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

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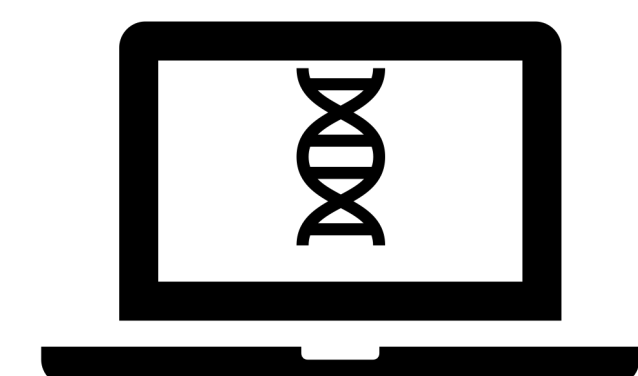
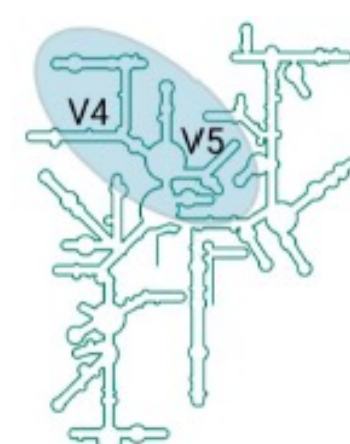
## CONTEXT

- 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:

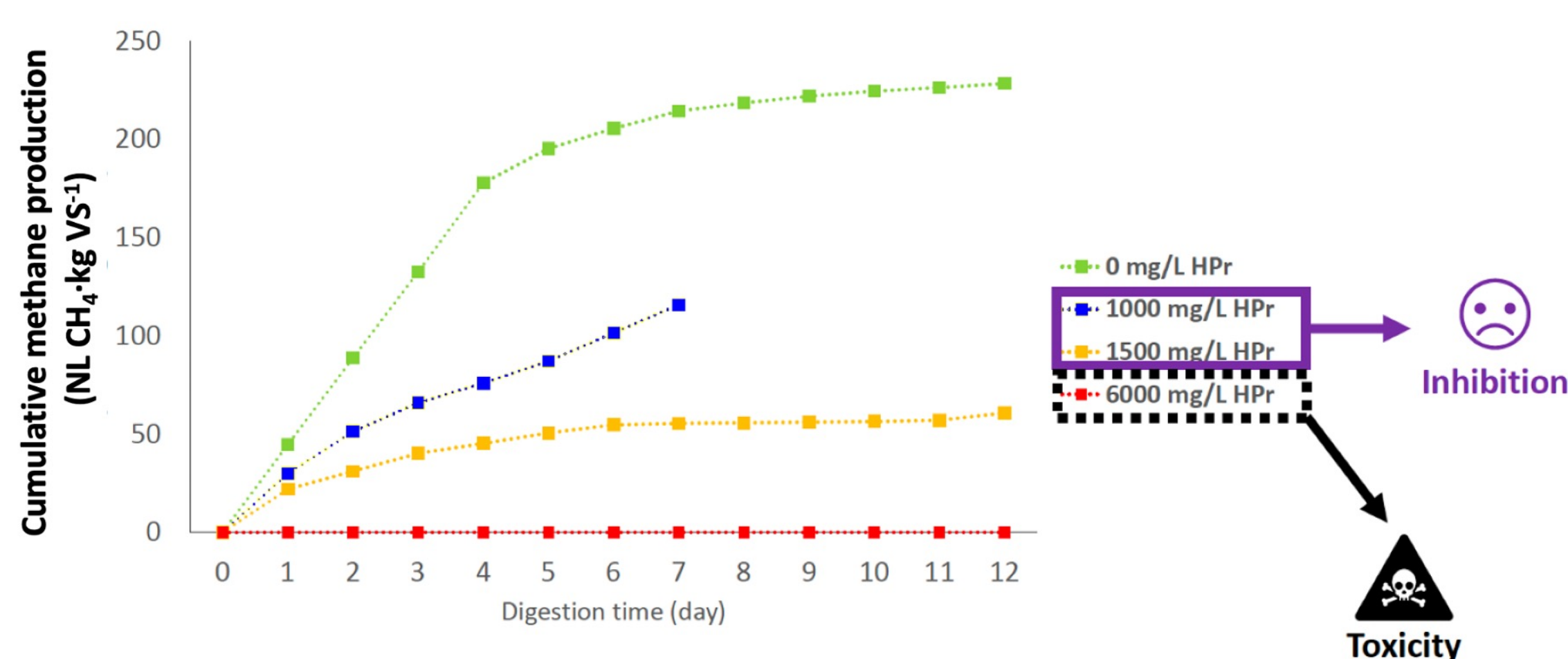
- Propionic acid (HPro)
- Sodium propionate (NaPro)
- Equivalent pH by adding HCl
- Equivalent Na<sup>+</sup> and Cl<sup>-</sup> concentration by adding NaCl

### Microbial diversity analysis

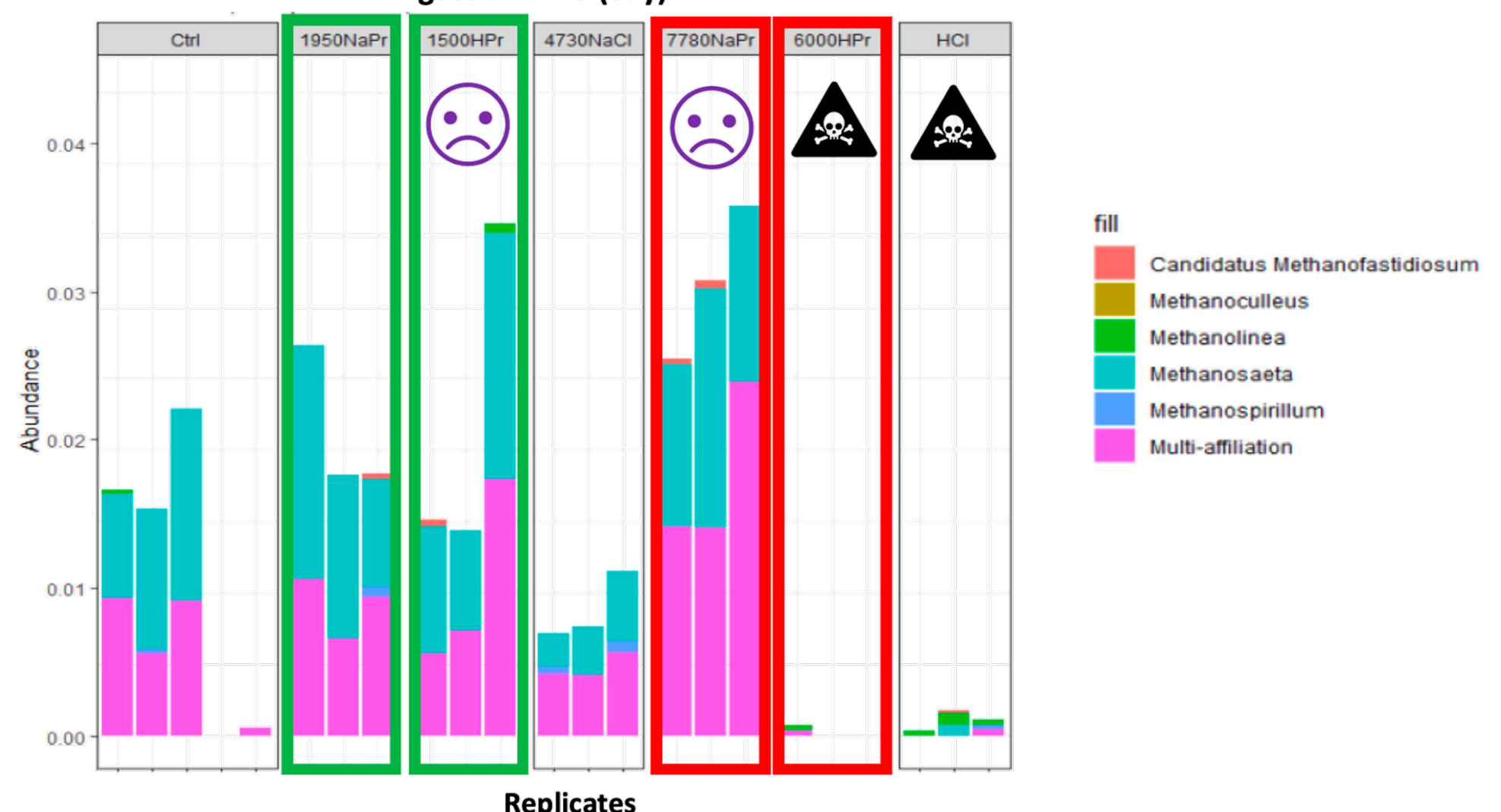
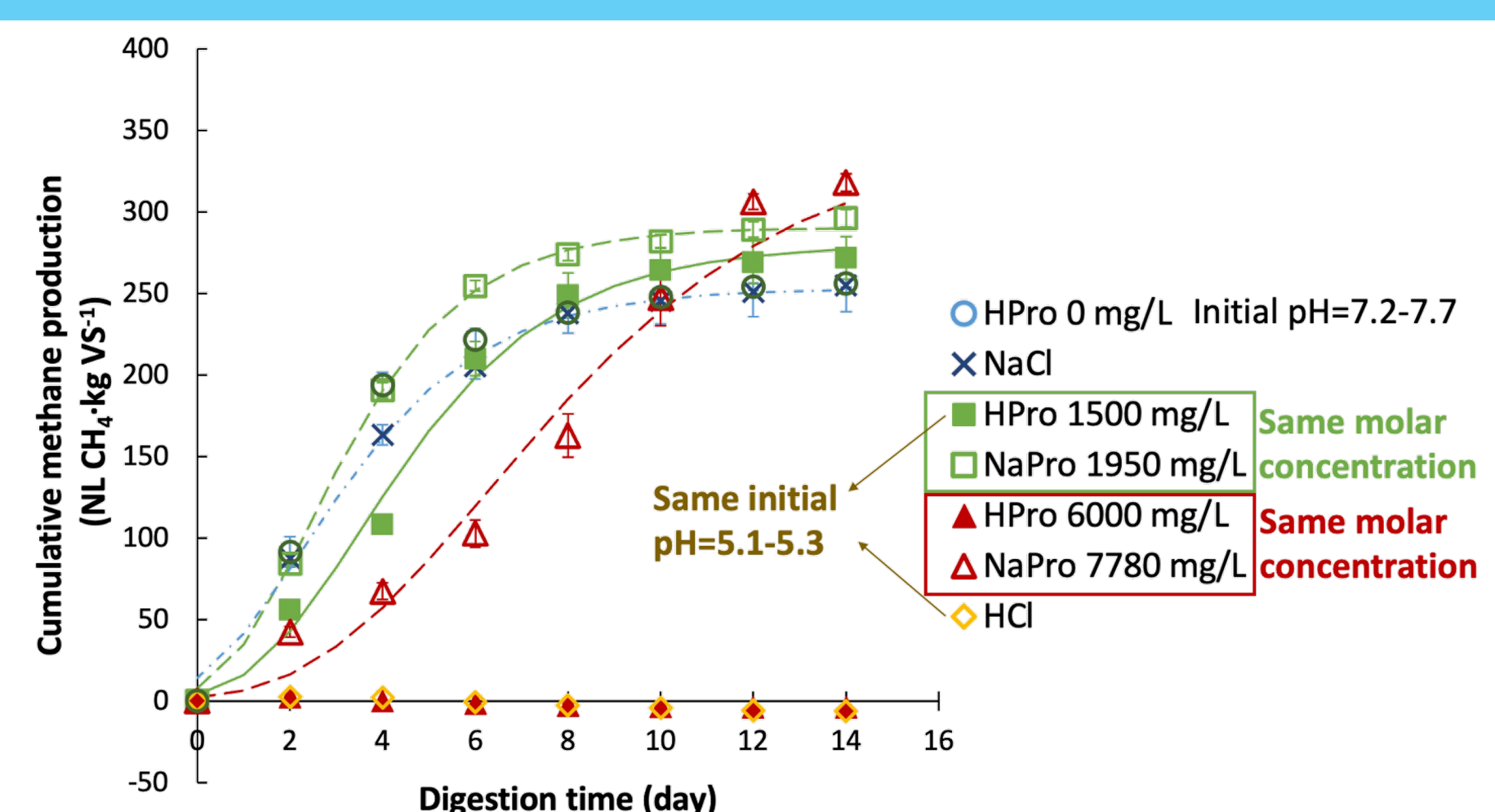
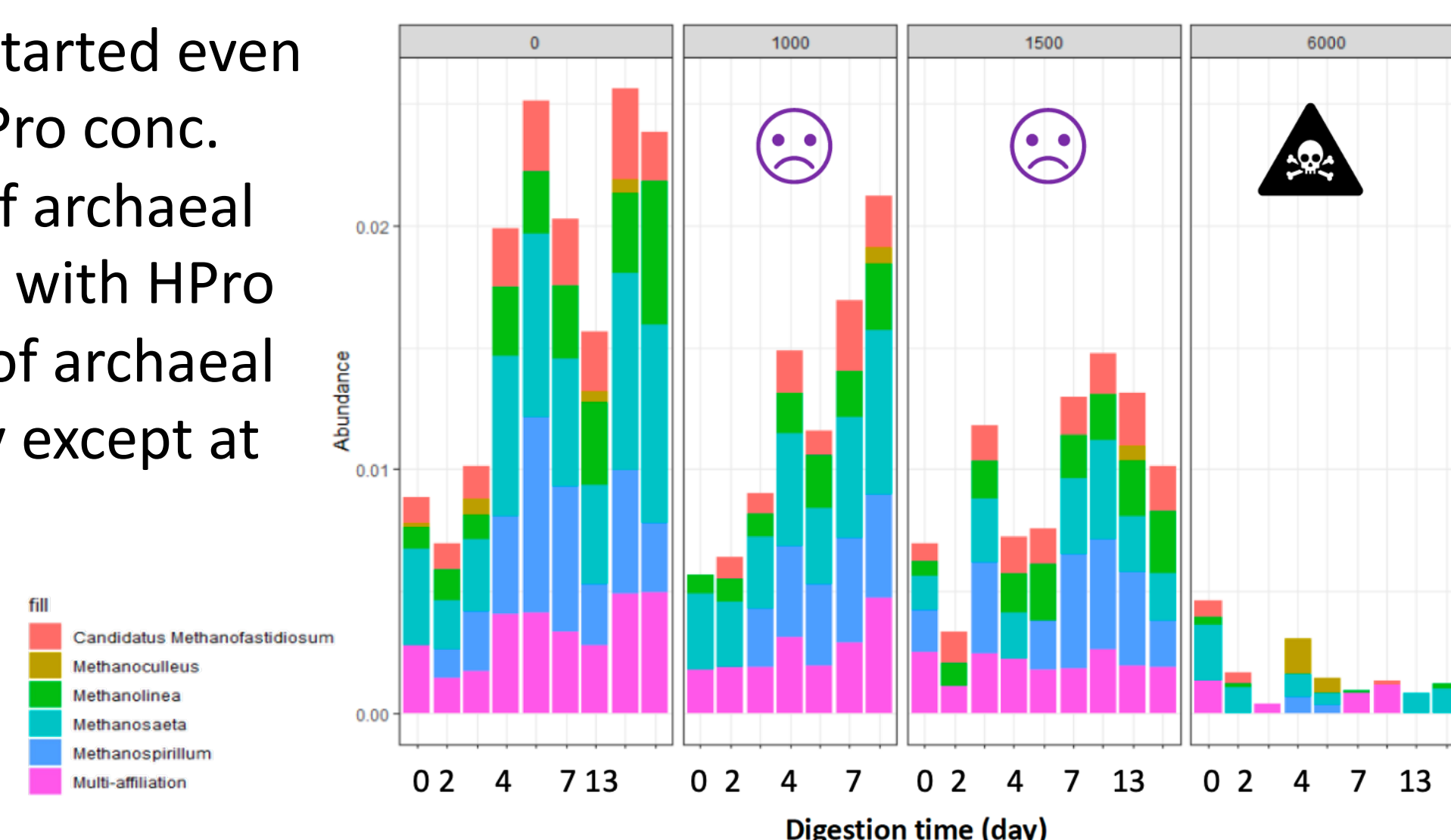
Sacrifice of reactors for microbial community analysis to identify biomarkers

- 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 CH<sub>4</sub> 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

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For more information <https://inneauvation.fr/>

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