



Impacts of headspace volume and overhead-pressure measurement frequency on specific methane yields in *in vitro* anaerobic digestion using micro-BMP method

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BMP test methods

Volumetric

Pressure is kept constant and the volume of biogas is measured by a displacement volume device



BPA-800 Biomethane Potential Analyzer

Manometric or micro-BMP

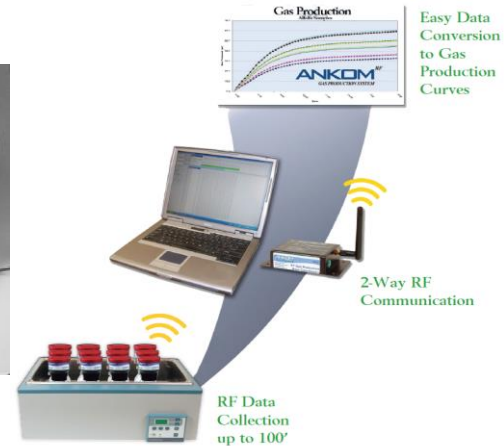
Volume is kept constant and an increase in pressure is measured

$$\text{Gas produce (ml)} = \frac{v_h}{P_a} \times P_t$$

v_h - headspace volume (ml),
 P_a - atmospheric pressure (hPa)
 P_t - gas headspace pressure (hPa).



AMPTS II



ANKOM RF Gas Production System

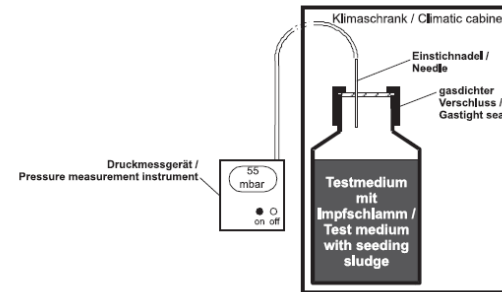
Equipment

- Reactor - Glass serum bottle
- Pressure transducer - Tracker 220, Gems Sensors and Controls, Basingstoke, UK
- CH₄ conc. - Shimadzu GC2014



VDI 4630 guideline

In contrast to DIN 38414-8, with DIN EN ISO 11734 the gas volume is measured indirectly by means of a pressure measurement instrument (Figure 4). The gas volume is calculated from the gas pressure registered and the gas temperature measured. The gas pressure should not exceed a value of 100 hPa.



ur nach DIN EN ISO 11734 – Gasvolumenmessgerät

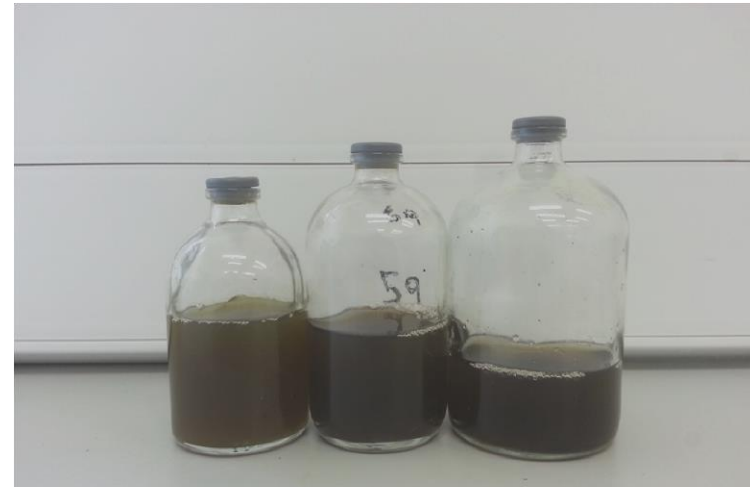
Figure 4. Test apparatus according to DIN EN ISO 11734: Gas volume measurement with a gas pressure measurement instrument

Table 3. Data relating to predominant characteristic of the biogas (output)

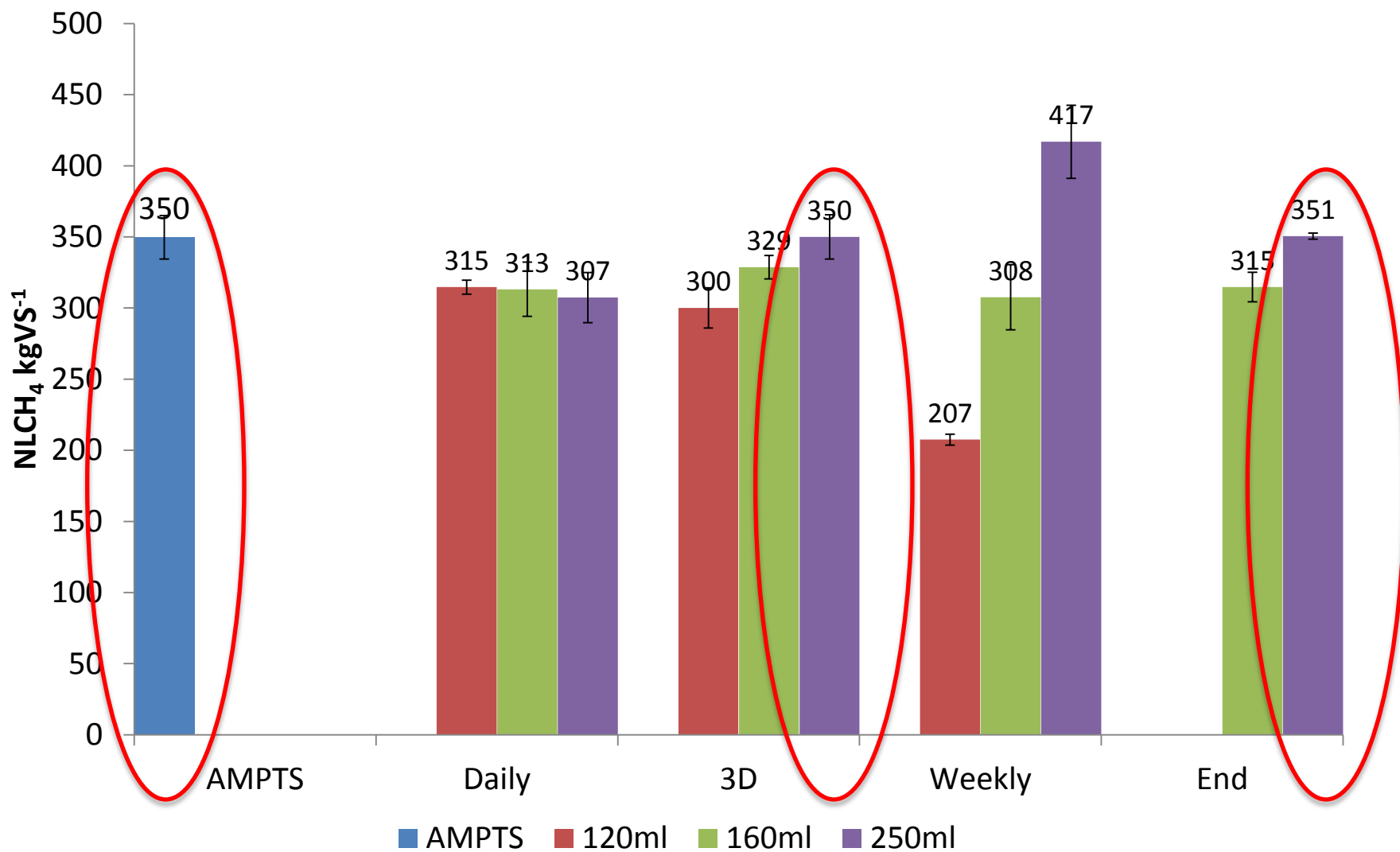
Measured variable	Measurement procedure	Practical experience, comments	Input		Output		Relevance	
			Collection	Frequency	Collection	Frequency ^{*)}	General ^{**)}	Specific ^{***)}
Volume	Eudiometer (with batch tests); drum-type gas meter (with quasi-continuous tests); micro gas meter (gas quantities up to maximum of 8 l/h)	Due to (pressure-dependent) water solubility of CO ₂ , with batch tests 6N NaCl should be used as confining liquid in the eudiometers			x	t	A	Be, Ba, P, F
Pressure	Manometer (batch tests)				x	t	C	F
CH ₄ , CO ₂	Gas chromatography (batch tests); infrared measurement				x	t	A	Be, Ba, P, F

Methodology

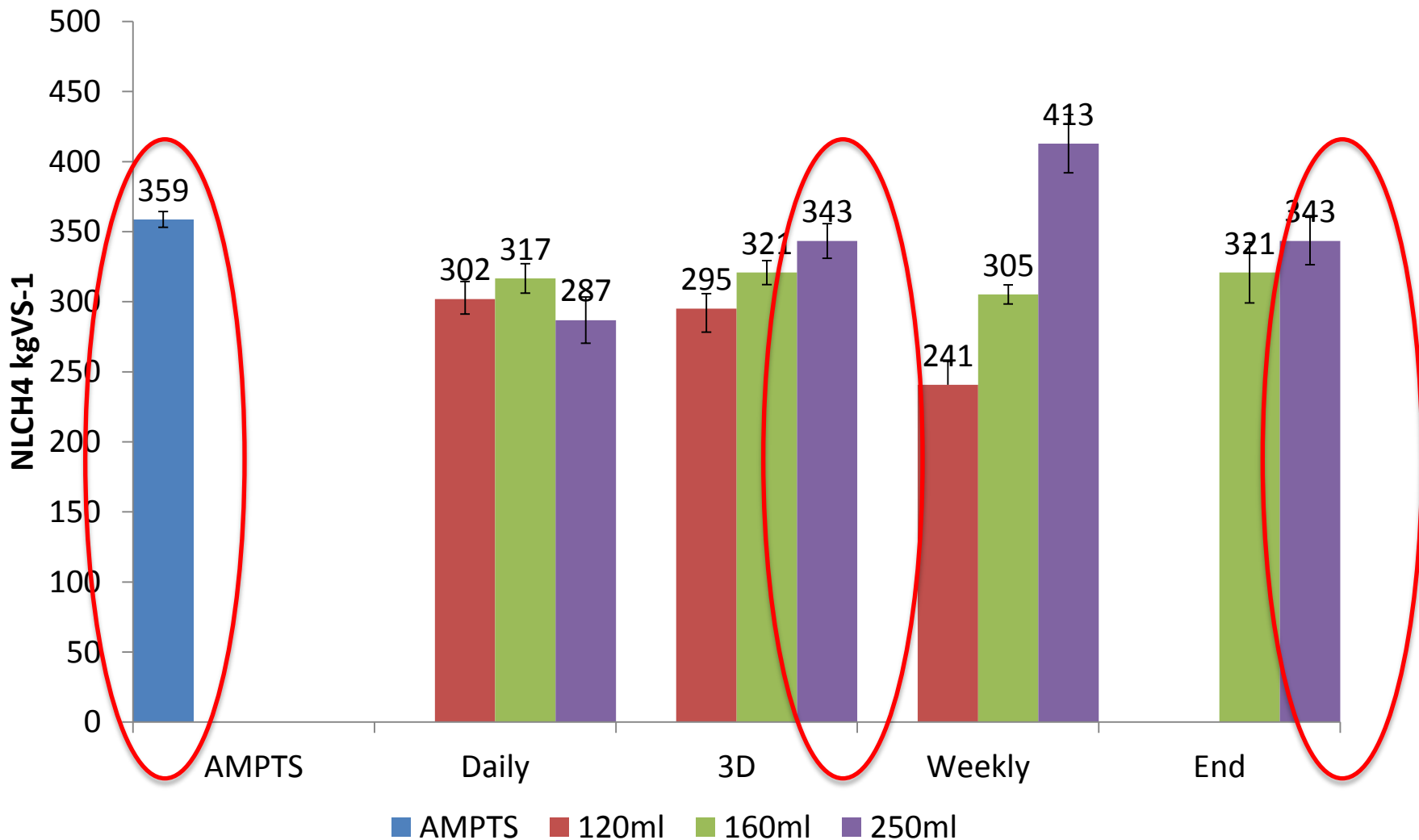
- Reactor bottle volumes - 120ml, 160ml and 250ml, 70ml total medium in all of them.
- Headspace –
 - 50 ml - 120 ml bottle
 - 90 ml - 160 ml bottle
 - 180 ml - 250 ml bottle
- Sampling frequency
 - Daily
 - Every 3rd day
 - Weekly
 - Only at the end – 35th Day
- Substrates
 - Dried milled barley grains
 - Dried milled grass silage
 - Cattle slurry
- Comparison with AMPTS II



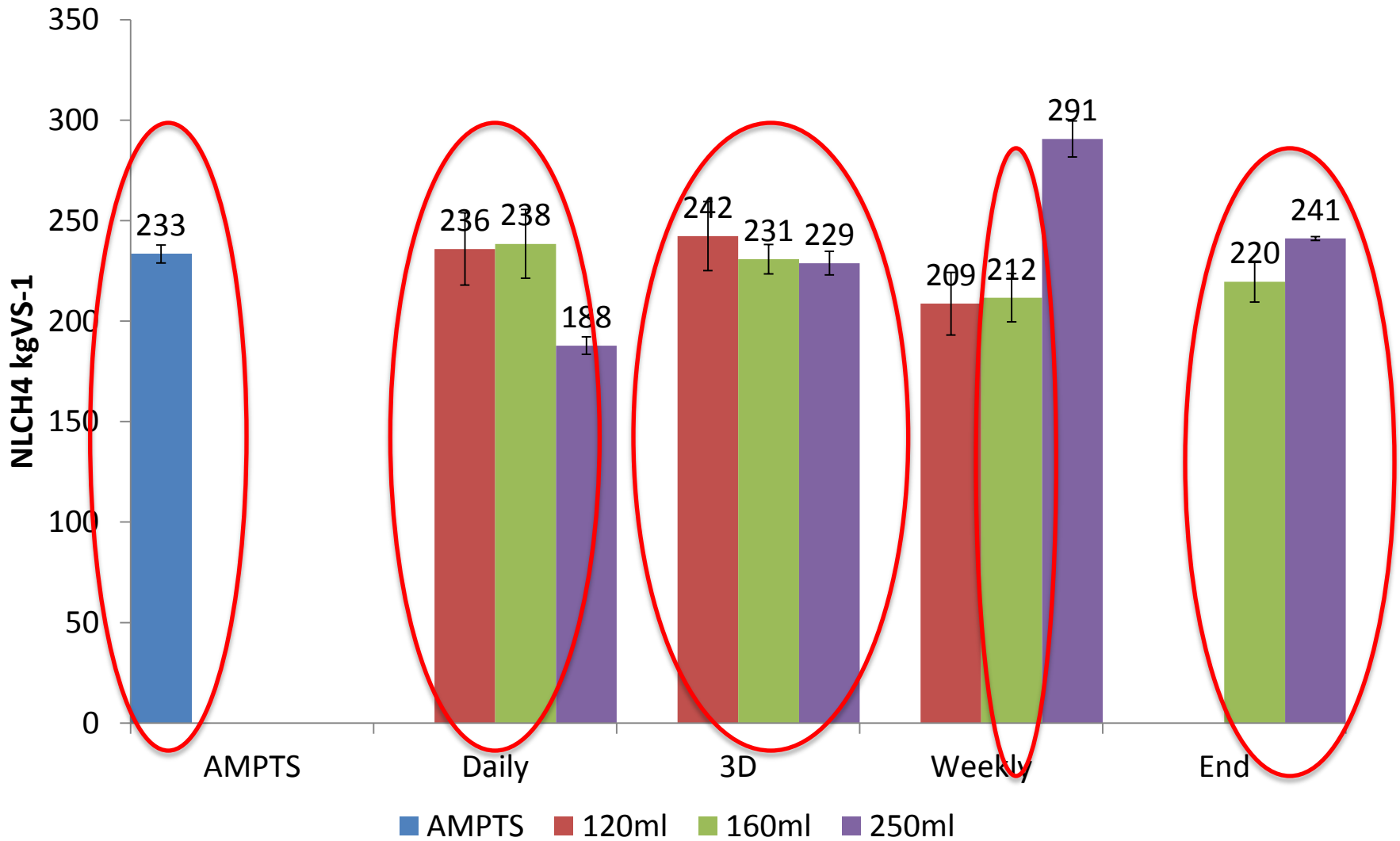
SMY - Barley



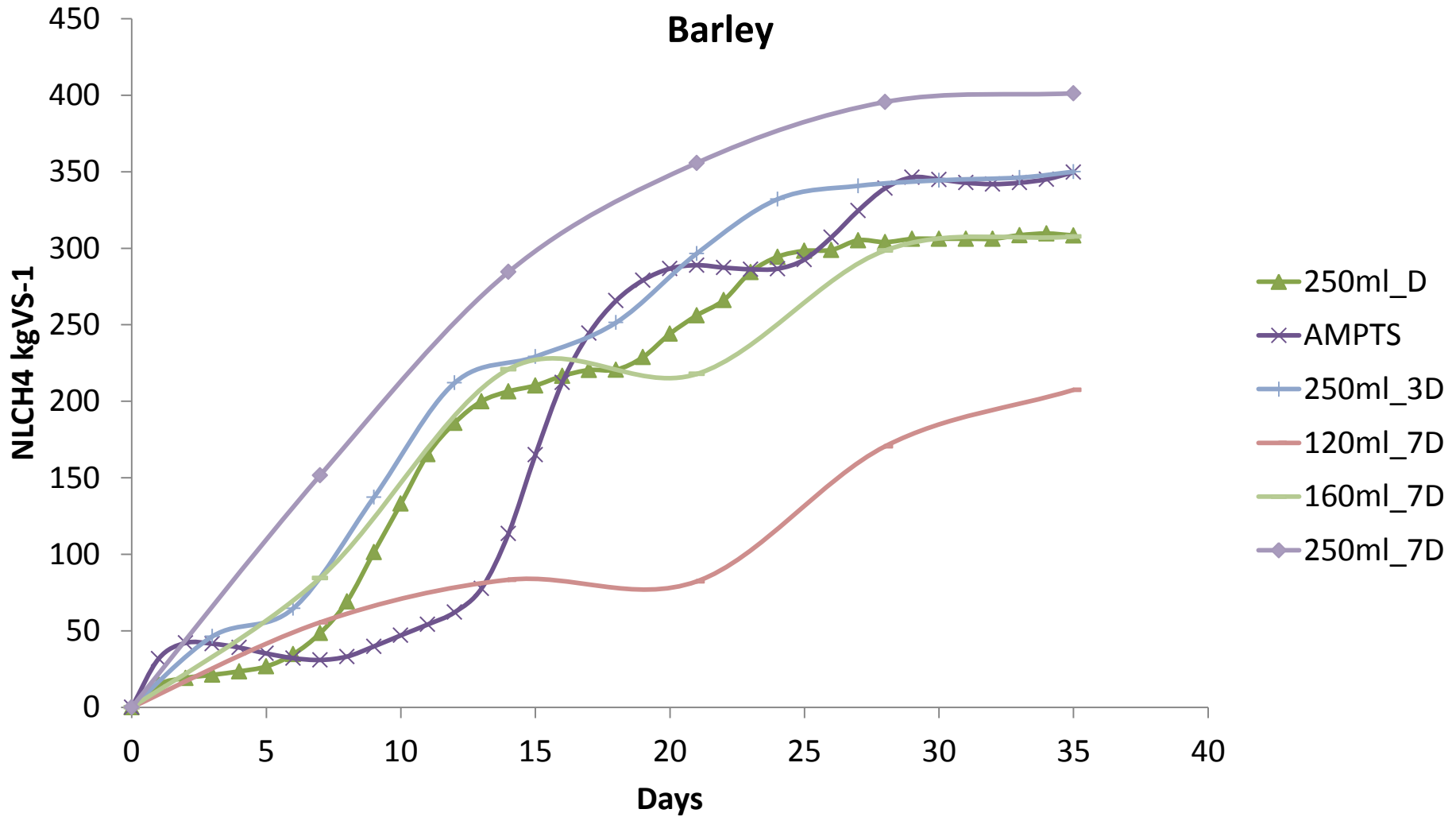
SMY – Grass silage



SMY – Cattle slurry



Kinetics



Conclusion

- Both, bottle volume and OHP measurement frequency have an impact on the SMY
- OHP measurement on every third day, with 250ml bottle has SMY in accordance with AMPTS
- During weekly OHP measurement, 250 ml bottles had maximum SMY for all three substrates
- Frequent sampling e.g. every third day is recommended for kinetics
- If only SMY is required, it is recommended to use a 250 ml bottle with 70 ml total medium volume and an OHP measurement at the end of the BMP test i.e. 35th day.

Questions?





Thanks for listening



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