Anaerobic co-digestion of Food waste and Pruning waste under mesophilic range

E. Suarez, M. Tobajas, A.F. Mohedano, M.A. de la Rubia
Universidad Autónoma de Madrid
eneko.suarez@uam.es
8th International Conference on Sustainable Solid Waste Management

Food waste (FW)

Pruning waste (PW)
2.0 \cdot 10^{12} \text{ t MSW/year (2017)}

3.4 \cdot 10^{12} \text{ t MSW/year (2050)}
Thermochemical treatment

Pyrolysis  Gasification  Torrefaction  Hydrothermal Carbonization

Biological treatment

Composting  Anaerobic digestion
High biodegradability
Low C/N ratio

Low biodegradability
Low methane yield

**Anaerobic Codigestion (AcoD)**

Biogas production
Process Stability

Energy Crops
Food Waste
OBJECTIVE

To evaluate the viability of the co-digestion of the two most important urban residues, Food waste and Pruning waste, to determine synergistic effects on methane production

- To evaluate biochemical methane potential (BMP)
  - Biogas Production
  - Biogas Composition

- To monitorize the process stability
  - pH
  - Alkalinity
  - Ammoniacal nitrogen
  - Soluble chemical oxygen demand (SCOD)
  - Volatile fatty acid content (VFA)
Materials and Methods

Characterization

Experimental Design
# FEEDSTOCK CHARACTERIZATION

<table>
<thead>
<tr>
<th></th>
<th>Inoculum</th>
<th>Food Waste (FW)</th>
<th>Pruning Waste (PW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TS (g/kg)</td>
<td>42 ± 2</td>
<td>130 ± 3</td>
<td>939 ± 1</td>
</tr>
<tr>
<td>VS (g/kg)</td>
<td>36 ± 2</td>
<td>120 ± 1</td>
<td>872 ± 2</td>
</tr>
<tr>
<td>COD (g/kg)</td>
<td>18.4* ± 1.4</td>
<td>186 ± 2</td>
<td>1144 ± 51</td>
</tr>
<tr>
<td>TKN (mg/kg)</td>
<td></td>
<td>1290 ± 59</td>
<td>980 ± 20</td>
</tr>
<tr>
<td>C (%)</td>
<td></td>
<td>44.5 ± 0.1</td>
<td>44.9 ± 0.1</td>
</tr>
<tr>
<td>H (%)</td>
<td></td>
<td>6.2 ± 0.1</td>
<td>6.1 ± 0.1</td>
</tr>
<tr>
<td>N (%)</td>
<td></td>
<td>1.9 ± 0.1</td>
<td>0.9 ± 0.1</td>
</tr>
<tr>
<td>S (%)</td>
<td></td>
<td>0.2 ± 0.1</td>
<td>0.4 ± 0.1</td>
</tr>
<tr>
<td>C/N ratio</td>
<td></td>
<td>23.6 ± 0.1</td>
<td>52.2 ± 0.1</td>
</tr>
</tbody>
</table>

*g/L
**EXPERIMENTAL DESIGN**

<table>
<thead>
<tr>
<th></th>
<th>Food Waste %</th>
<th>Pruning Waste %</th>
</tr>
</thead>
<tbody>
<tr>
<td>FW</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>75FW</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>50FW</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>25FW</td>
<td>25</td>
<td>75</td>
</tr>
<tr>
<td>PW</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

- **[INOCULUM] (VS) (g/L)**: 15
- **ISR**: 2

Biogas flow diagram:
- FW + PW
- T = 35°C, pH = 7.0
- Methanogenesis
RESULTS AND DISCUSSION

- Initially trials based on FW showed a significant decrease in the pH and buffer capacity.
- Trial based mainly on PW maintained stable during the process.
Higher reduction of SCOD for trials based on high FW content due to the difference of biodegradability of the residues.

Higher VFA content related to pH decrease and exhaustion of buffer capacity was observed at higher FW percentage.
• Trial based exclusively on FW reported the highest methane yield
• 50FW showed the fastest start up
• 75FW reached the highest methane yield among co-digestion trials
CONCLUSIONS

• AcoD of FW and PW enhance the process stability balancing C/N ratio and biodegradability rate differences.

• The anaerobic co-digestion trial, 75FW, showed the most promising results in terms of methane yield.

• AcoD of FW and PW turns out interesting from the perspective of energetic valorization of PW but yields for 50FW and 25FW are still low suggesting the requirement of pretreatments for PW.
Acknowledgements

Authors greatly appreciate funding from Spain’s Ministry of Science and Innovation (PID2019-108445RB-I00) and Madrid Regional Government (S2018/EMT-4344) through BIO3 project. E. Suárez acknowledges financial support from Community of Madrid (PEJD-2019-PRE/AMB-14231).
THE END
THANK YOU FOR YOUR ATTENTION