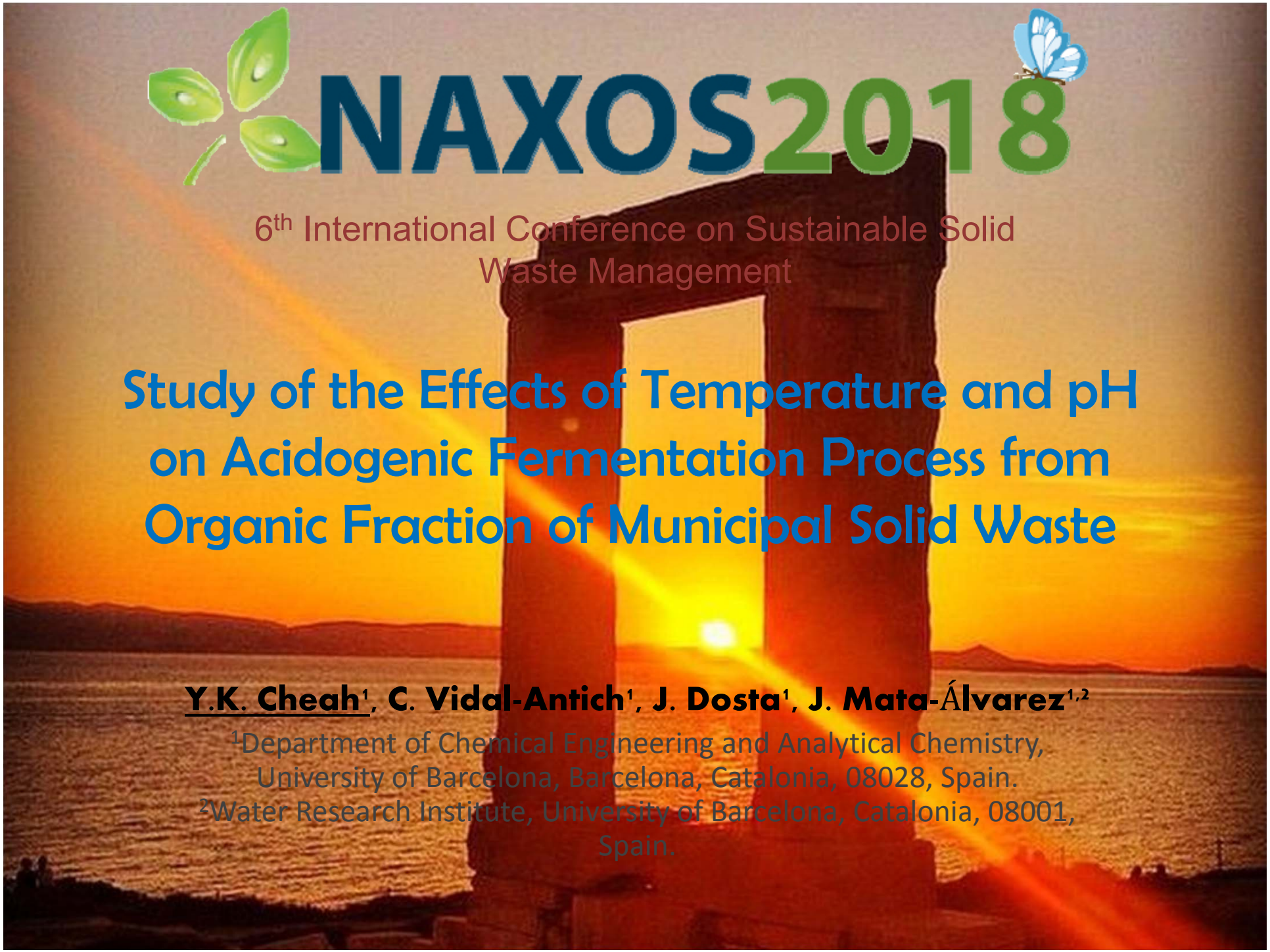
NAXOS2018
6th International Conference on Sustainable Solid Waste Management
Study of the Effects of Temperature and pH on Acidogenic Fermentation Process from Organic Fraction of Municipal Solid Waste
Y.K. Cheah[1], C. Vidal-Antich[1], J. Dosta[1], J. Mata-Álvarez[1,2]
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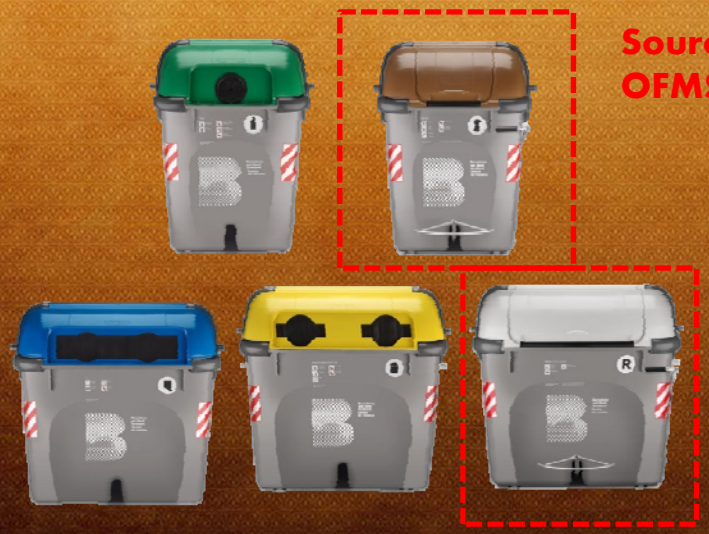
Contents

Waste to resource

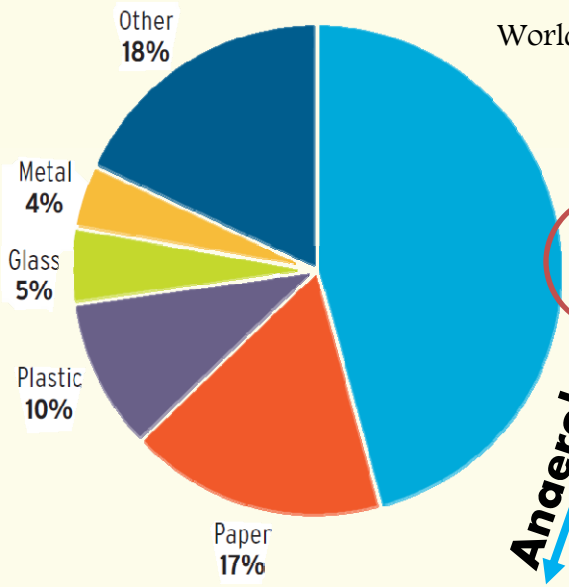


Source sorted OFMSW

Mechanically sorted OFMSW

VFA

OFMSW



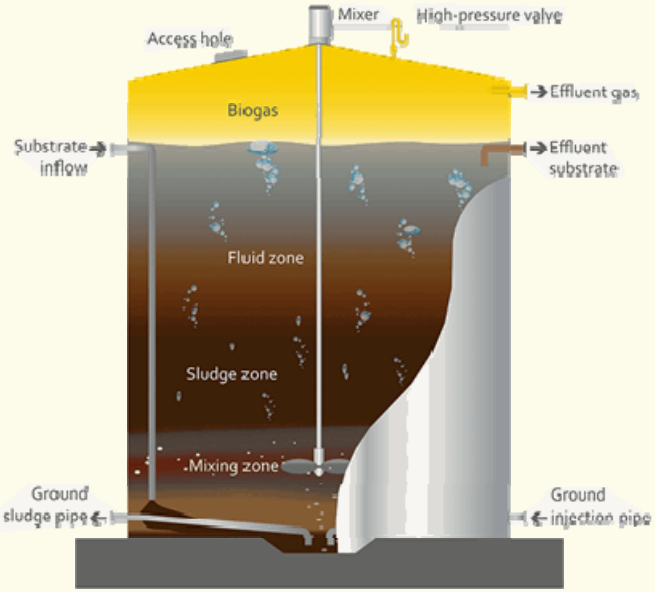
World Bank, 2012

Landfill

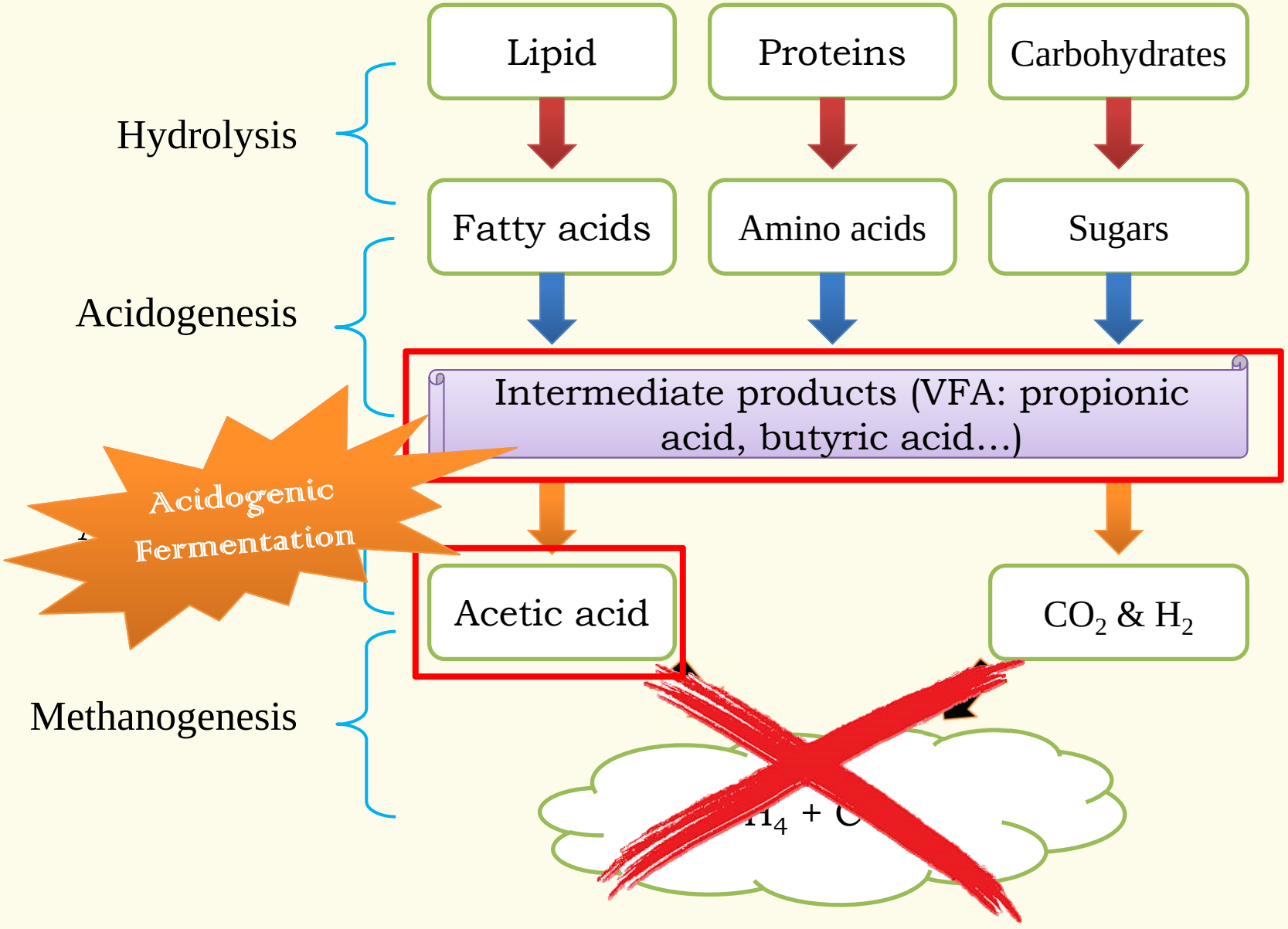
Incineration

Anaerobic Digestion

Composting



Anaerobic Digestion



Research goals

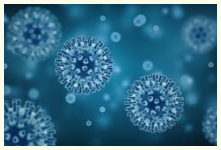
- To evaluate the VFA production in acidogenic fermentation of OFMSW by manipulating **pH** and **temperature** conditions which can be performed in continuous reactors.

- To assess the **distribution of individual VFA** (acetic, propionic, butyric and valeric acids) in the effluent which will be used for PHA production.

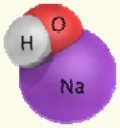
Experimental Set-up

Batch test

OFMSW



Inoculum



Effects of Temperature (A1)

T = 35, 55, 70 ºC
Without pH control
Period = 6 d

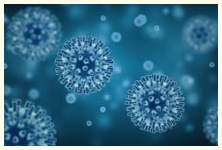
Effects of pH (A2)

T = 70 ºC
pH = 3, 4, 5, 8, 9, 10, 12, without pH control
Period = 6 d

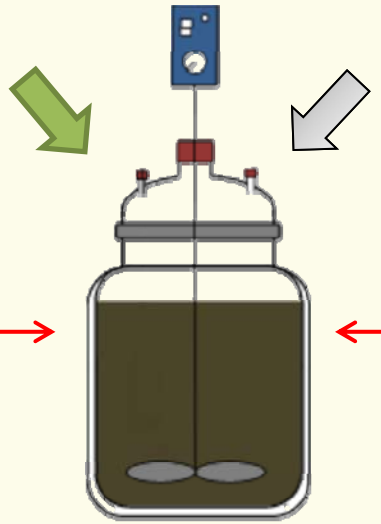
Experimental Set-up

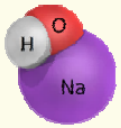
Continuous

OFMSW



Inoculum





Effects of Temperature
B1, B2

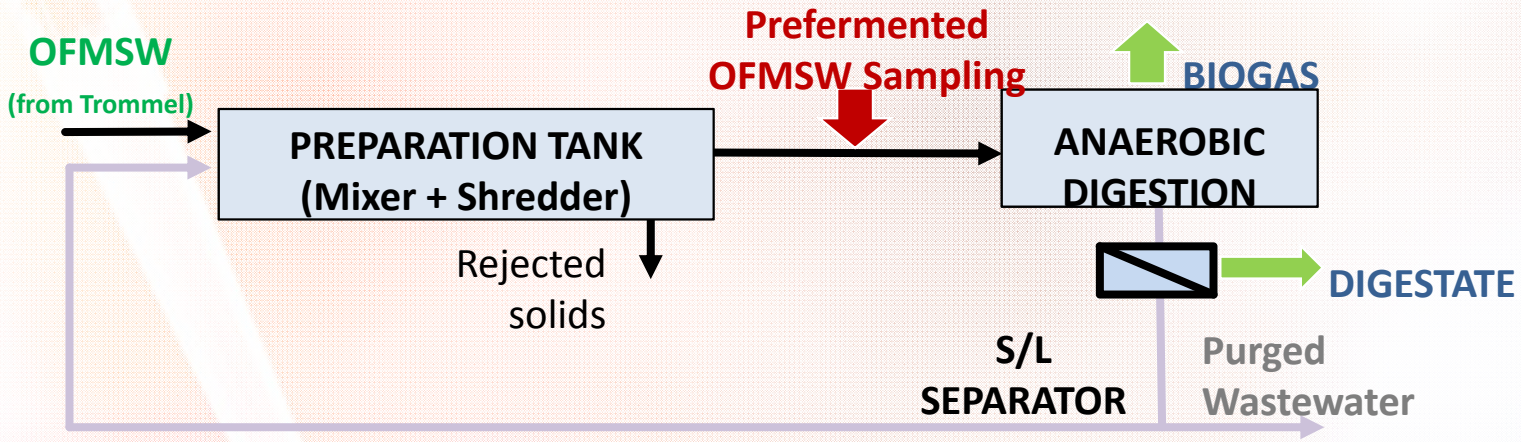
T = 35, 70 ºC
Without pH control
HRT = 3.5 d

Effects of pH
B2, B3, B4

T = 35, 70 ºC
pH = 10, without pH control
HRT = 3.5 d

Characterization

Source sorted OFMSW from a mechanical-biological treatment plant (Ecoparc) of the Barcelona Metropolitan Area

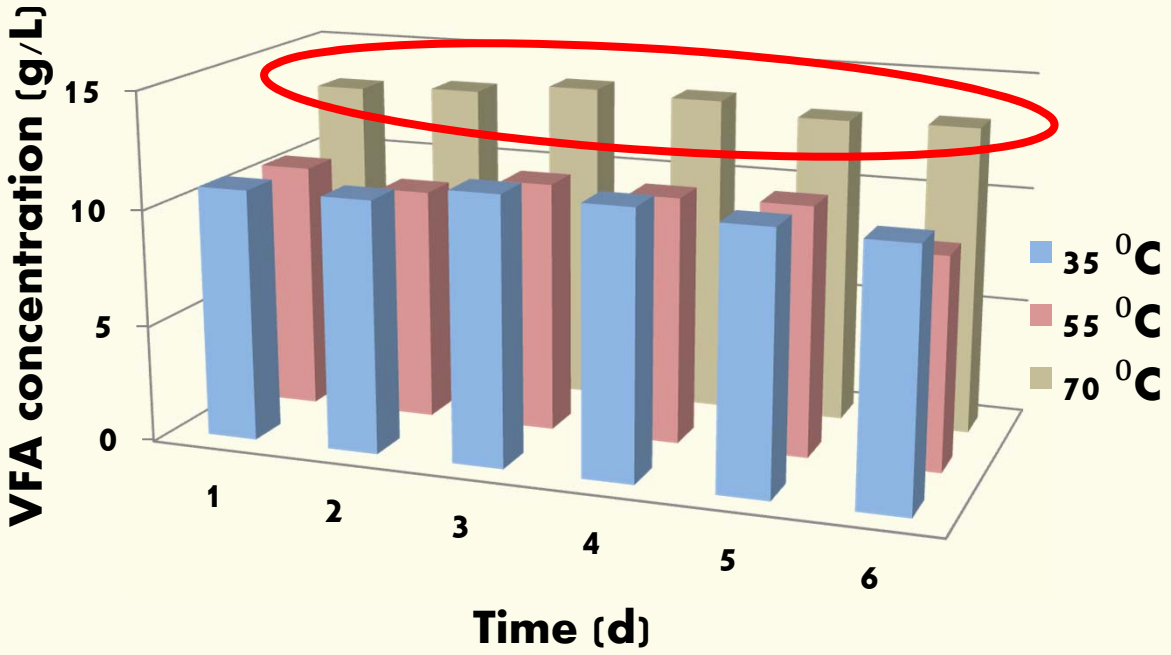


Characterization of OFMSW	Units	Value
Total Solids (TS)	% w/w	6.21 ± 1.29
Volatile Solids (VS)	% w/w	4.76 ± 1.13
Soluble Chemical Oxygen Demand (SCOD)	g/L	72.53 ± 12.98
Volatile Fatty Acids (VFA)	g/L	9.57 ± 1.05
Alkalinity	$gCaCO_3/L$	4.99 ± 0.51
Ammonium-nitrogen concentration	gNH_4^+-N/L	2.84 ± 0.66
pH	-	6.28 ± 0.36

Effects of temperature

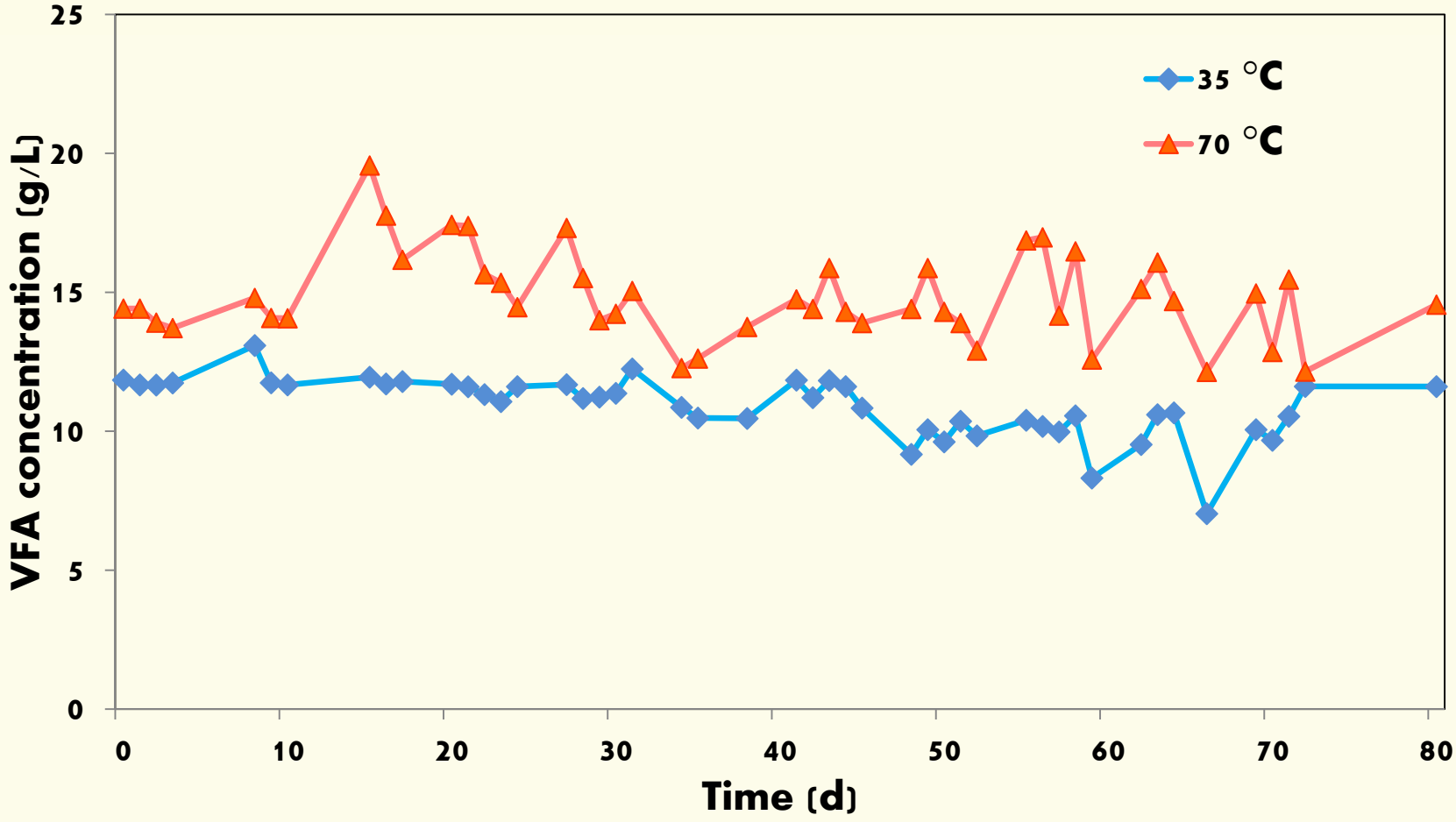
Batch

Temperature	35°C	55°C	70°C
Inoculum	Sludge from acidogenic fermenter at 35 °C	Sludge from acidogenic fermenter at 70 °C	Sludge from acidogenic fermenter at 70 °C
Ratio VS_{feed}/VS_{sludge}	1	1	1
pH control	No	No	No



Effects of temperature

Continuous



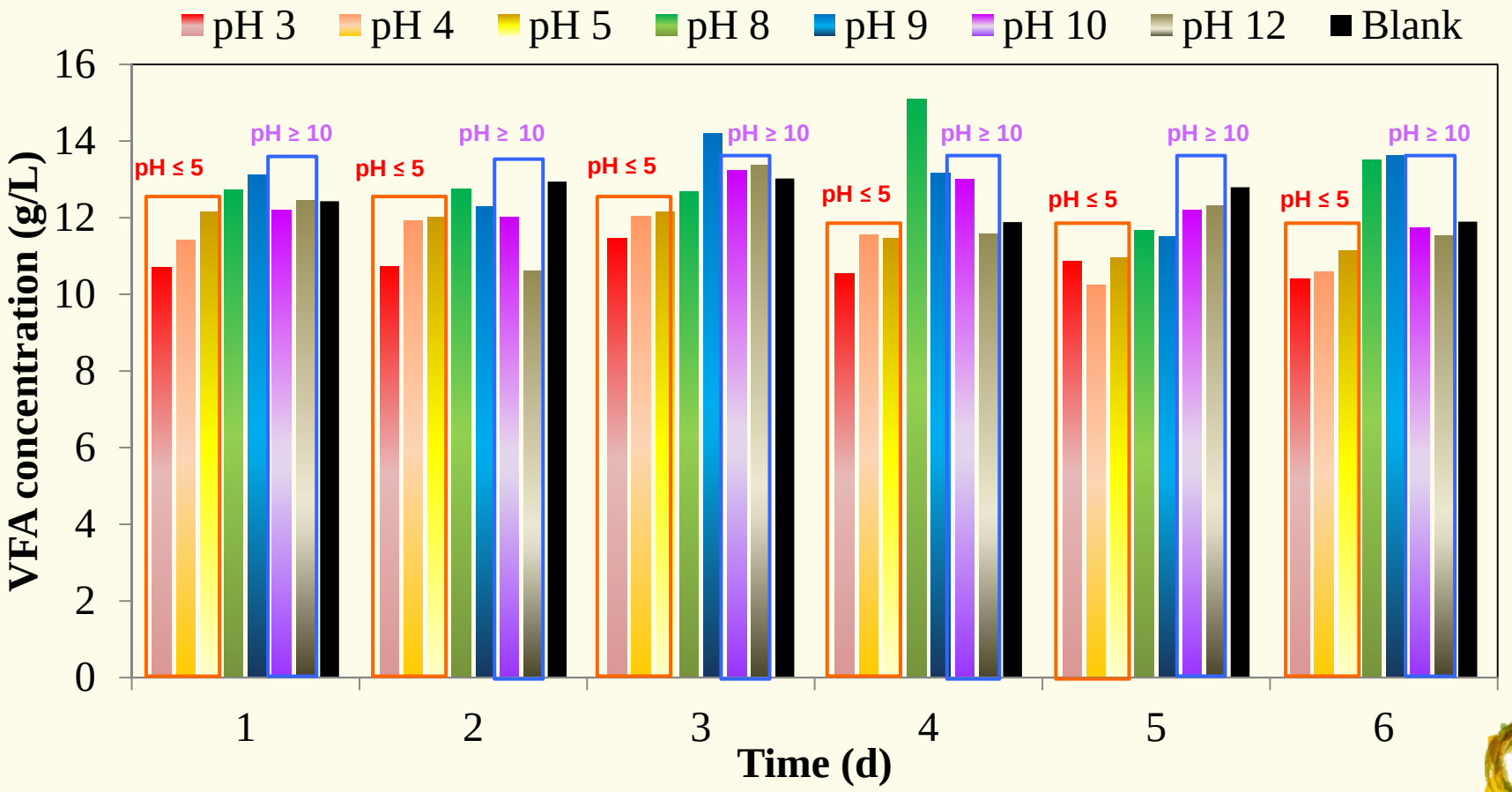
Effects of temperature

Parameters	Units	B1 (35°C, without pH control)	B2 (70°C, without pH control)
Alk	$gCaCO_3/L$	3.01 ± 2.82	7.34 ± 1.42
NH_4^+-N	gNH_4^+-N/L	3.14 ± 0.10	4.83 ± 0.81
Free ammonia	gNH_3-N/L	0.003 ± 0.000	0.07 ± 0.01
pH	-	5.96 ± 0.32	6.17 ± 0.33
sCOD	g/L	76.66 ± 12.48	95.10 ± 16.00
$_{VFA}$COD/sCOD	%	22.59 ± 3.78	21.32 ± 4.22
VFA	g/L	10.91 ± 1.08	14.59 ± 2.54
Acetic	%	38.16 ± 4.21	39.81 ± 2.67
Propionic	%	20.93 ± 1.83	21.65 ± 0.91
Butyric	%	18.67 ± 2.06	19.19 ± 2.52
Valeric	%	10.83 ± 1.27	9.93 ± 0.82
$(C_2+C_4)/(C_3+C_5)$	-	1.76 ± 0.23	1.85 ± 0.09

Effects of pH

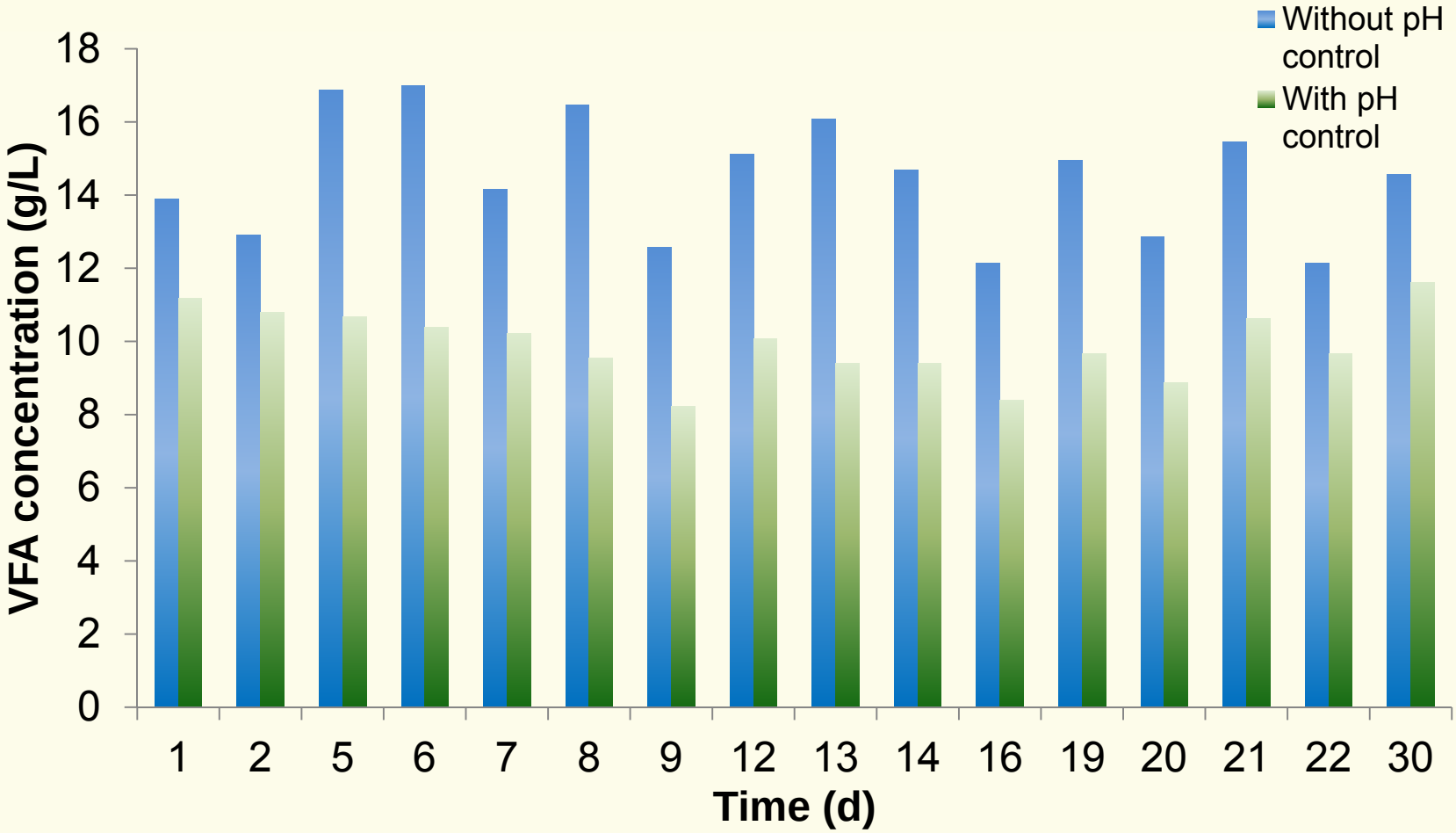
Batch

T = 70 ºC; Experiments were carried out in duplicate
Inoculum: Sludge from B2 (70 ºC without pH control)



Effects of pH

Continuous

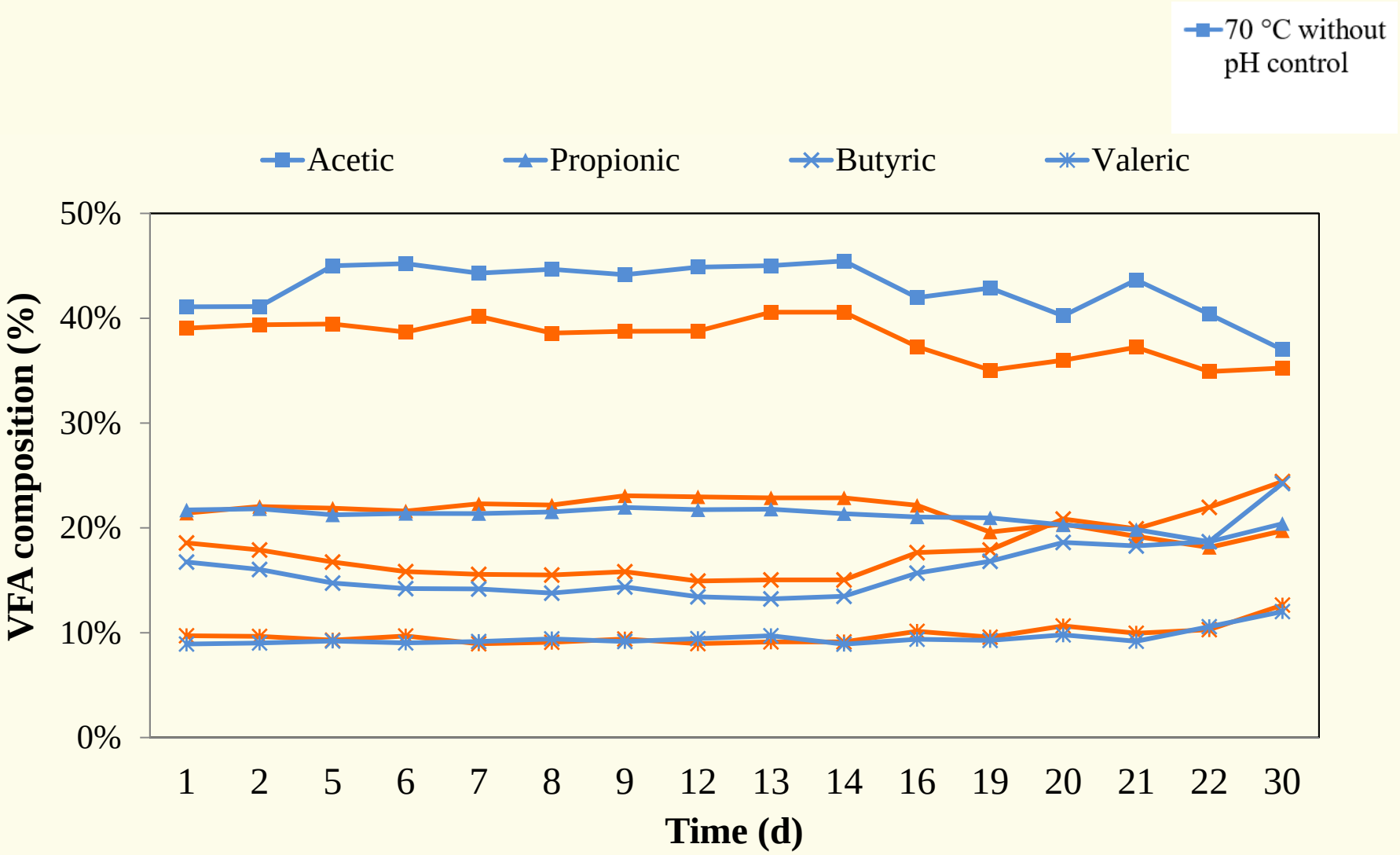


VFA distribution

Parameters	Units	B1 (35 °C, without pH control)	B2 (70 °C, without pH control)	B3* (70 °C, pH=10)	B4 (35 °C, pH=10)
Alk	$gCaCO_3/L$	3.01 ± 2.82	7.34 ± 1.42	9.36 ± 0.30	10.10 ± 0.82
NH_4^+-N	gNH_4^+-N/L	3.14 ± 0.10	4.83 ± 0.81	1.42 ± 0.67	1.97 ± 0.59
Free ammonia	gNH_3-N/L	0.003 ± 0.000	0.07 ± 0.01	1.40 ± 0.66	1.77 ± 0.53
pH	-	5.96 ± 0.32	6.17 ± 0.33	9.95 ± 0.18	9.90 ± 0.16
sCOD	g/L	76.66 ± 12.48	95.1 ± 16.0	84.72 ± 15.41	88.21 ± 21.99
$_{VFA}$COD/sCOD	%	22.59 ± 3.78	21.32 ± 4.22	19.19 ± 5.07	18.05 ± 3.29
VFA	g/L	10.91 ± 1.08	14.59 ± 2.54	9.85 ± 1.04	10.43 ± 1.13
Acetic	%	38.16 ± 4.21	39.81 ± 2.67	38.77 ± 1.61	40.08 ± 4.49
Propionic	%	20.93 ± 1.83	21.65 ± 0.91	22.10 ± 1.26	20.22 ± 2.07
Butyric	%	18.67 ± 2.06	19.19 ± 2.52	16.29 ± 1.89	18.12 ± 3.97
Valeric	%	10.83 ± 1.27	9.93 ± 0.82	9.92 ± 0.96	9.86 ± 1.95
$(C_2+C_4)/(C_3+C_5)$	-	1.76 ± 0.23	1.85 ± 0.09	1.79 ± 0.09	1.93 ± 0.13

*** 30 days of operation**

VFA distribution



Conclusive remarks

- ✓ Collected OFMSW was **prefermented** at pH 6.2 and the distribution of VFA was even suitable for PHA production.
- ✓ Without pH control, the hyperthermophilic range at **70 ºC** is more favourable for maximum VFA production.
- ✓ Generally, the **composition** of individual VFA in all reactors were similar to that of influent (OFMSW from Ecoparc).
- ✓ Fermenters at 35 ºC and 70 ºC working at pH 10 did not produce a higher VFA quantity than the fermenters working at acidic pH, probably due to the **free ammonia inhibition**.
- ✓ Effluents from the fermenters has a proportion $\frac{C_2+C_4}{C_3+C_5} \approx 1.8$; $\frac{COD_{VFA}}{COD_S} \approx$ 18-22 % and high NH_4^+-N ≥ 1.4 g/L.

Acknowledgement

RESources from URban BIo-waSte

Thank you for your attention

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