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Inhibition of anaerobic digestion of urban sewage sludge by sodium propionate: biogas production and microbial community shift in continuous reactors

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CONTEXT

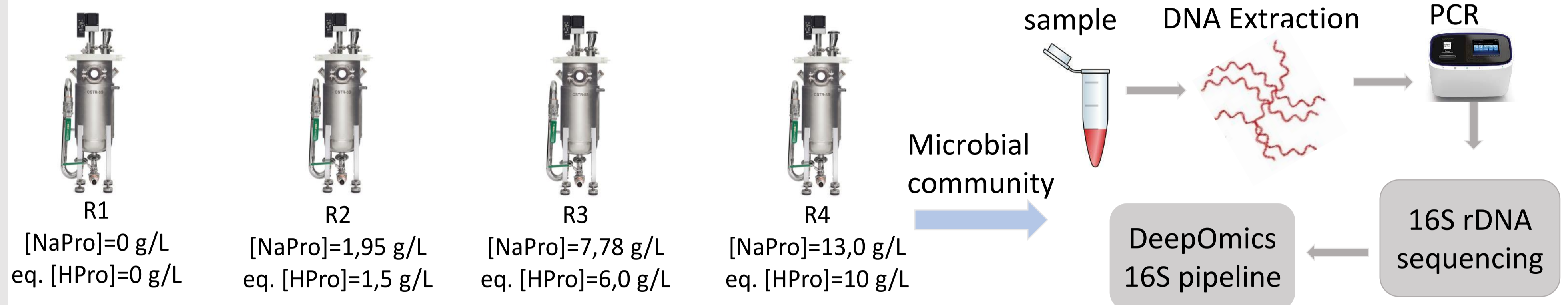
Anaerobic digestion (AD) is widely used to convert sewage sludge to biogas. Volatile fatty acid (VFA) accumulation, especially that of propionic acid, can inhibit AD and may lead to AD failure. Knowledge about the level of VFA concentration that inhibits the AD process as well as the microbial targets is limited. Further research is needed to understand this inhibition and to identify microbial biomarkers that predict possible reactor failure.

OBJECTIVE: Assess the impact of propionic acid (HPro) (its dissociated form, propionate (NaPro)) on biogas production and microbial community shift in order to identify potential microbial biomarkers

MATERIALS AND METHODS

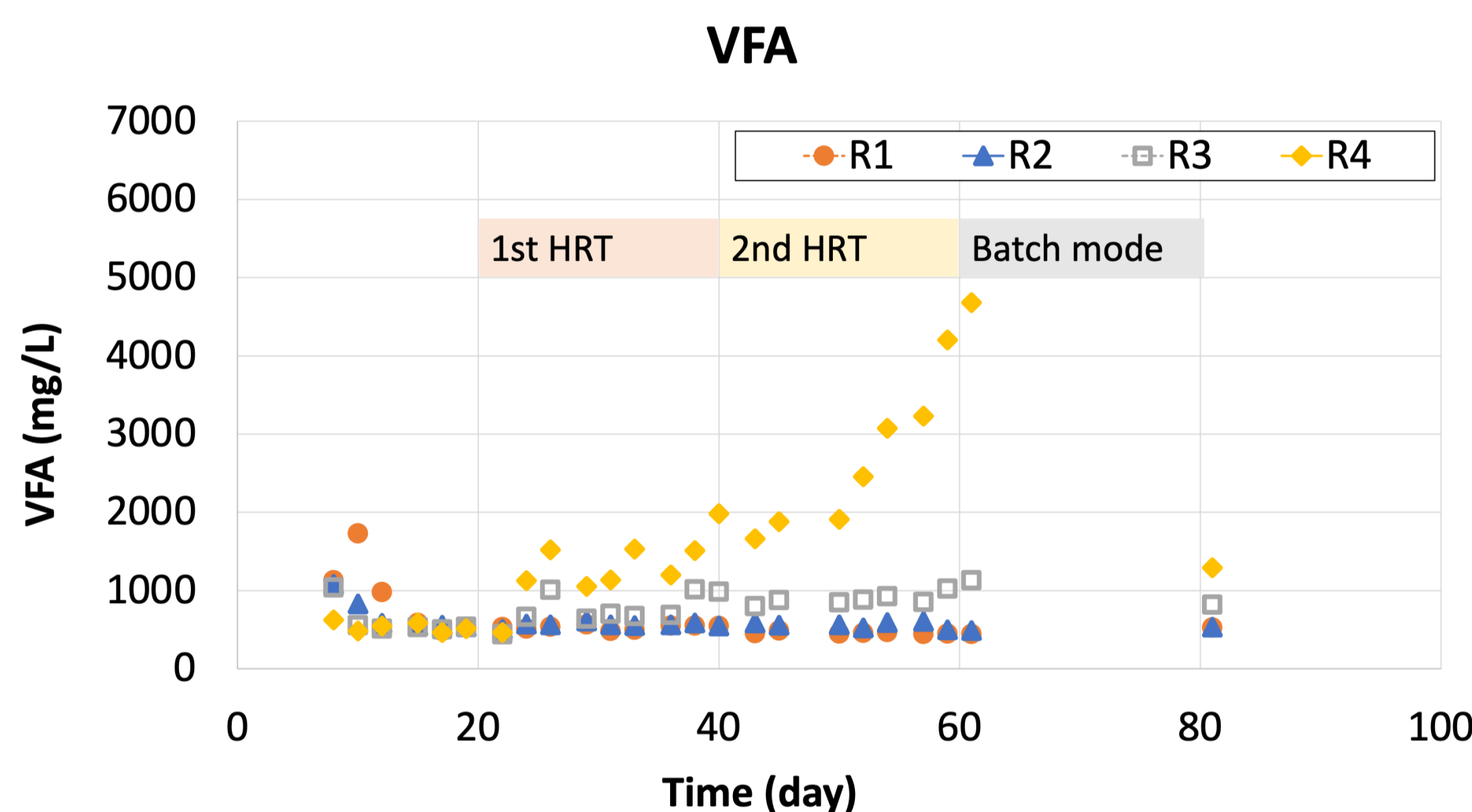
4 Continuous Stirred Anaerobic Reactors (R1, R2, R3 and R4)

- Substrate: Urban sewage sludge, with different amounts of sodium propionate
- HRT: 20 days
- Duration: 2HRT+Batch mode (no heating and feeding)
- Volume: 5 L

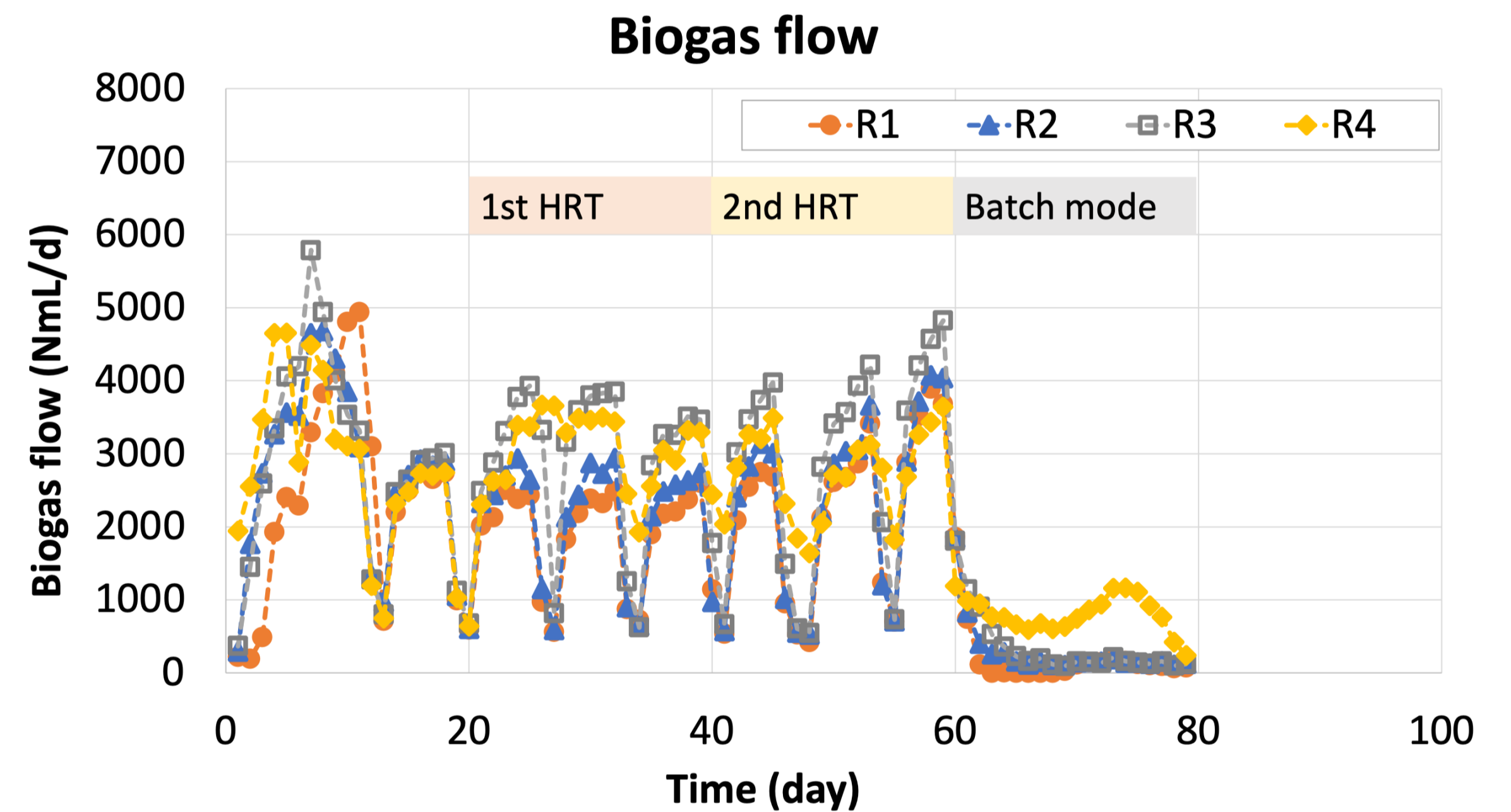


RESULTS AND DISCUSSION

EVOLUTION OF VFA AND BIOGAS PRODUCTION

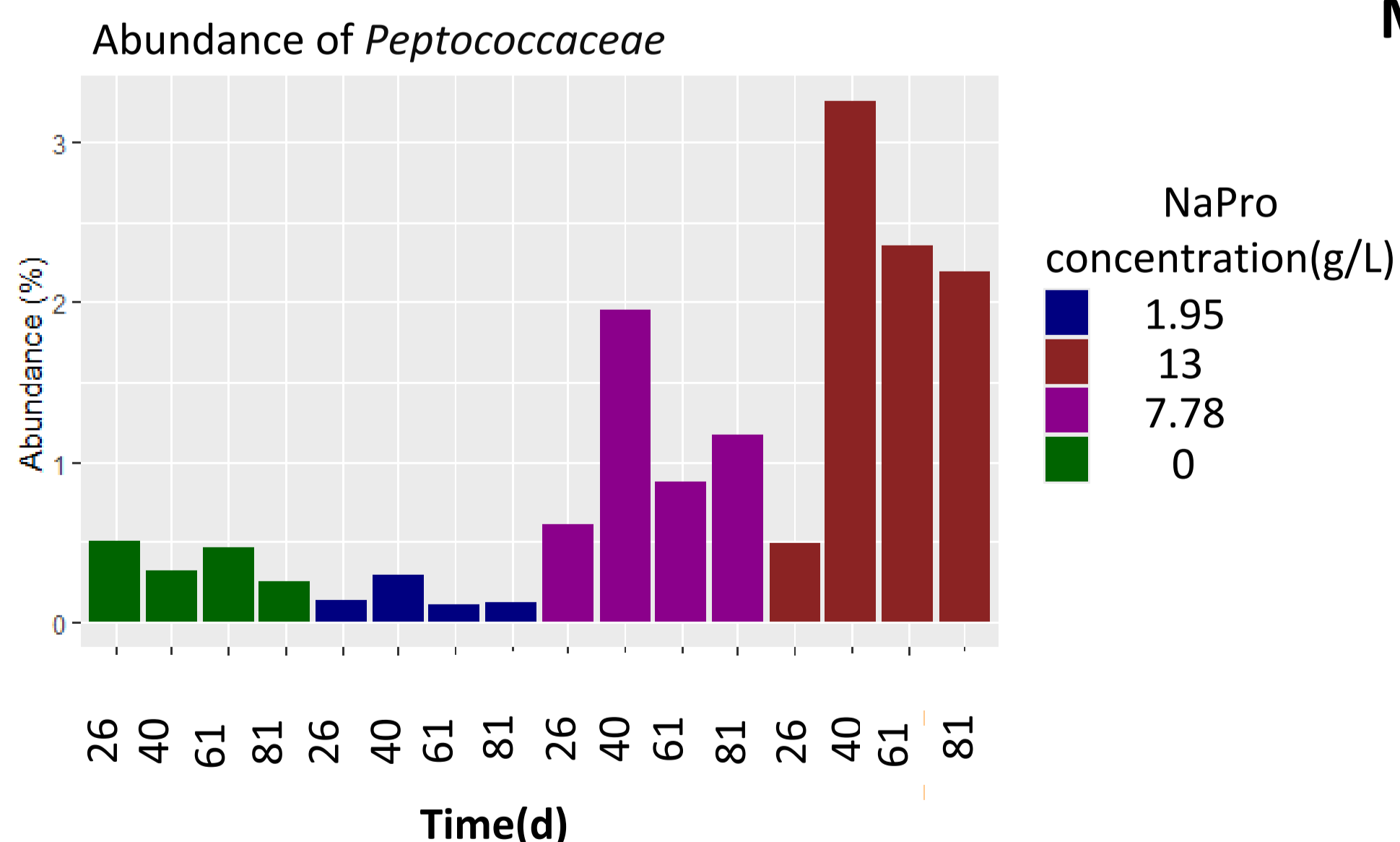


- No VFA accumulation in R2 (1.95 g/L NaPro), negligible in R3 (7.78 g/L NaPro)
- Highest VFA accumulation observed in R4

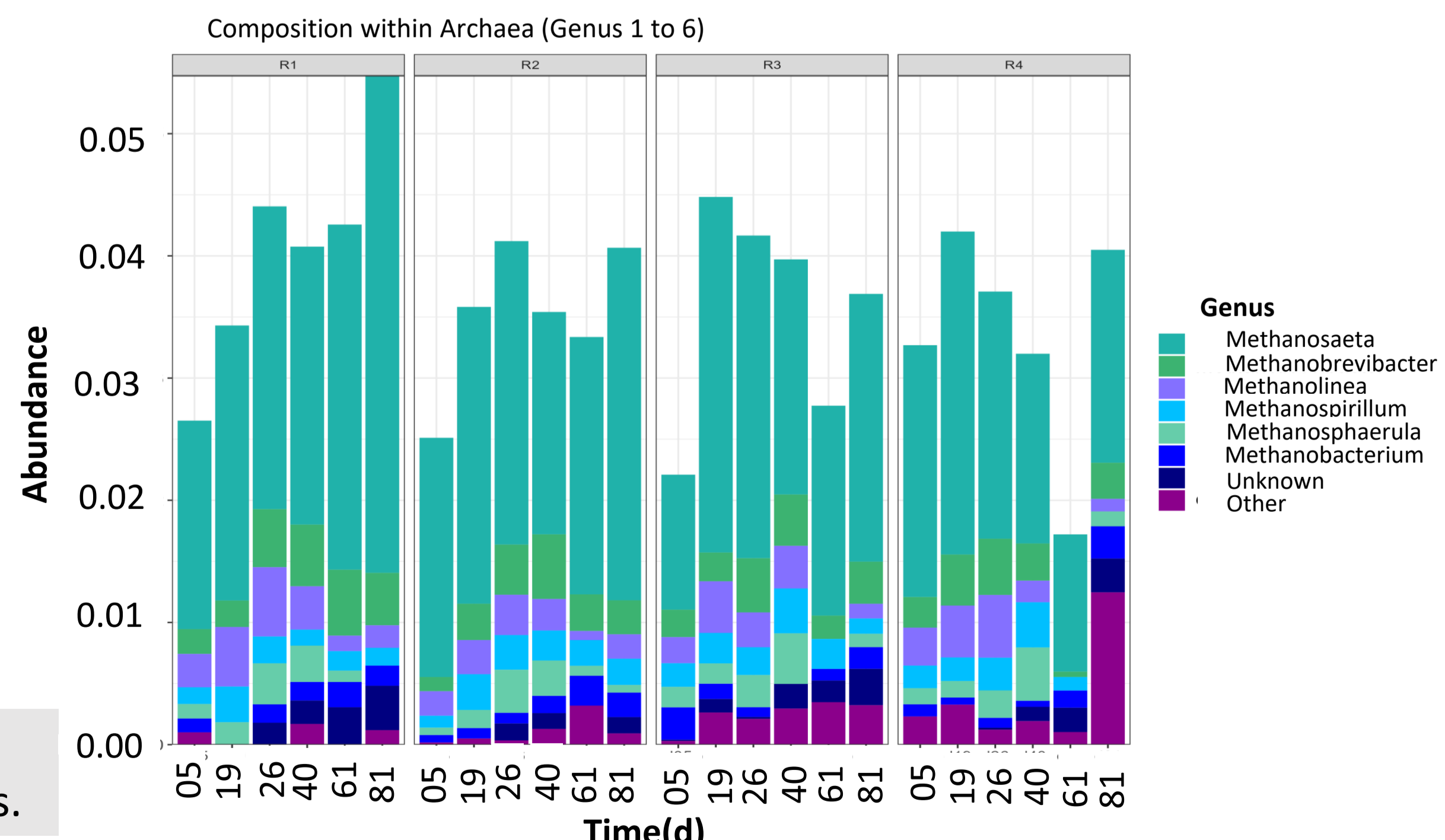


- R4 produced less biogas at the end of 2nd HRT due to inhibition
- R4 showed a significant 40% reduction in CH₄ compared to expected value (data not shown)

MICROBIAL COMMUNITY



- Identification of *peptococcaceae* family whose abundance increases at high propionate concentrations.



- The proportion of methanogenic archaea decreases according to the applied NaPro concentration

CONCLUSION

- No inhibition at 1.95 g/L NaPro
- Slight inhibition at 7.78 g/L NaPro, inhibition at 13 g/L NaPro
- Drop in archaea abundance with addition of NaPro from 1.95 g/L NaPro
- Peptococcaceae* family could be a possible biomarker and could allow inhibition to be detected quickly

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REFERENCES

