

Assessing the bio-methane potential (BMP) and concomitant pathogen removal of UDDT faeces with(out) additional organic substrates

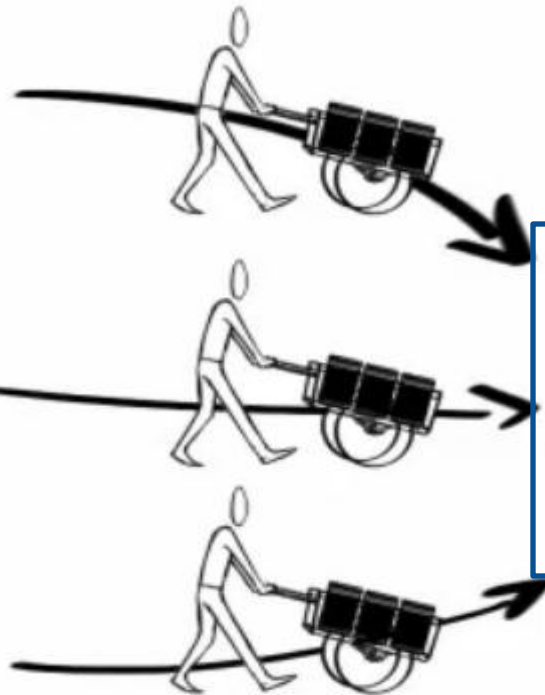
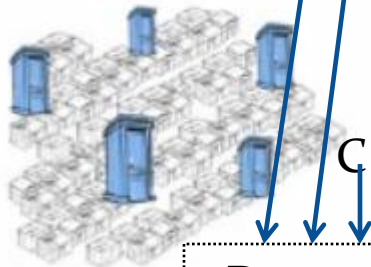
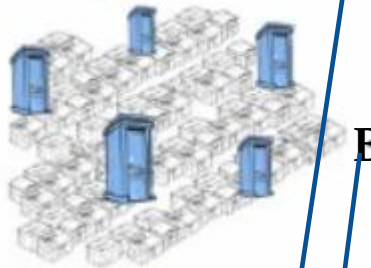
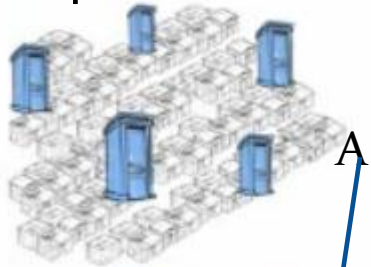
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Problem definition

Informal slum settlements sanitation improvement

Low cost transportation

SANERGY: Central collection and treatment site

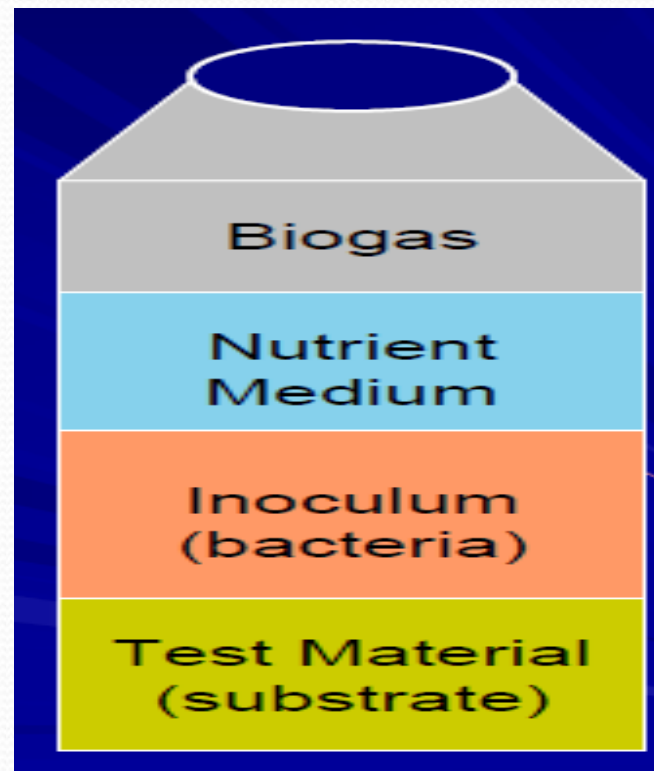


-617 toilets
-Every day, appr. 7 tones waste. 3.5 → UDDT faeces, 3 → urine

Decentralized collection points

-Treatment???

Biochemical methane potential (BMP) test



Objectives....

- Single substrate digestion of
 - F = UDDT faeces,
 - W = whey
 - MFW = food waste
 - MVW = vegetable waste
- Co-digestion of F and MVW
- Pathogen removal in digestion of organic waste
- VFA effect on pH and Ecoli

Waste substrates...

➤ Waste collection

- UDDT feaces
- Organic waste substrates
- Inoculum

Test procedure

- 100 ml serum bottles
- I:S ratio=2:1
- Nutrients
- Add water to working volume of 80 ml
- pH = 7
- Add buffer
- Close serum bottle
- Bubble argon gas
- Incubate at 35 degrees
- Shake manually every 4hrs
- Blank sample

Conducting tests:

- Each test conducted in three batches
- Each batch done in triplicates

Measurements

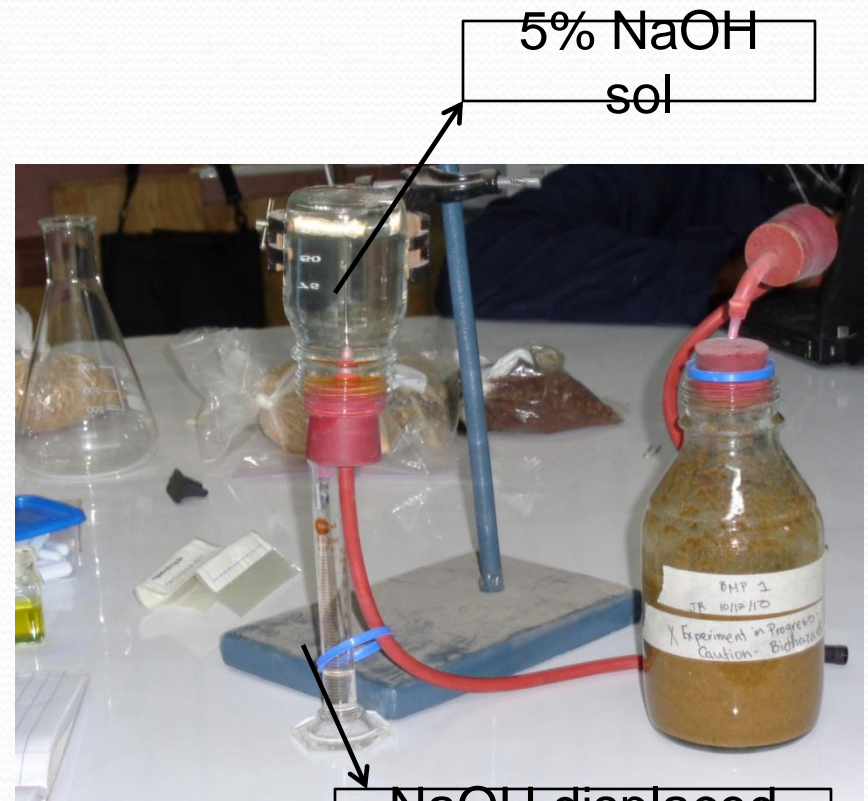
Biogas measurement, by measuring ΔP



Obeys eq. of state of ideal gas

$$V_{\text{Biogas}} = \frac{\Delta P \cdot V_h \cdot V_{\text{mol}}}{R \cdot T}$$

Measurement CO₂ content



NaOH displaced by methane gas



Ecoli enumeration



VFA measurement setup

Other parameters

- VS, TS (APHA, 1998)
- pH meter calibrated with soln's at pH4, 7

Results

Characterization of material used batch experiments

Substrate type	% TS (w/w)	%VS (w/w)	SMA (g COD-CH ₄ /gVSS/day)	pH	% VS/TS
Inoculum (I)	14.0±0.4%	10.7±0.4%	0.13±0.01	7.5±0.2	76
F	19.2±0.8%	17.1±1.0%		7.0±0.03	89
MFW	19.7±1.2%	15.9±3.6%		4.5±0.1	80
MVW	8.5±0.8%	7.5±0.7%		6.7±0.1	88
W	7.2±1.0%	5.4±0.6%		4.5±0.02	75

Single substrate digestion

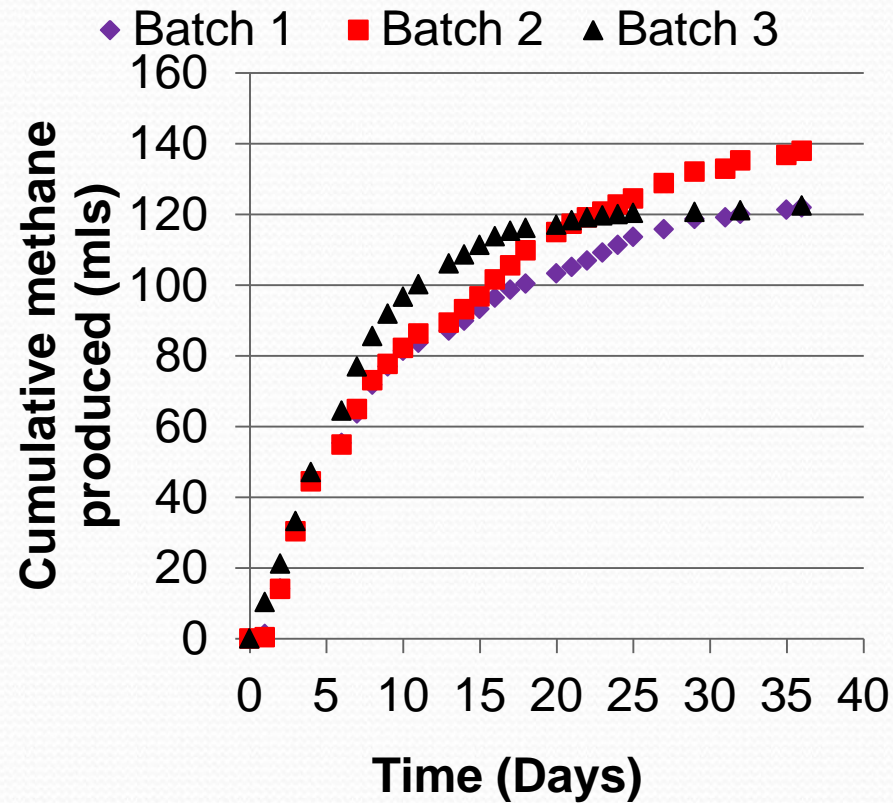


Figure 1: Cumulative methane produced on **vegetable waste**

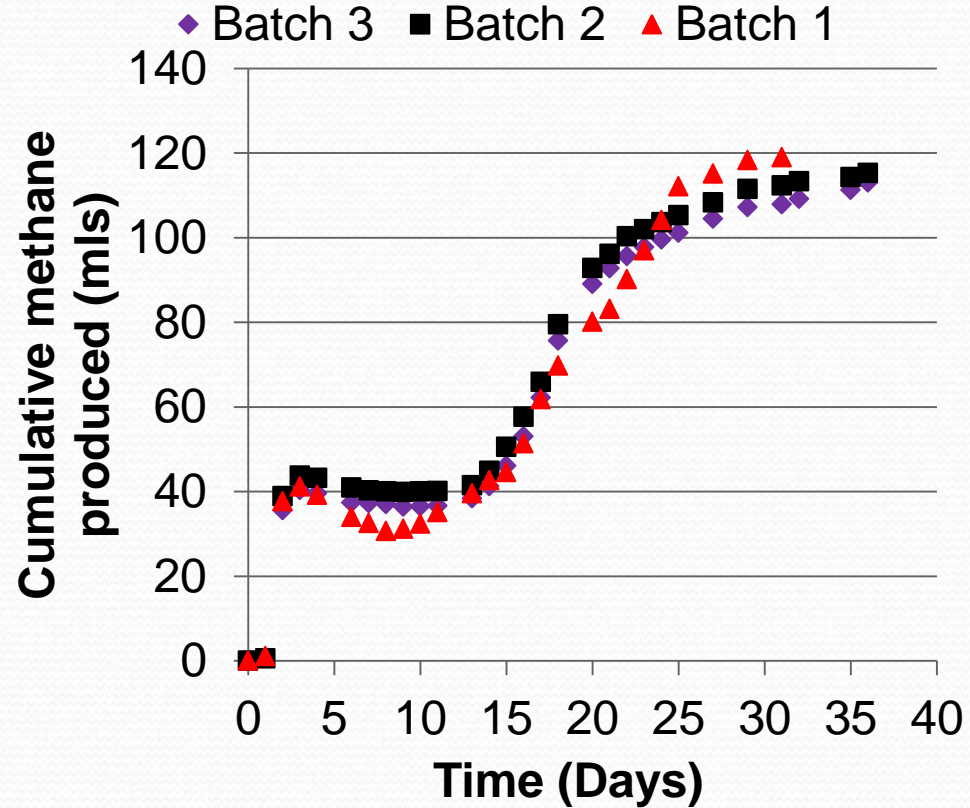


Figure 2: Cumulative methane produced on **whey**

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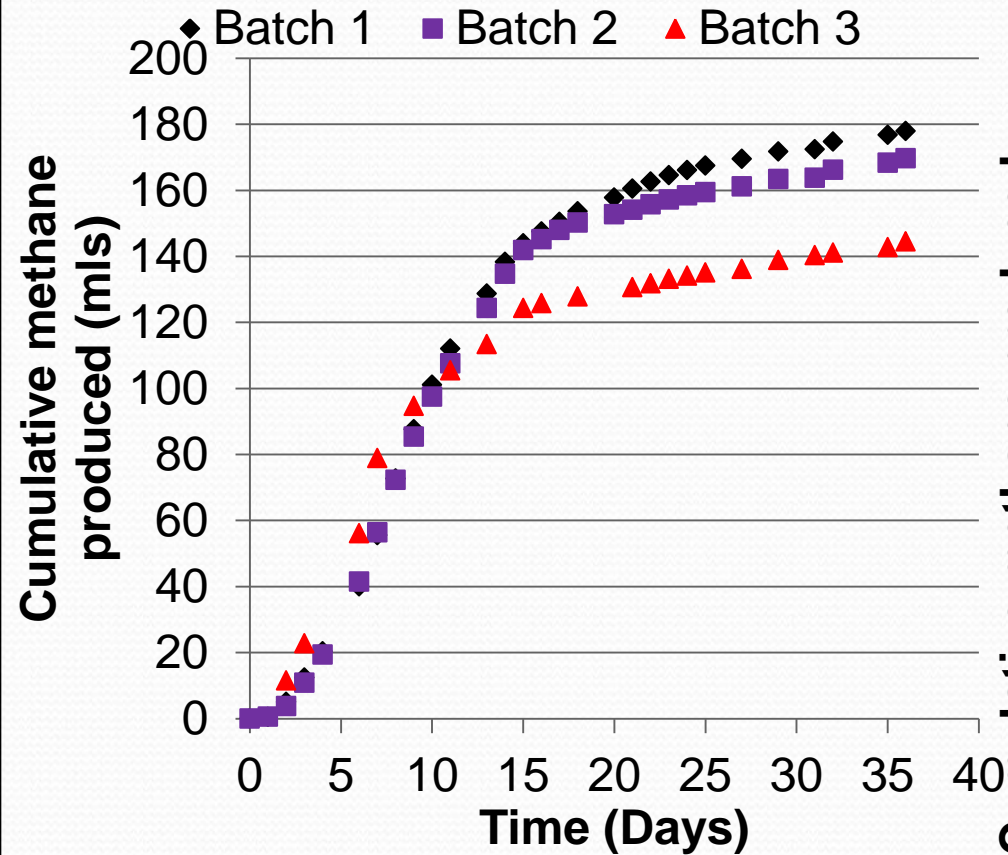


Figure 3: Cumulative methane produced on **UDDT faeces**

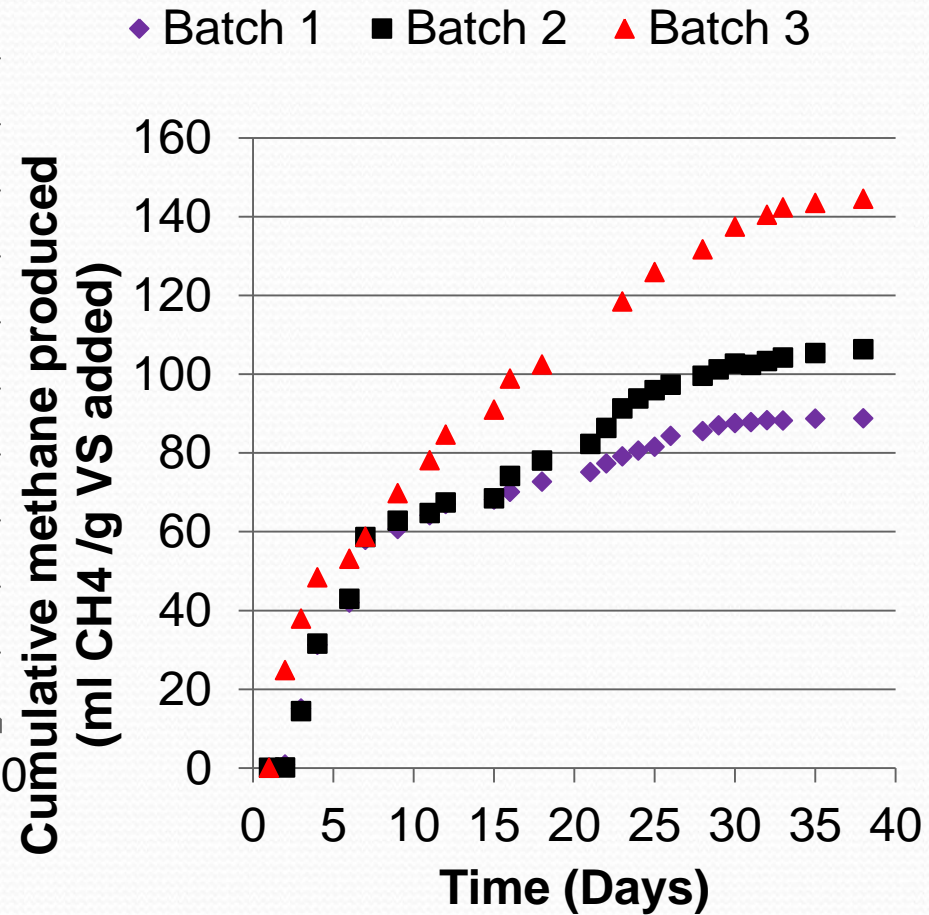


Figure 4: Cumulative methane produced on **Food waste**

Methane production (ml CH₄/g VS added)

Methane %

- MVW= 436±16
- F= 295±20
- W= 260±5
- MFW= 452±83

- MVW= 69%
- F= 78%
- W= 73%,
- MFW= 71%

Co-digestion

Comparison between mix ratios

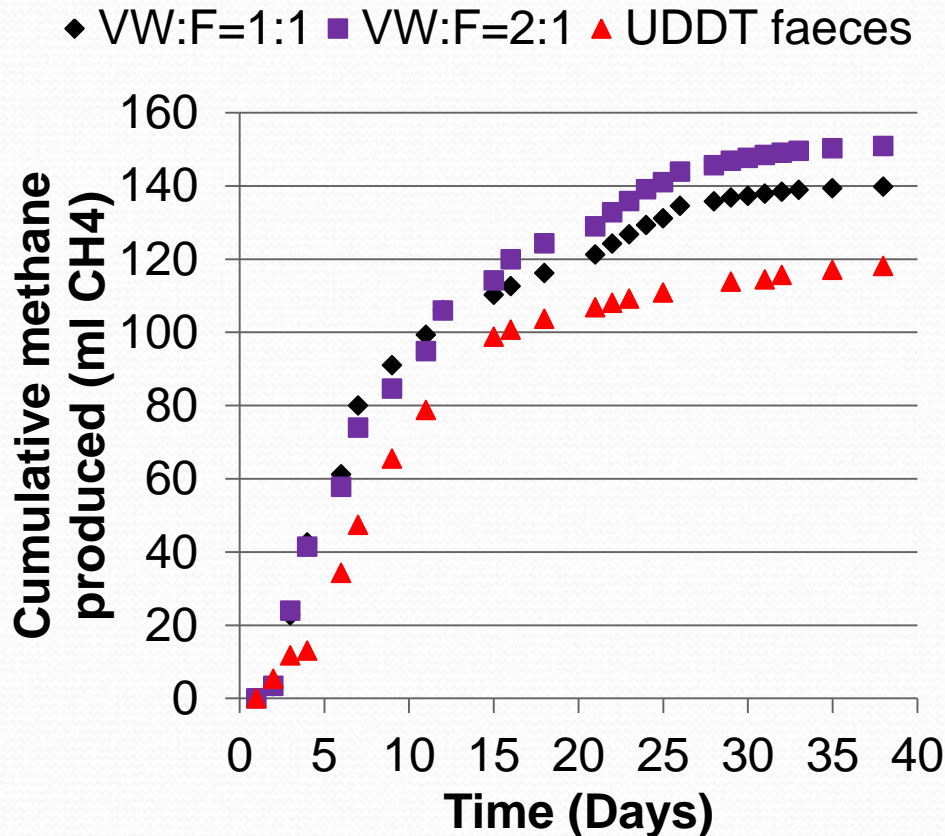


Figure 5: Cumulative average methane produced in co-digestion MVW &F

VFA and its effect and E. Coli

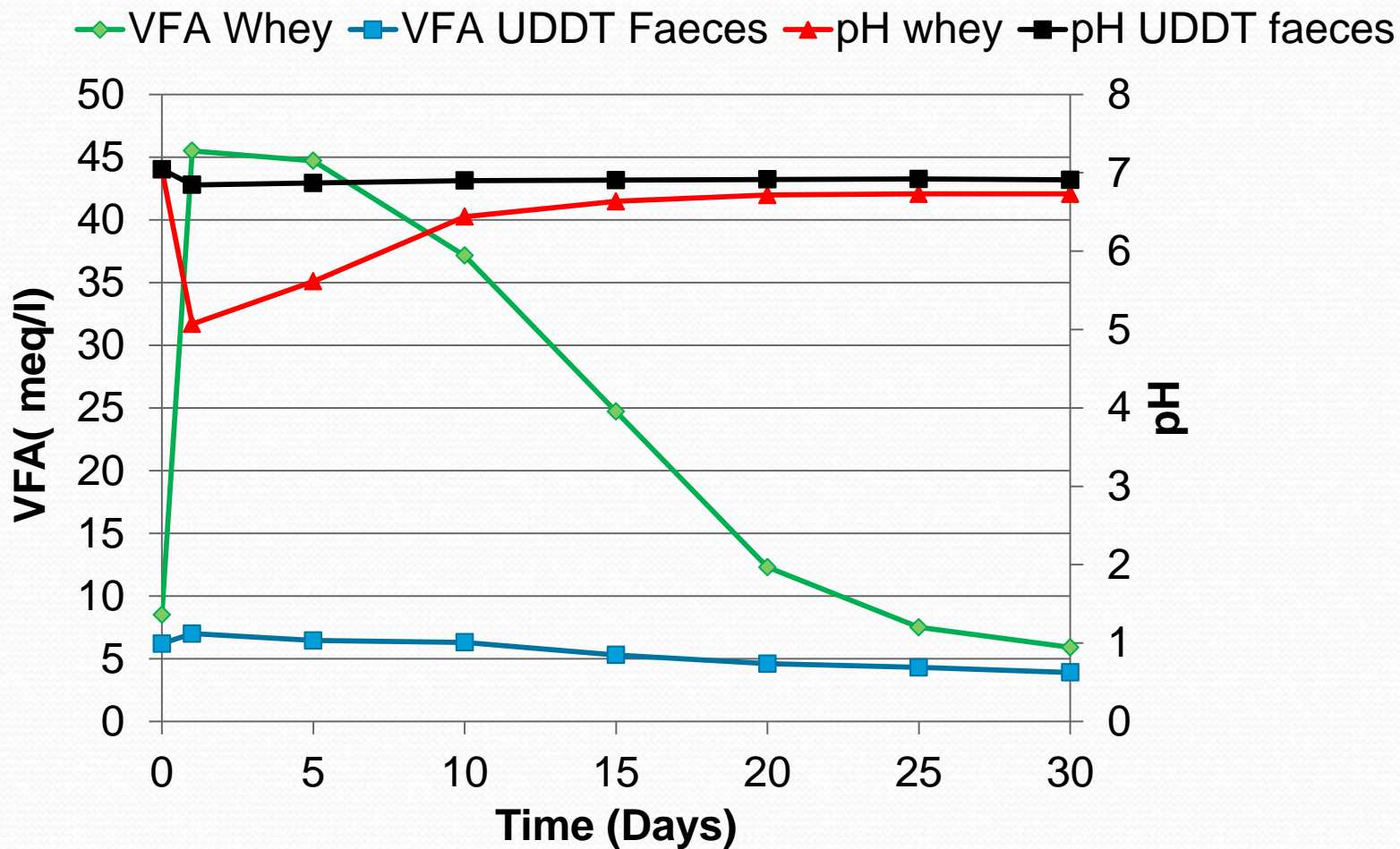


Figure 5: Changes in VFA and pH against time

Cont'd..

Whey

- 1st day-VFA rise:
8.5 - 45.5 meq/l .
- 1st day-pH drop from:
7 - 5.07
- 2nd -10 day-No gas prodn
- Ecoli- Undetectable level day 10. $K=1.32$

Faeces

- 1st day-VFA rise: **6.2 - 7**
- 1st day-pH drop: **7 - 6.8**
- Steady rise in gas prod
- Ecoli-Undetectable level in **30** days, $K=0.5$

Conclusion

- High VFA –precursor to methane production (whey)
- VFA build up in digester- improves sanitization effect
- In co-digestion, the more the MVW fraction, the more the CH₄ produced.
- Possible to (re-)start methane production after inhibition by low pH.
- 30 days required for E. Coli removal in UDDT faeces at 35 degrees.



Thank you!