Comparison of mesophilic and thermophilic digestion of food waste

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Food waste as a substrate can lead to the accumulation of volatile fatty acids (VFA) due to high ammonia concentrations causing toxicity.

The research compared mesophilic and thermophilic digestion in response to this when fed on the same food waste.
Methods

- The methods are described in the full paper
Results and discussion

Food waste characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TS (% fresh matter)</td>
<td>23.9</td>
</tr>
<tr>
<td>VS (% fresh matter)</td>
<td>21.6</td>
</tr>
<tr>
<td>TKN (N) (g kg(^{-1}) TS)</td>
<td>30.9</td>
</tr>
<tr>
<td>Elemental analysis (%TS)*</td>
<td></td>
</tr>
<tr>
<td>Nitrogen (N)</td>
<td>3.1</td>
</tr>
<tr>
<td>Carbon (C)</td>
<td>51.1</td>
</tr>
<tr>
<td>Hydrogen (H)</td>
<td>6.4</td>
</tr>
<tr>
<td>Oxygen (O)</td>
<td>32.5</td>
</tr>
</tbody>
</table>

Theoretical SMP 0.66 L CH\(_4\) g\(^{-1}\) VS with biogas methane content 58% (from Buswell Equation)
• Both meso–AD and thermo–AD required some acclimatisation

• pH rose to ~7.8–8.0 due to increasing TAN

• IA/PA ratio increased in thermo–AD with early signs of failure around day 120

• Meso–AD appeared very stable, with decreasing IA/PA ratio
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- TAN ~ 3.5 g N l⁻¹ by day 120 in both sets of digesters
- Stable methane in meso-AD at ~58%, but a slight temporary loss in % in thermo-AD at the same time
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Biogas production

\[ \text{L day}^{-1} \]

Specific Methane Production \((\text{L CH}_4 \text{ g}^{-1} \text{ VS})\)

\(\rightarrow\) meso-AD 0.47

\(\rightarrow\) thermo-AD 0.45

(excluding early failed data)
Conclusions for Meso–AD

- Stable conditions maintained
- Gradual increase in pH and alkalinity
- Decreasing IA/PA ratio
- SMP \(0.47 \, \text{L CH}_4 \, \text{g}^{-1} \, \text{VS}\)
- VFA concentrations low low after initial acclimatisation
VFA profile in Thermo-AD

1x TE

Increased to 4x TE

Early signs of failure
Conclusions from Thermo-AD

- VFA accumulation from day 100, and started to fail around day 112
- Sharp rise in acetic acid with a peak around day 120, instability shown by increased IA/PA and fall in methane %
- Recovery in gas production
- Increasing concentrations of propionic acid
- SMP recovered to $0.45 \text{ L CH}_4 \text{ g}^{-1} \text{ VS}$
- Increasing TE dose unable to prevent propionic acid accumulation
Conclusions

- Meso-AD and thermo-AD gave similar SMP, around 70% of theoretical value based on the Buswell equation.
- Meso-AD was more stable than Thermo-AD.
- Thermo-AD showed symptoms of failure at an ammonia concentration of ~3500 mg l\(^{-1}\).
- Increase in propionic acid eventually overcame the digester buffering with a catastrophic drop in pH <6 and digester failure around day 280 (data not shown).
Acknowledgements

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