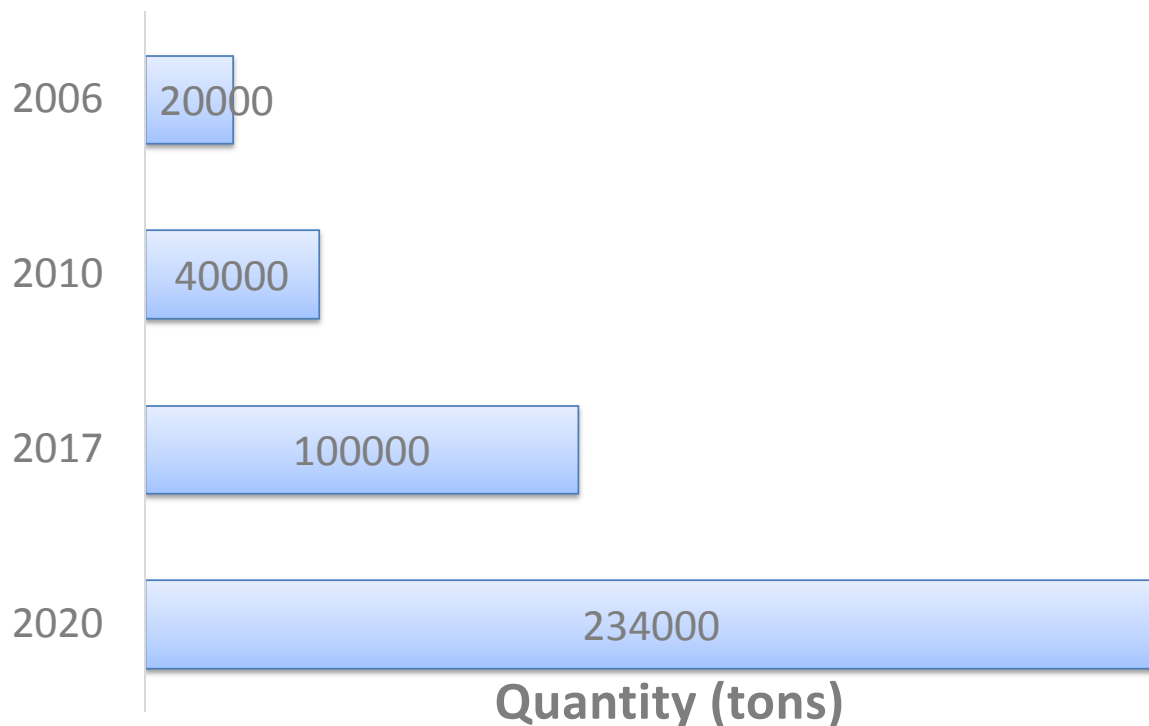
- Renovation and extension of the sewage network
- Separation of storm drain system
- Development of wastewater treatment plants



- Achieve an overall connection rate to the sewage network of 80% by 2020 and 100% by 2030
- Achieve 60% wastewater treatment by 2020 and 100% by 2030

Side effect of NSP

- significant increase in sludge production



WWTP of Marrakech

- Necessity to find a sustainable valorisation pathway

Composting and soil amendment

- Compensates loss of carbon due to crop
- Enhances soil structural stability
- Contributes to carbon “immobilisation”



However an immature compost can cause soil mineralisation, phytotoxicity, low nitrogen disponibility, ...

Objective of the study



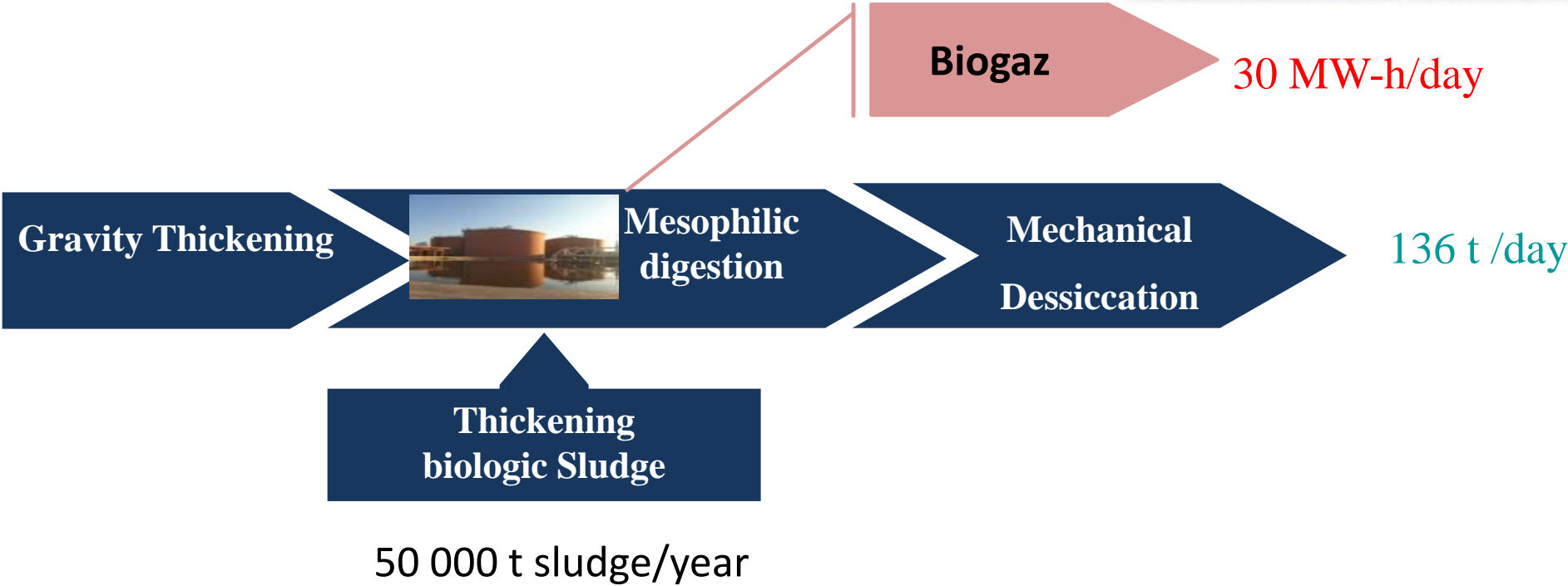
Understand the process leading to an humified material

Correlate maturity factors (C/N or $\text{NH}_4^+/\text{NO}_3^-$)

with molecular changes

Marrakech wastewater treatment plant

118 000 m³ wastewater/day



Composting trials

- Conducted for 6 months
- Composting platform of Marrakech



- **Two different mixtures :**

A: 1/3 Sludge + 2/3 palm waste

B: 1/2 Sludge + 1/2 palm waste

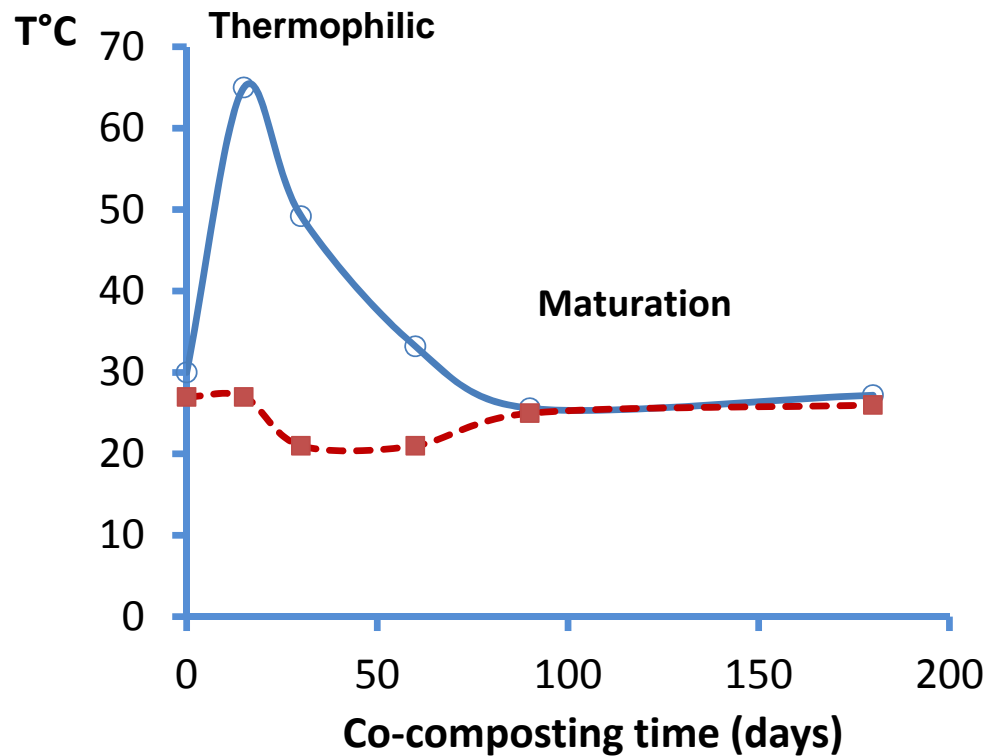
- 4 m³ compost windrow turned over weekly

- Temperature, pH, C, N monitoring
- Molecular characterisation

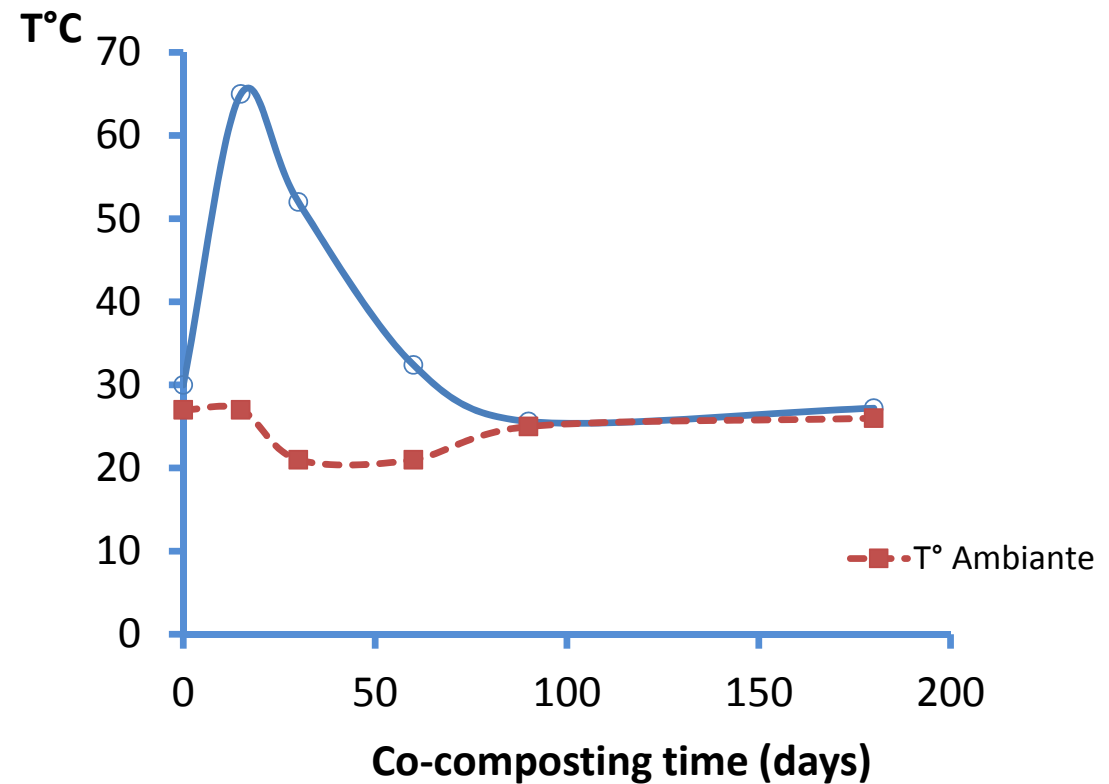


Temperature monitoring

A: 1/3 Sludge + 2/3 palm waste



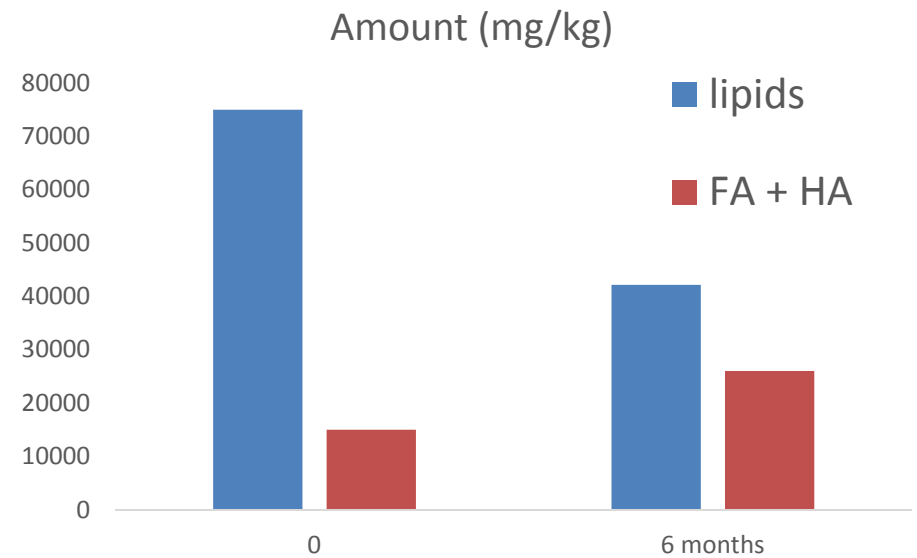
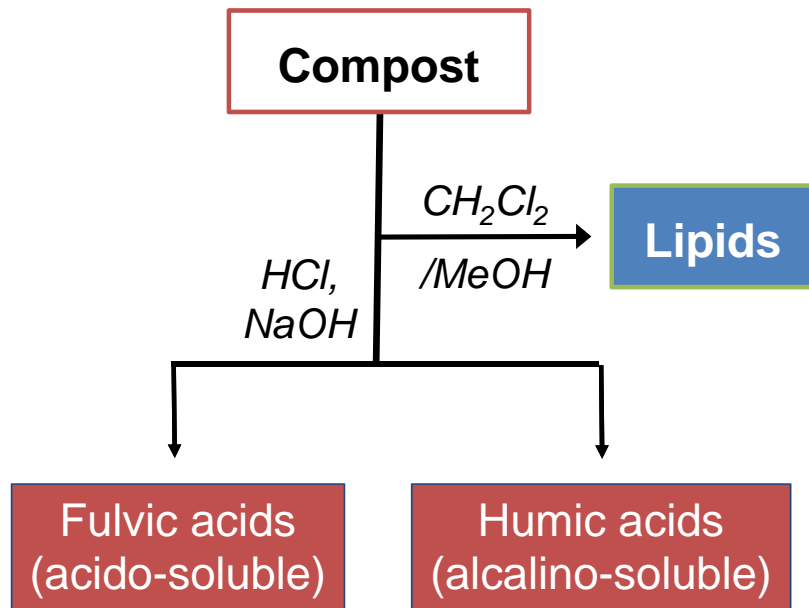
B: 1/2 Sludge + 1/2 palm waste



Physico-chemical parameters

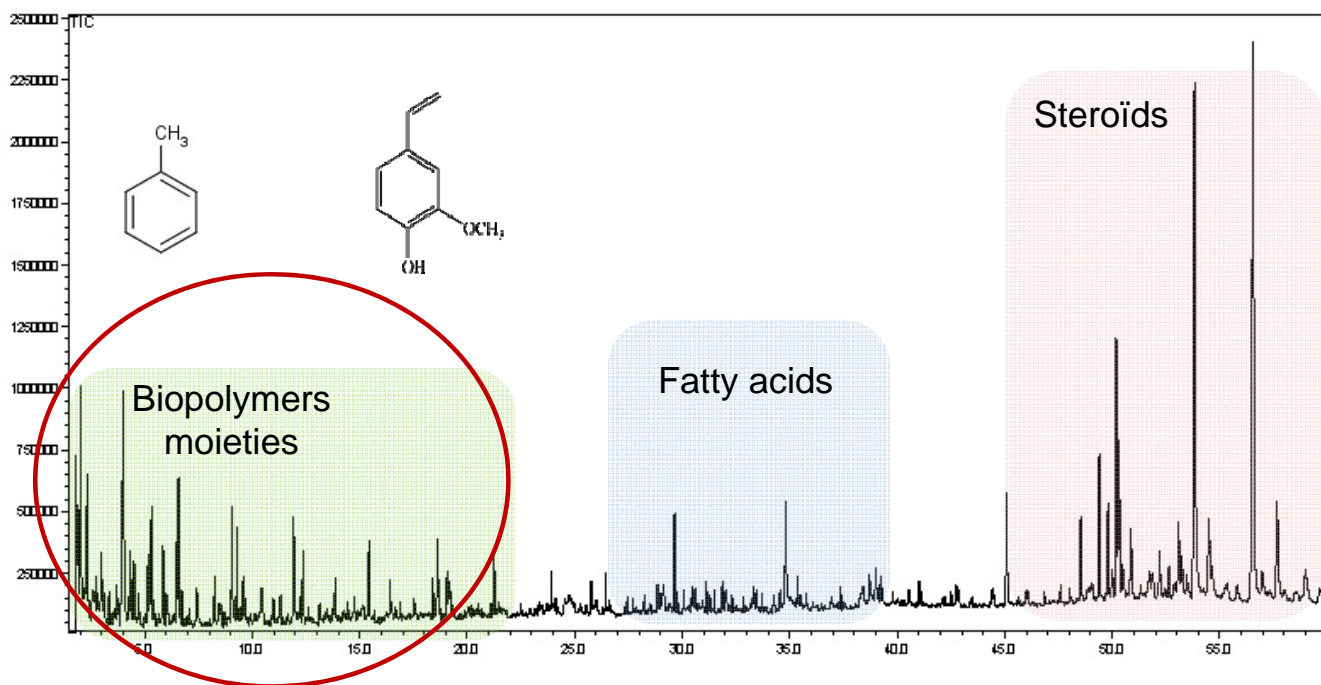
Mixtures	Composting time (months)	pH	C/N	NH ₄ ⁺ /NO ₃ ⁻
A	0	6.34 ±0.03	26.2	13.75
	6	6.79 ±0.06	10.09	0.12
B	0	6.04 ±0.28	27.4	15.6
	6	7.03 ±0.08	10.08	0.14

Chemical fractionation

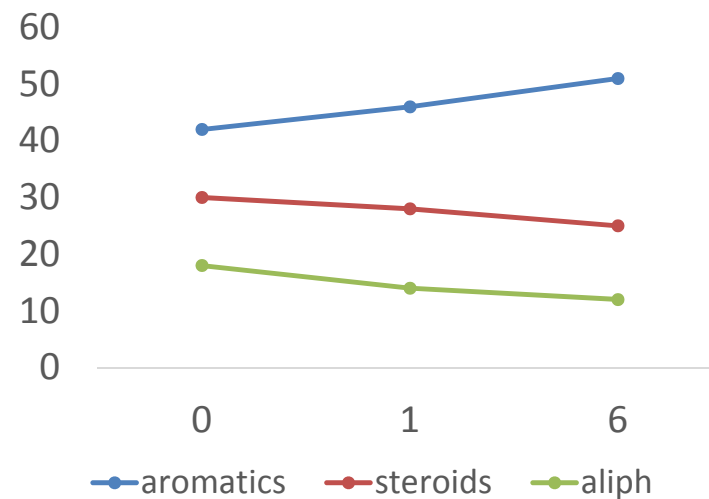


Analytical pyrolysis (Py-GC/MS)

➤ Pyrolysis at 600°C

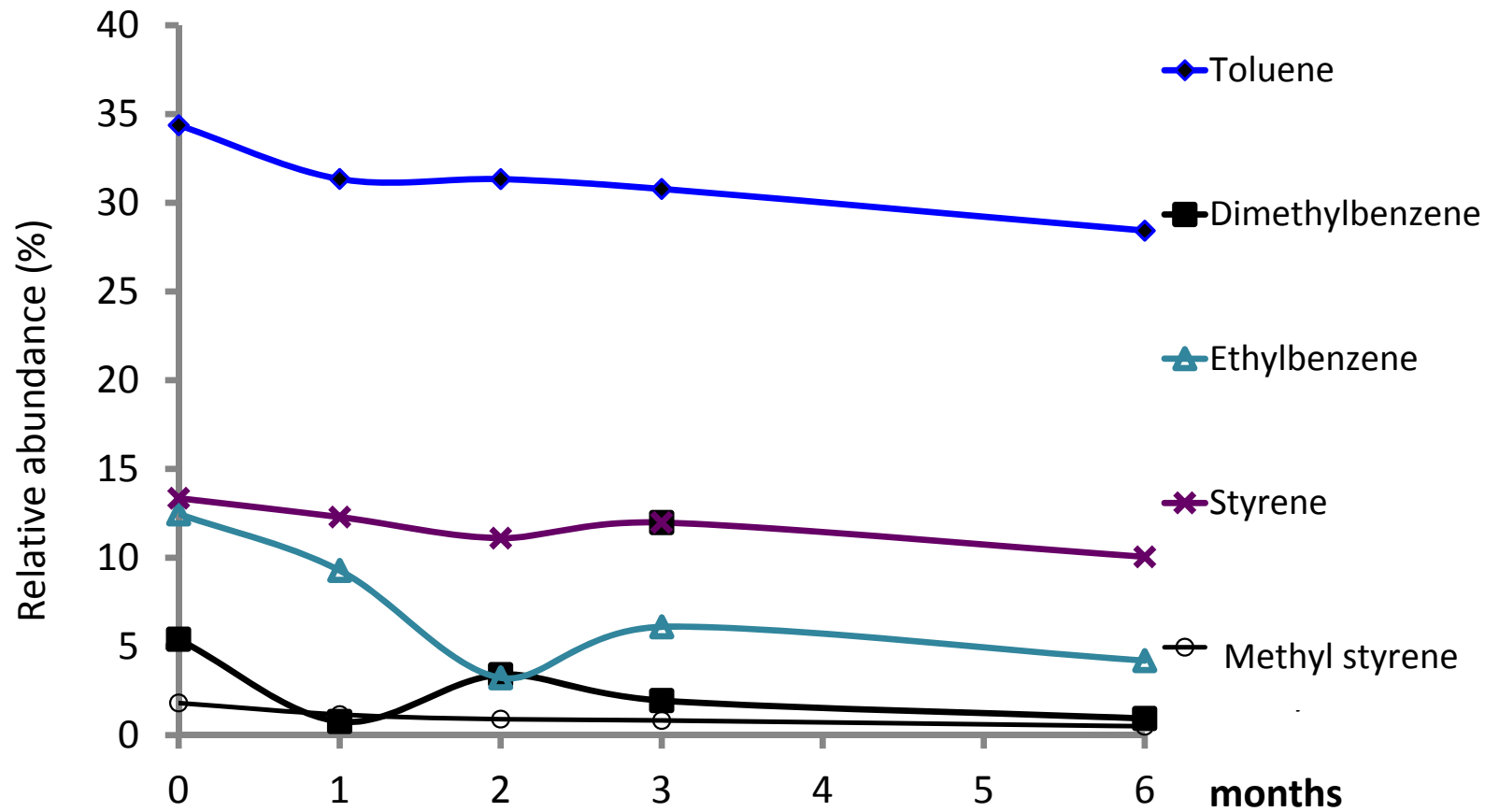


Compost A, t0



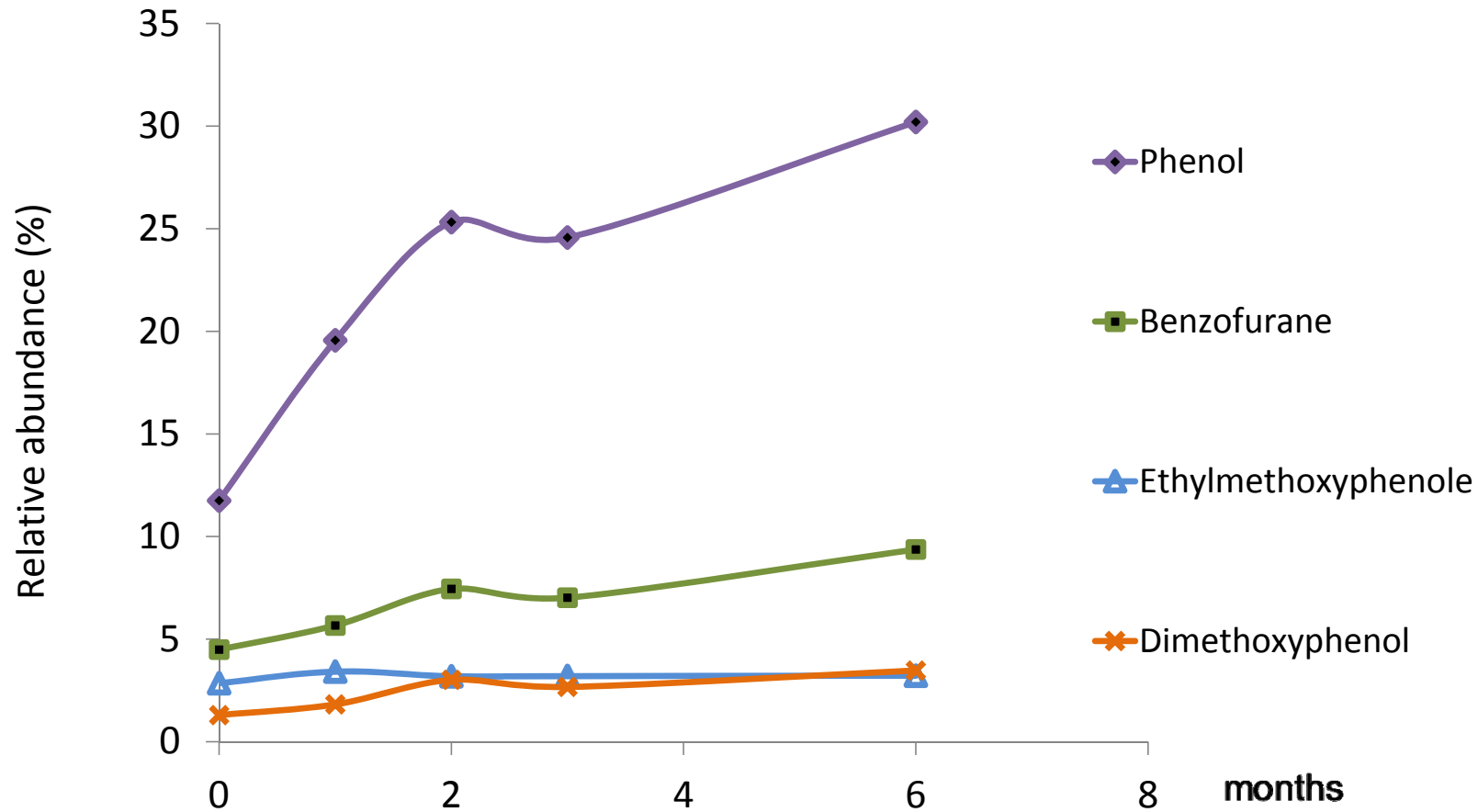
Focus on aromatics of lignin origin, likely to participate to the structure of humified material

Decrease during the co-composting process



decrease due to metabolisation or transformation

Increase during the co-composting process



increase due to release with lignin degradation and incorporation in HS

Conclusion

- Co-composting of sludge with palm waste is a suitable valorisation pathway to obtain a fertilizing and stable organic matter, rich in humic substances
- Classical maturity parameters (C/N, $\text{NH}_4^+/\text{NO}_3^-$) correlate with molecular transformation (HS/lipids and increase in aromatics)
- Pyrolysis demonstrates different transformation pathways of lignin moieties degradation of lignin parallel to humic substances formation
- Molecular information of interest to understand the mechanisms of sequestration of carbon in soils



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Thank you for your attention

