



HAL
open science

Deciphering the effect of propionic acid on anaerobic digestion of sludge: gas production and microbial community structure

Chloé Soulard, Xiaojun Liu, André Pauss, Laura André, Thierry Ribeiro, Sabrina Guérin-Rechdaoui, Vincent Rocher, Carlyne Lacroix, Chrystelle Bureau, Cédric Midoux, et al.

► To cite this version:

Chloé Soulard, Xiaojun Liu, André Pauss, Laura André, Thierry Ribeiro, et al.. Deciphering the effect of propionic acid on anaerobic digestion of sludge: gas production and microbial community structure. 18th IWA World Conference On Anaerobic Digestion, Jun 2024, Istanbul, Turkey. , 18th IWA World Conference on Anaerobic Digestion CONFERENCE PROCEEDINGS, 2024. hal-04647849

HAL Id: hal-04647849

<https://hal.science/hal-04647849v1>

Submitted on 15 Jul 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Deciphering the effect of propionic acid on anaerobic digestion of sludge: gas production and microbial community structure

Cholé Soulard¹, Xiaojun Liu², André Pauss², Laura André³, Thierry Ribeiro³, Sabrina Guérin⁴, Vincent Rocher⁴, Carlyne Lacroix⁴, Chrystelle Bureau⁵, Cédric Midoux⁵, Oliver Chapleur⁵, Ariane Bize⁵, Céline Roose-Amsaleg^{1,*}

¹ CNRS, ECOBIO-UMR 6553, Université Rennes 1, 35000 Rennes, France

² Université de technologie de Compiègne, ESCOM, TIMR, CS 60319, 60203 Compiègne Cedex, France

³ Institut Polytechnique UniLaSalle, Université d'Artois, ULR 7519, 60026 Beauvais, France

⁴ Direction Innovation SIAAP – Service public pour l'assainissement francilien, 92700 Colombes, France

⁵ Université Paris-Saclay, INRAE, PROSE, 92160, Antony, France

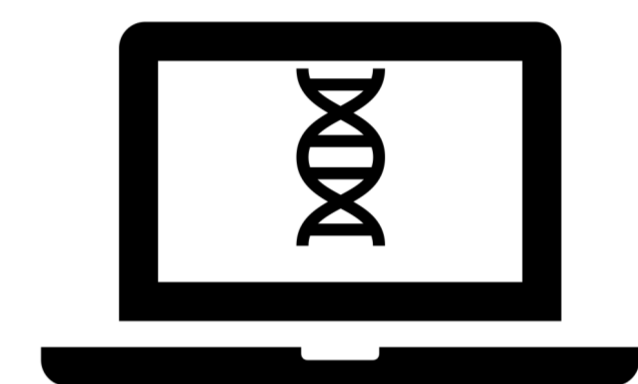
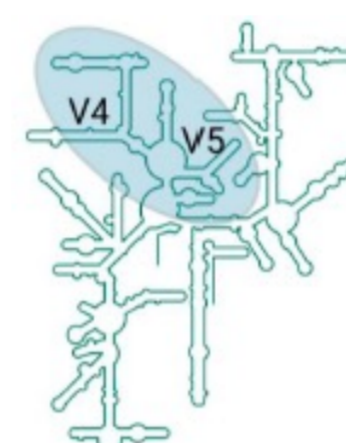
CONTEXT

- Anaerobic digestion (AD) is a promising way for the volume reduction and the energy valorization of **sewage sludge**
- During AD, the organic monomers are converted into **volatile fatty acids (VFA)** like acetic, propionic, butyric and valeric acids
- The **VFA accumulation** in reactors, especially for **propionic acid**, could **inhibit AD process** and lead to reduced biogas production
- The **inhibition induced by the molecules of propionic acid (HPro) and by pH reduction** in the reactor should be dissociated
- Research is needed to understand this inhibition and **identify the microbial biomarkers** predicting the potential reactor failure

OBJECTIVE:

To assess the impact of propionic acid (and its dissociated form, propionate in AD conditions) on biogas production and on microbial community shift in order to identify potential microbial biomarkers

MATERIALS AND METHODS



Biochemical methane potential (BMP) test using AMPTS II

Amendment at the beginning of the incubation:

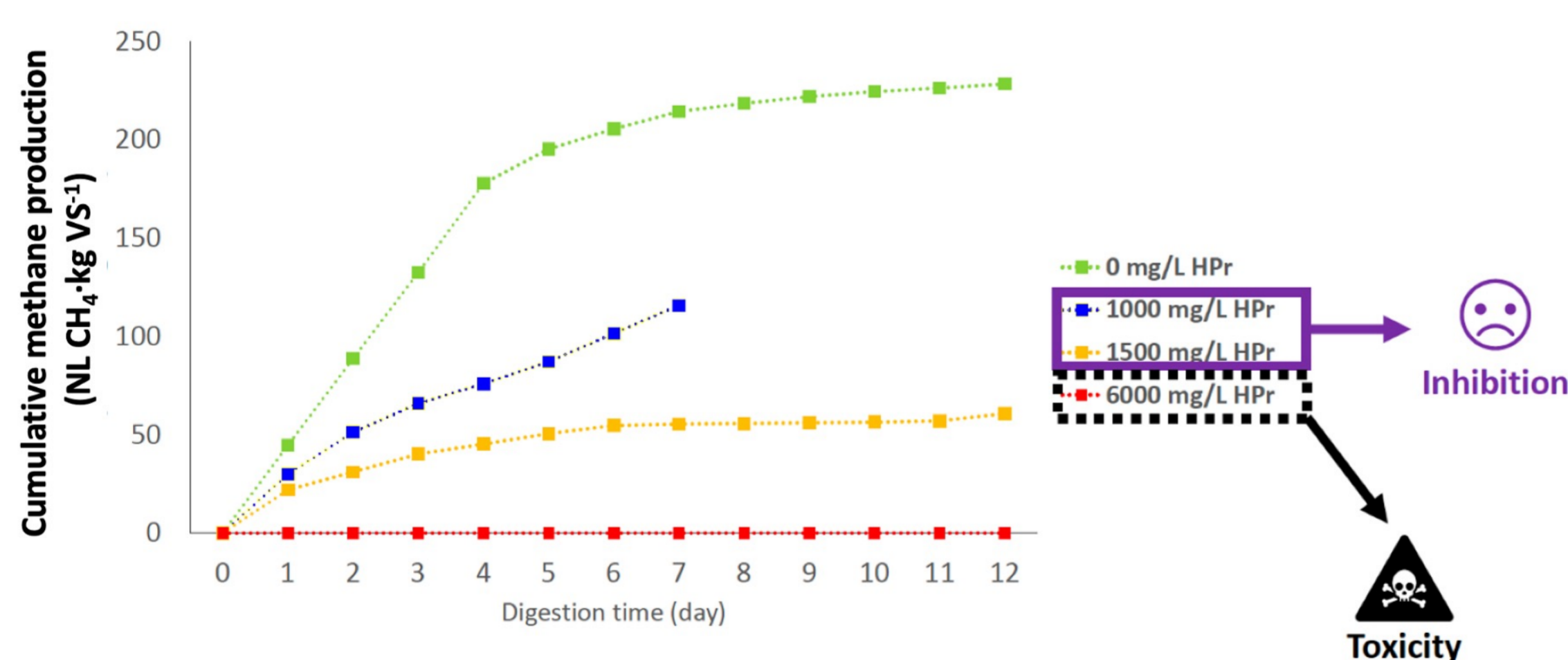
- Propionic acid (HPro)
- Sodium propionate (NaPro)
- Equivalent pH by adding HCl
- Equivalent Na⁺ and Cl⁻ concentration by adding NaCl

Microbial diversity analysis

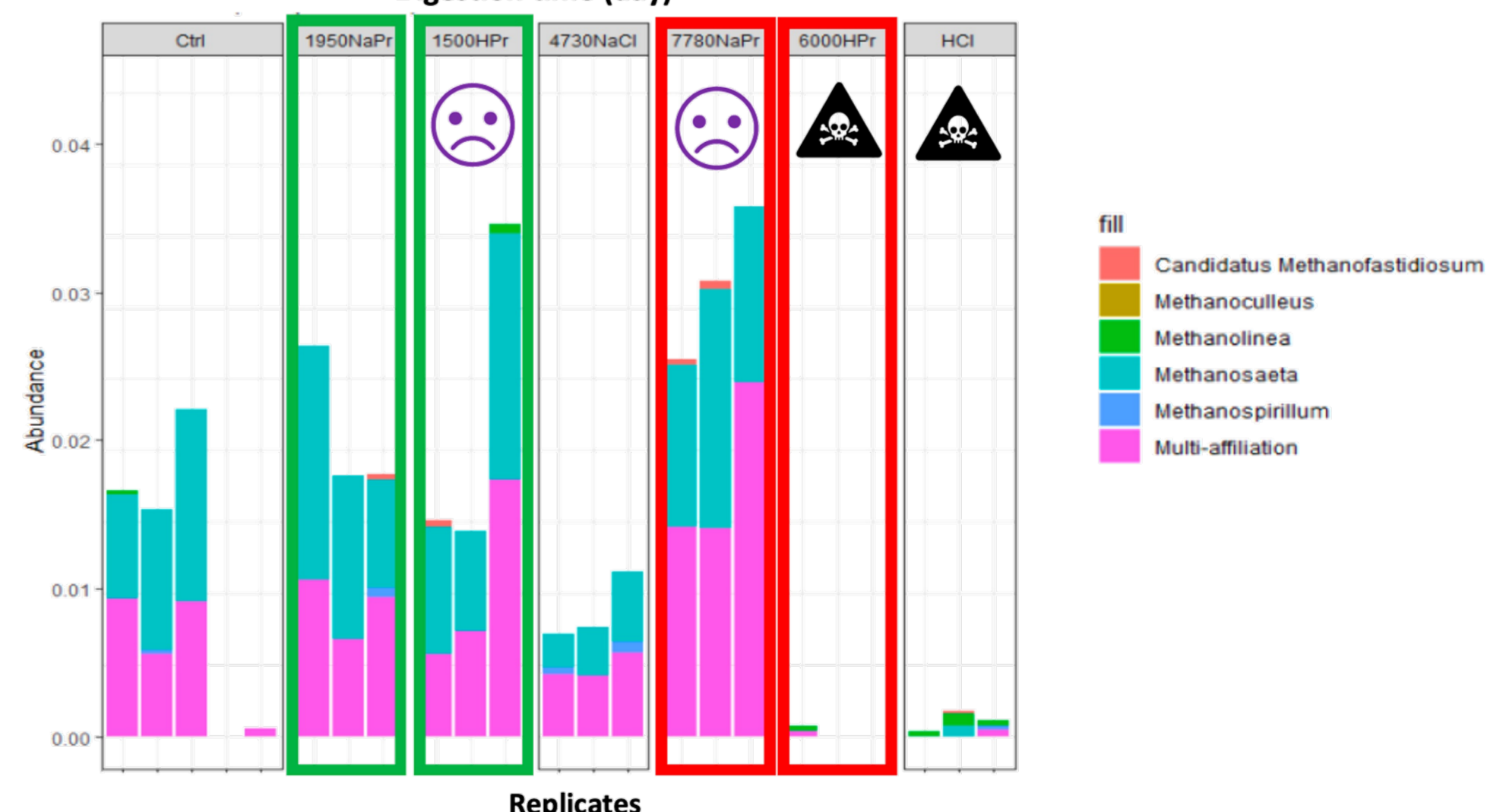
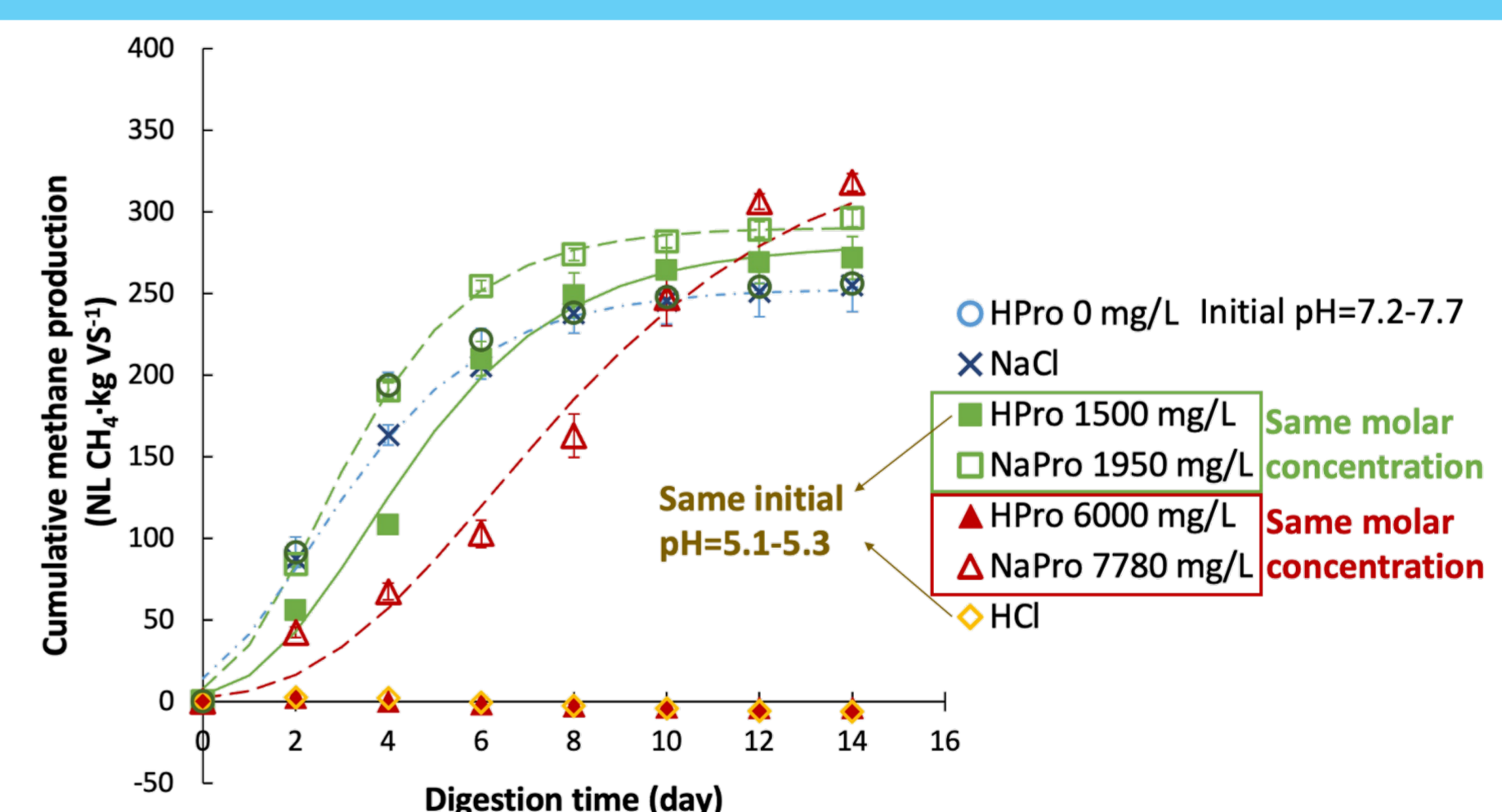
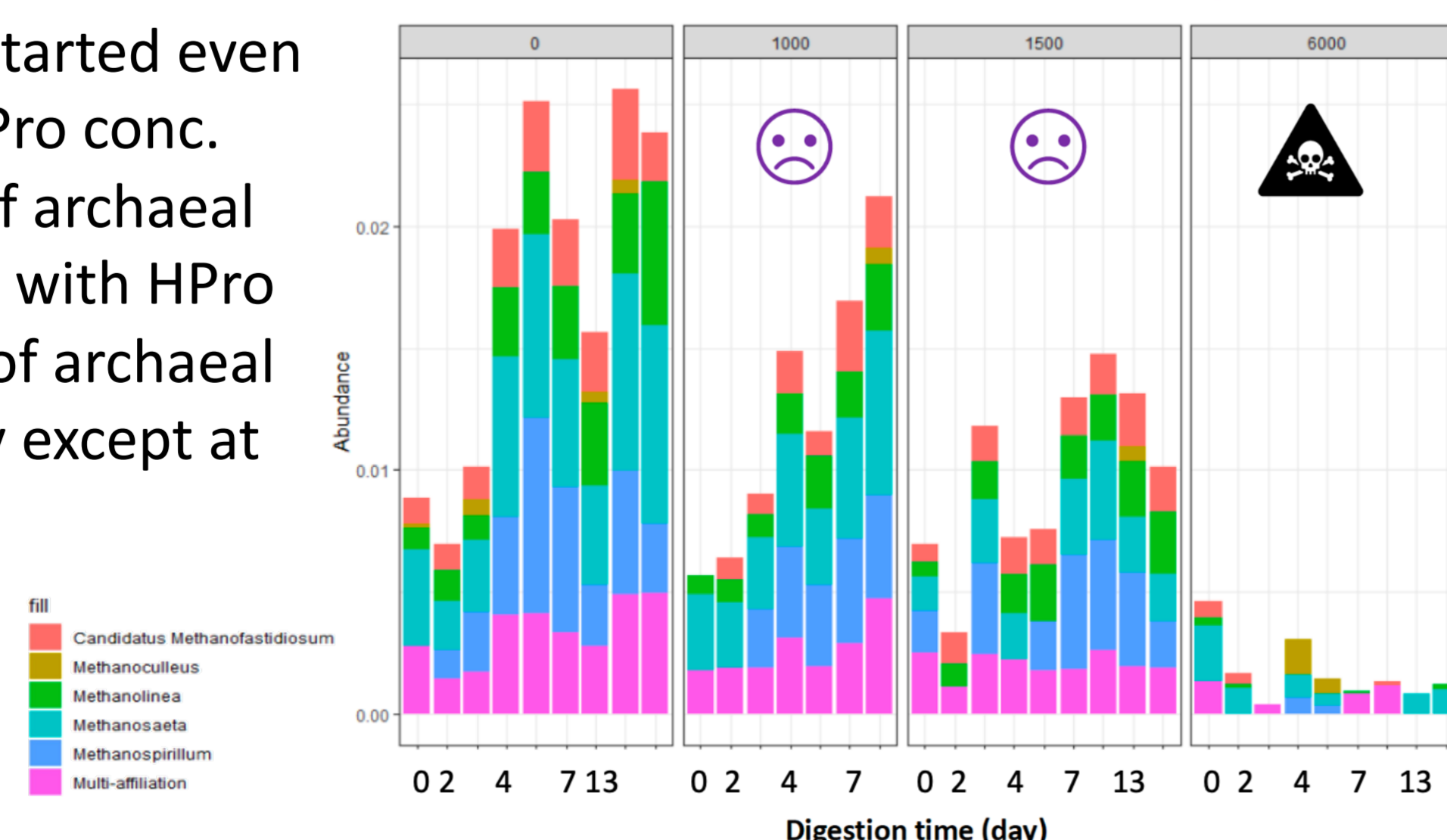
Sacrifice of reactors for microbial community analysis to identify biomarkers

- DNA extraction (NucleoBond® RNA Soil kit and DNA co-elution set)
- PCR of V4-V5 regions of the 16S rRNA gene of bacteria and archaea
- Sequencing with Ion torrent PGM technology (Life Technologies, US)
- V4 regions reads analysis with Galaxy platform on the "INRAE Migale11 bioinformatics platform servers", using the FROGS pipeline

RESULTS



- Inhibition started even at lower HPro conc.
- Decrease of archaeal abundance with HPro
- Resilience of archaeal community except at 6 g HPro/L



- No CH₄ production with 6 g HPro/L and with HCl at eq. pH
- Slight inhibition for eq. concentration in NaPro (7.78 g/L)
- No inhibition at 1.95 g/L NaPro
- Resilience of archaeal community with NaPro up to 7.78 g/L

CONCLUSIONS

- Inhibition is likely due to the pH decrease caused by the dissociation of the propionic acid
- Reactors could tolerate high NaPro concentrations up to 6 g/L
- Further validation on larger scale and in continuous feeding mode should be performed
- Further biostatistics should be realized to identify potential biomarker

ACKNOWLEDGEMENT

Thanks to program MOCOPÉE for funding this work.
For more information <https://inneauvation.fr/>

celine.amsaleg@univ-rennes1.fr