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

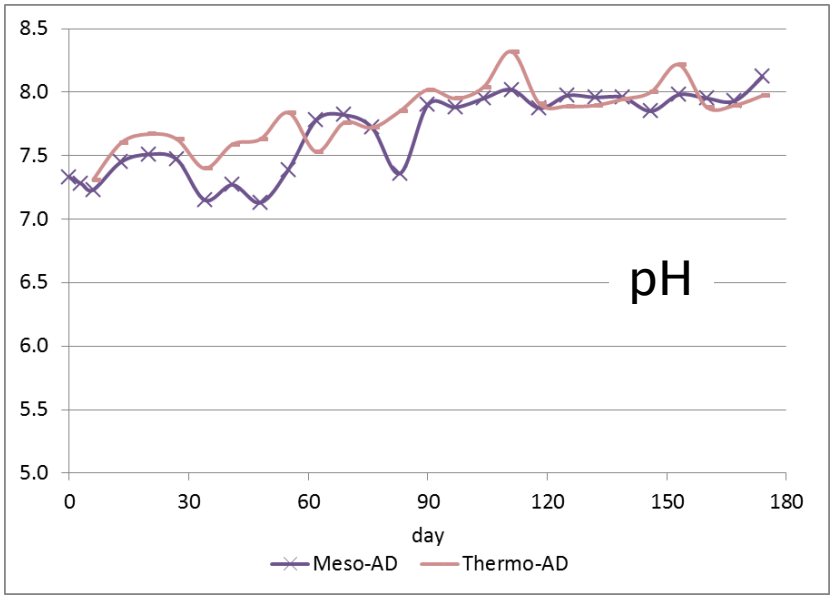
Results and discussion

Food waste characteristics

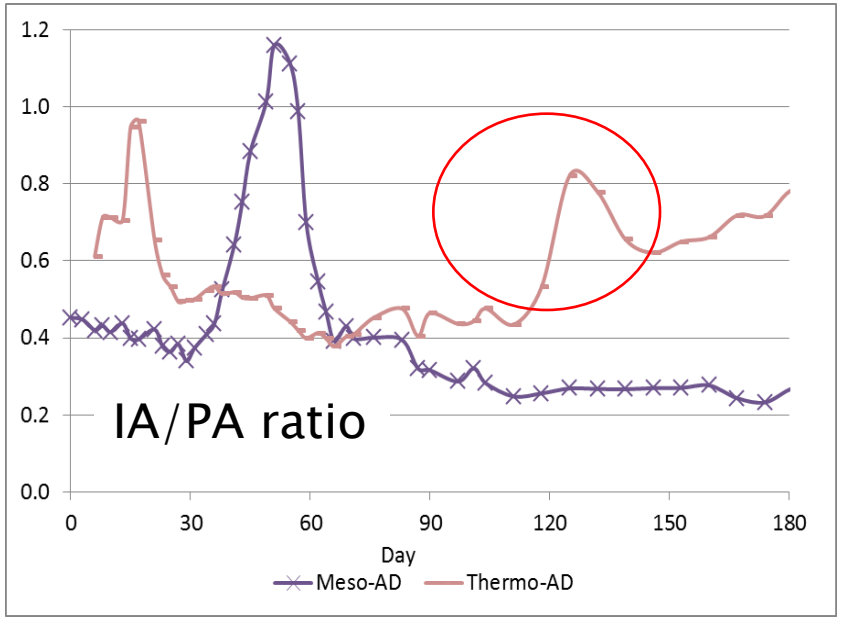
Parameter	Value
TS (% fresh matter)	23.9
VS (% fresh matter)	21.6
TKN (N) (g kg^{-1} TS)	30.9
Elemental analysis (%TS)*	
Nitrogen (N)	3.1
Carbon (C)	51.1
Hydrogen (H)	6.4
Oxygen (O)	32.5

Used to calculate the theoretical specific methane yield (SMP)

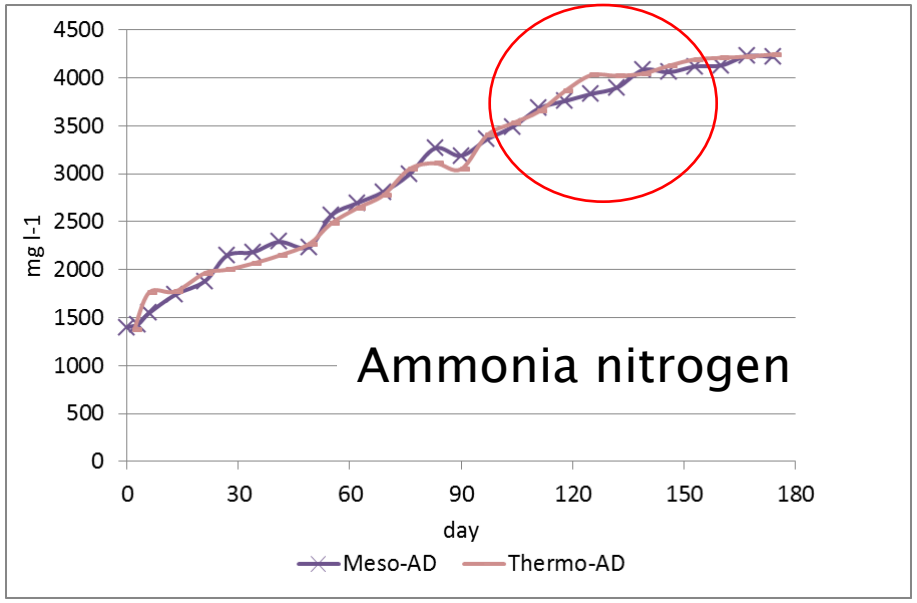
Theoretical SMP 0.66 L CH_4 g^{-1} VS with biogas methane content 58% (from Buswell Equation)



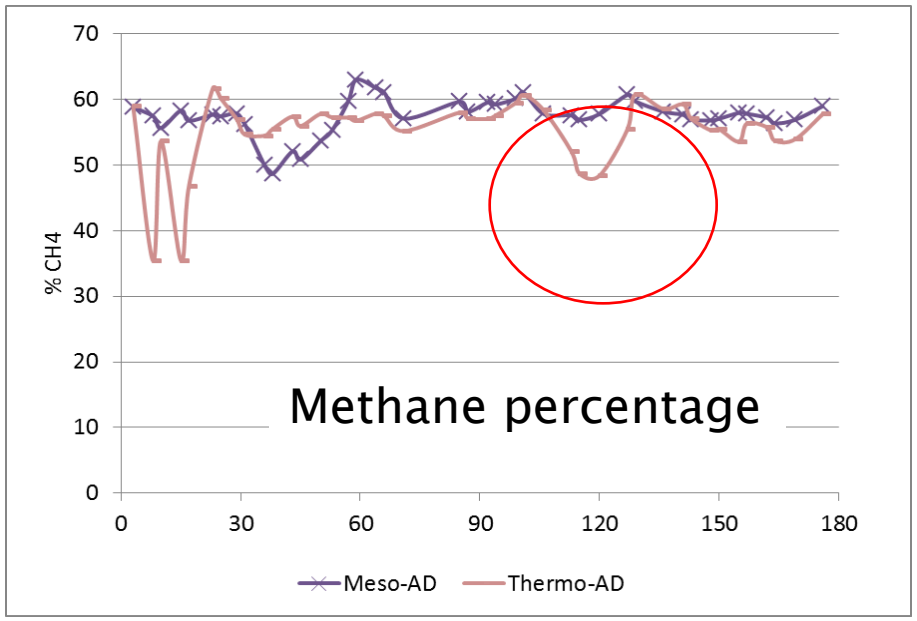
- Both meso-AD and thermo-AD required some acclimatisation
- pH rose to ~7.8-8.0 due to increasing TAN



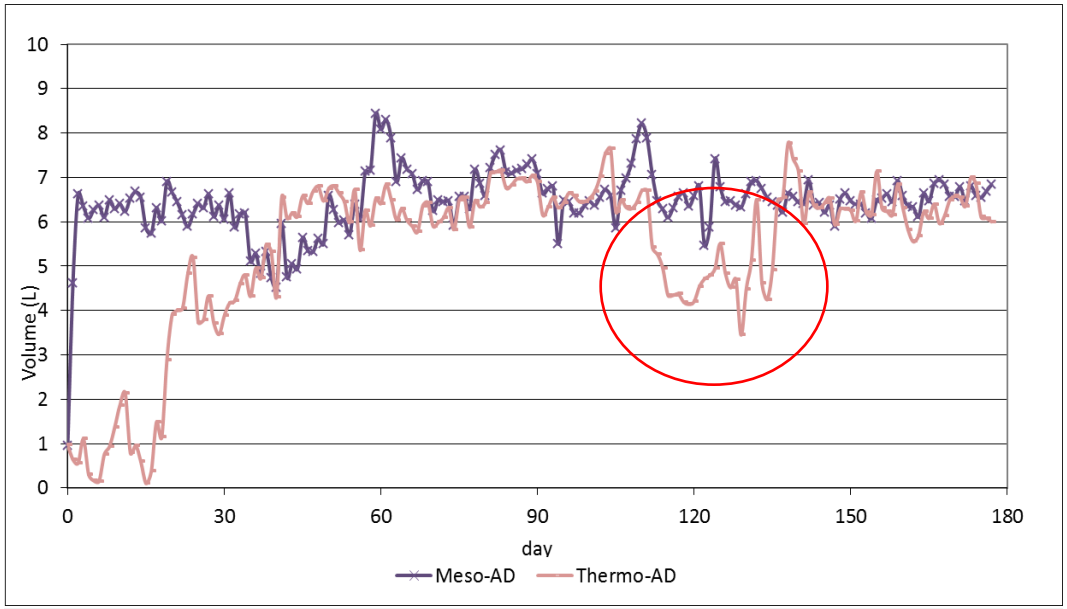
- IA/PA ratio increased in thermo-AD with early signs of failure around day 120
- Meso-AD appeared very stable, with decreasing IA/PA ratio



- TAN ~ 3.5 g N l^{-1} by day 120 in both sets of digesters

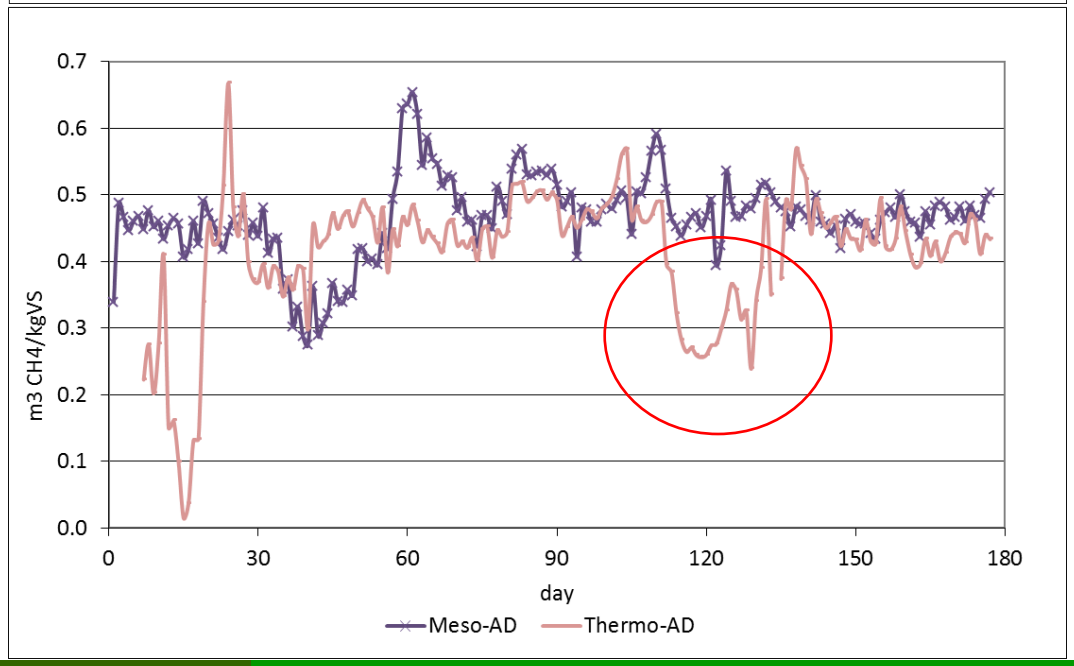


- Stable methane in meso-AD at ~58%, but a slight temporary loss in % in thermo-AD at the same time



Biogas production

L day^{-1}



Specific Methane Production (L CH_4 g^{-1} VS)

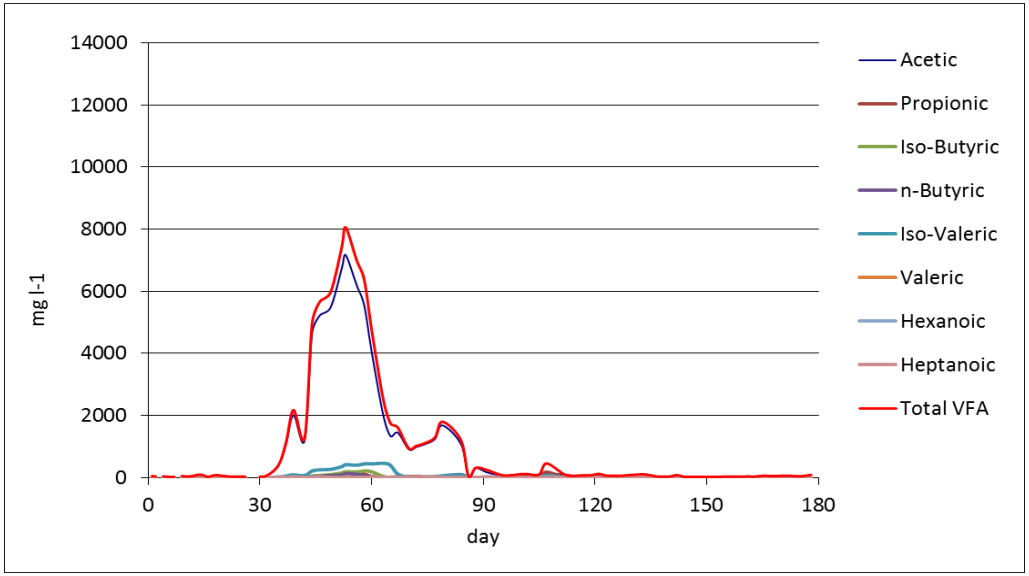
→ meso-AD 0.47

→ thermo-AD 0.45

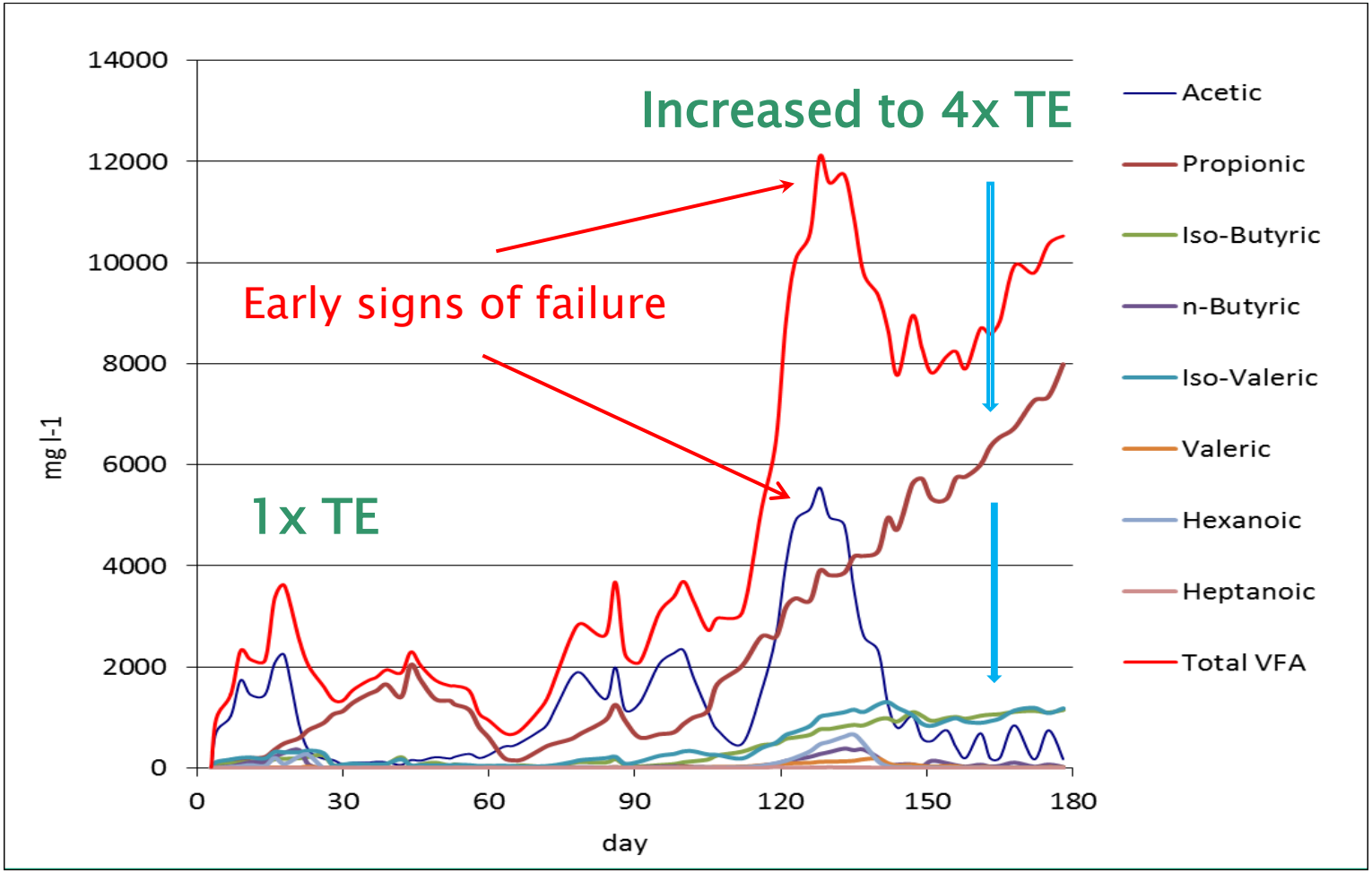
(excluding early failed data)

Conclusions for Meso-AD

- Stable conditions maintained
- Gradual increase in pH and alkalinity
- Decreasing IA/PA ratio
- SMP 0.47 L CH_4 g^{-1} VS
- VFA concentrations low low after initial acclimatisation



VFA profile in Thermo-AD



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 L CH_4 g^{-1} 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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SEVENTH FRAMEWORK PROGRAMME

VALORGAS