Assessment of lignin compounds during composting of sewage sludge using pyrolysis-GC/MS

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According to the Moroccan Ministry of Agriculture and Fisheries, the volume of wastewater produced in Morocco annually was estimated to 700 million m^3 in 2010 and is projected to reach 900 million m^3 by 2020. Untreated wastewater is thus one of the major sources of water pollution in Morocco (in coastal water, surface water, and underground water), one that causes diseases and spread epidemics. Wastewater has thus to be treated however wastewater treatment plants generates sewage sludge and its management in an eco-friendly way has become a matter of increasing importance during the last few years.

The main sustainable valorization pathway for sewage sludge is land farming which is of great interest for soil in Morocco thus preventing erosion. Moreover co-composting of sludge with green waste can degrade remaining organic micro contaminants. The characteristics of the final material influence its fertilising capacity and its impact on soil structural stability. In this context, the knowledge of the molecular structure of the material during the co-composting process is of great importance.

For this purpose, we monitored during 6 months the transformation of the organic matter during co-composting of activated sludge from wastewater treatment plant of Marrakech with palm tree waste using pyrolysis coupled with gas chromatography and mass spectrometry (Py-GC/MS). Amongst this organic matter, aromatics which mainly originate from lignin are of particular interest since it participates to the composition of humic substances playing an essential role for soil properties.

During the composting process the relative percentage of dimethylbenzene, methylnaphthalene, ethyl-methylbenzene, ethylbenzene, styrene, toluene and methylphenol were decreasing due to oxidation or biodegradation. At the contrary phenol, benzofuran, ethyl-methoxyphenol and dimethoxyphenol were increasing as they were released by lignin attack.

The results demonstrated the interest of pyrolysis as a tool to assess lignin biotransformation and humification during biological pretreatment of solid waste. Co-composting with green waste was demonstrated to be a suitable pathway to valorisate sewage sludge into a fertilizing and stable organic matter rich in humic substances. The molecular information are of great interest to understand the mechanisms of sequestration of carbon through landfarming.