Greenhouse gas emissions assessment in composting from biostabilized municipal solid waste

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PROYECTO DE INVESTIGACIÓN Y EXPERIMENTACIÓN EN COMPOSTAJE
AgroCompost

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Introduction

Figure 1: Composting piles

European Union (EU) promotes a **new plan of the waste management attending to the Circular Economy Package of the EU (Directive EU 2018/851)**. In the Valencian Community, the Spanish region where Castelló de la Plana is located, published its Integrated Municipal Solid Waste Plan (Decree 55/2019) that incorporates a **mandatory separate biowaste collection.**

Municipal solid waste (MSW) is characterized by significant amounts of organic biowaste which must be adequately treated **to avoid greenhouse gas emissions generated from their accumulation and disposal.**

Figure 2: GHG measurement

Therefore**, there is a growing interest in the study of GHG emissions of large-scale windrow composting method** and in the search for management practices that minimize their production**.**

The characteristics of **the starting nitrogen (N) and carbon (C) resources** affect the physic-chemical properties of the pile and, consequently, **govern the processes leading to the formation, diffusion and transport of GHGs.**

The main objective of the present study was to evaluate the impact of composting process on methane (CH_4), nitrous oxide (N_2O) and carbon dioxide (CO_2) emissions, in biowaste treatment at large scale.

Results & Discussion

Six windrow composting piles (7,800 kg f.m) (Composition in figure 3)

Ingredients

Source of C

- **olive mill waste (OMW)** kept constant in all mixtures, 65% f.m.
- **olive leaves waste (OLW)**
- **urban pruning residues (UPR)**
- **OLW+UPR (1:1, w/w)**

Source of N

Biostabilized material of urban waste management plants from (15% constant in all mixtures)

- **Valencia (MBT1)**
- **Castellón (MBT2)**

180 days of composting

Pile	MBT1	MBT2	OLW	UPR	OLW	OLW+UPR
1	15%	-	65%	20%	-	-
2	15%	-	65%	-	20%	-
3	15%	-	65%	-	-	20%
4	-	15%	65%	20%	-	-
5	-	15%	65%	-	20%	-
6	-	15%	65%	-	-	20%

Figure 3. Piles composition (% f.m)

	OMW	UPR	OLW	MBT1	MBT2
Moisture (%)	58,9	29,4	28,5	26,4	30,1
BD (g cm^3)	0,866	0,183	0,097	0,319	0,373
pH	6,7	7,5	6,1	6,9	7,6
EC (dS m^{-1})	3,05	2,71	1,34	6,50	5,07
TOC (%)	50,6	37,1	45,5	33,8	3,35
TN (%)	0,81	1,22	1,21	1,65	1,73
TOC/TN	62,51	30,31	37,67	20,46	18,12
PPH (mg kg^{-1})	5.757	2.492	6.295	1.458	2.680

Figure 4. Physico-chemical properties of raw material.

Static opaque closed chamber technique (volume: 0.007 m3, area: 0.049 m2) **was used to measure CO2, CH4 and N2O from the top of the compost piles.** Samples were taken **11 times at: 0, 7, 15, 30, 30, 52, 65, 79, 95, 122, 148 and 180 days after the start of composting**

Each gas flux was calculated from a single determination at the end of the closure by transforming the gas measurement of N_2O, CH_4 and CO_2, ppm to mg N_2O, CH_4 and CO_2 m^2 day-1.

Data analysis was performed with Infostat® statistical software. One-way analysis of variance **(ANOVA)** and the least significant difference (LSD) test at P < 0.05 were used

- ➢ **No significant differences were found in the effect of bulking agents on N_20, CH_4 and CO_2 fluxes**. The dynamics of the cumulative flow of emissions is similar for each of bulking agents assessed.
- ➢ There is a **slight trend towards higher N_2O and CO_2** emissions from **UPR+OLW,** and **CH_4** of the **OLW treatment**.

- ➢ **Significant differences** can be observed in the different **types of MBT in the total cumulative GHG emission (p<0.0001)**
- ➢ For each of the gases assessed, the emission has been **MBT1>MBT2** (Fig. 5). From sampling day 95, 52 and 7 of N_20, CH_4 and $C0_2$ **respectively emissions are significant and higher in MBT1.**

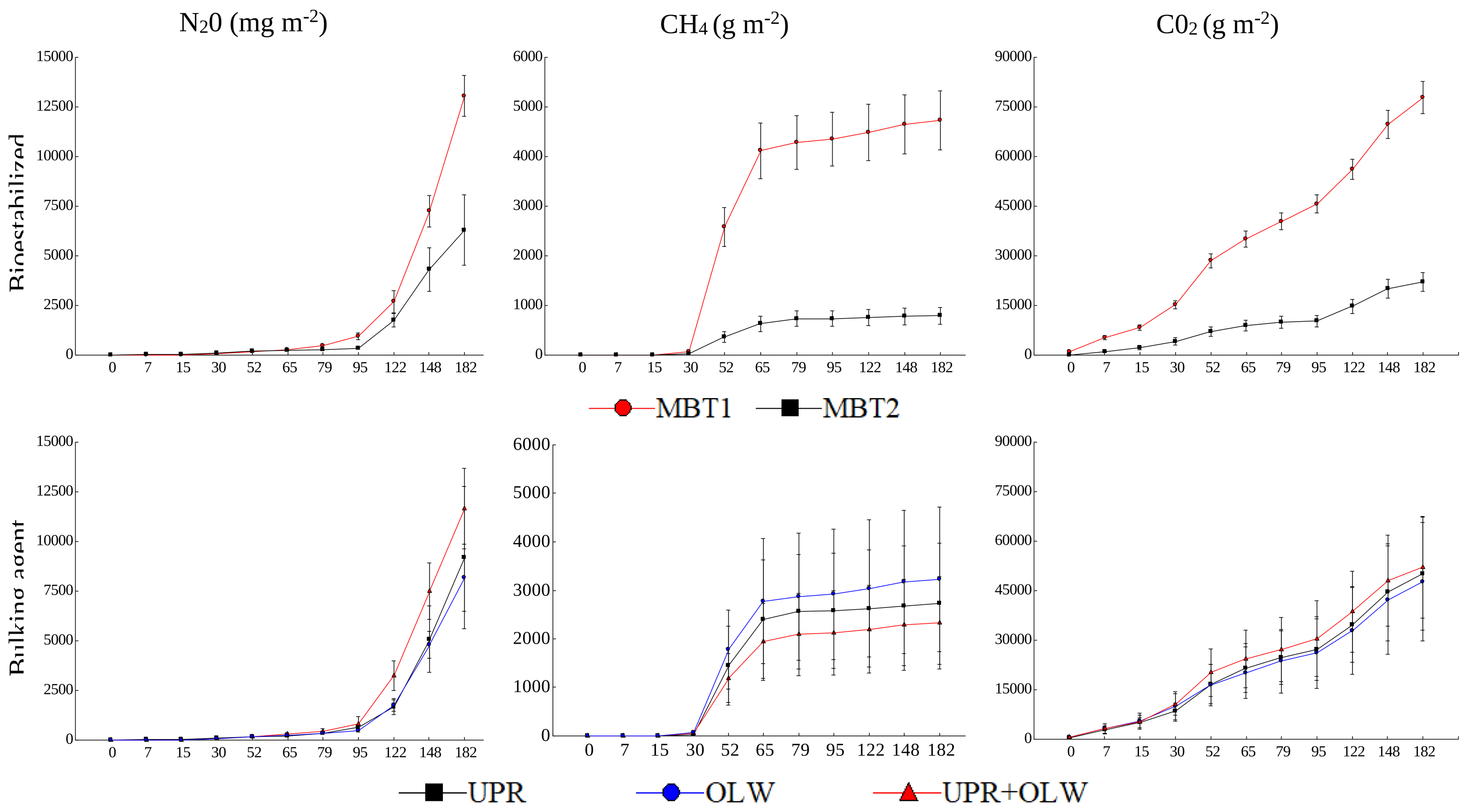

Figure 5. Evolution of N_2O, CH_4 and CO_2 fluxes during windrow composting. Bars represent standard error.

Conclusions

The gas emissions from composting process can be minimized by careful management during the treatment. The emissions generated during composting of biowaste were regulated by the composition of the starting mixtures. **GHG emissions were mainly affected by the use of MBT! in the starting mixture.**