

# Conversion of xylose to targeted volatile fatty acids as a key step in the lignocellulosic carboxylate biorefinery

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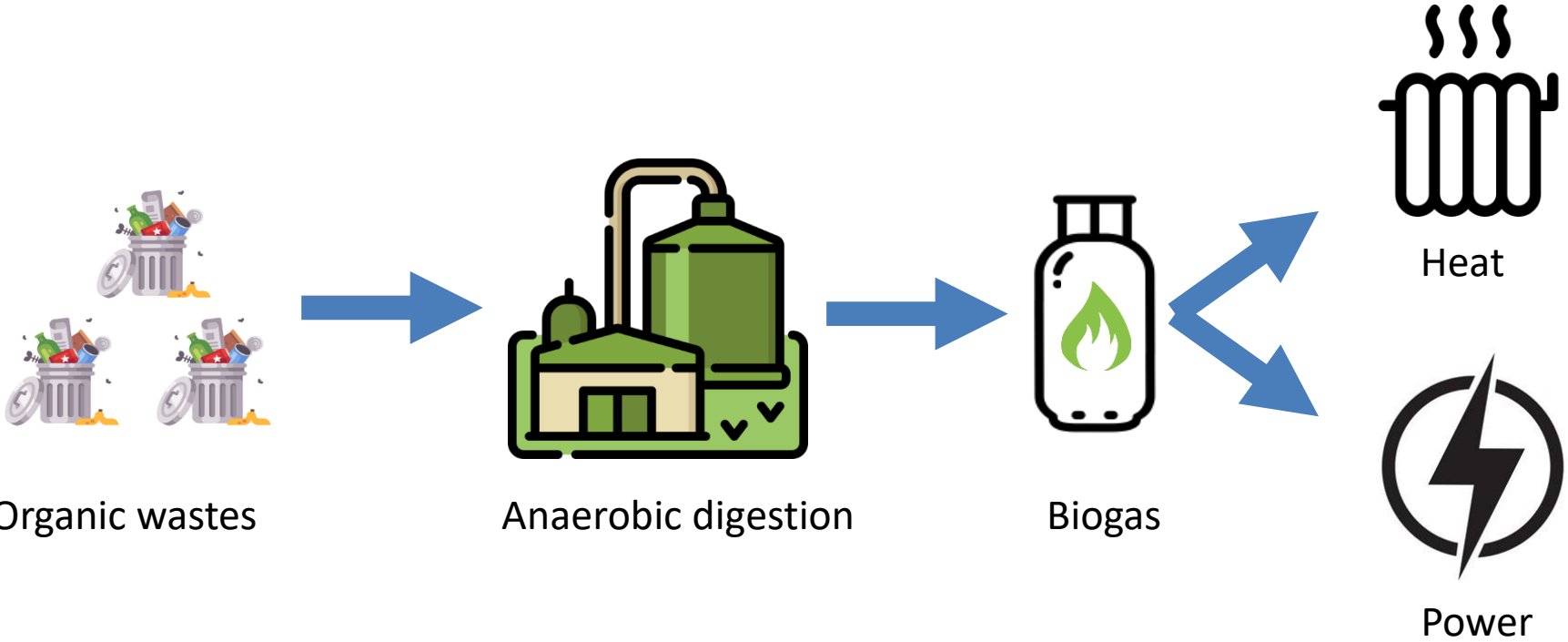
19 September 2023

# A central idea in circular economy is to convert residues in products

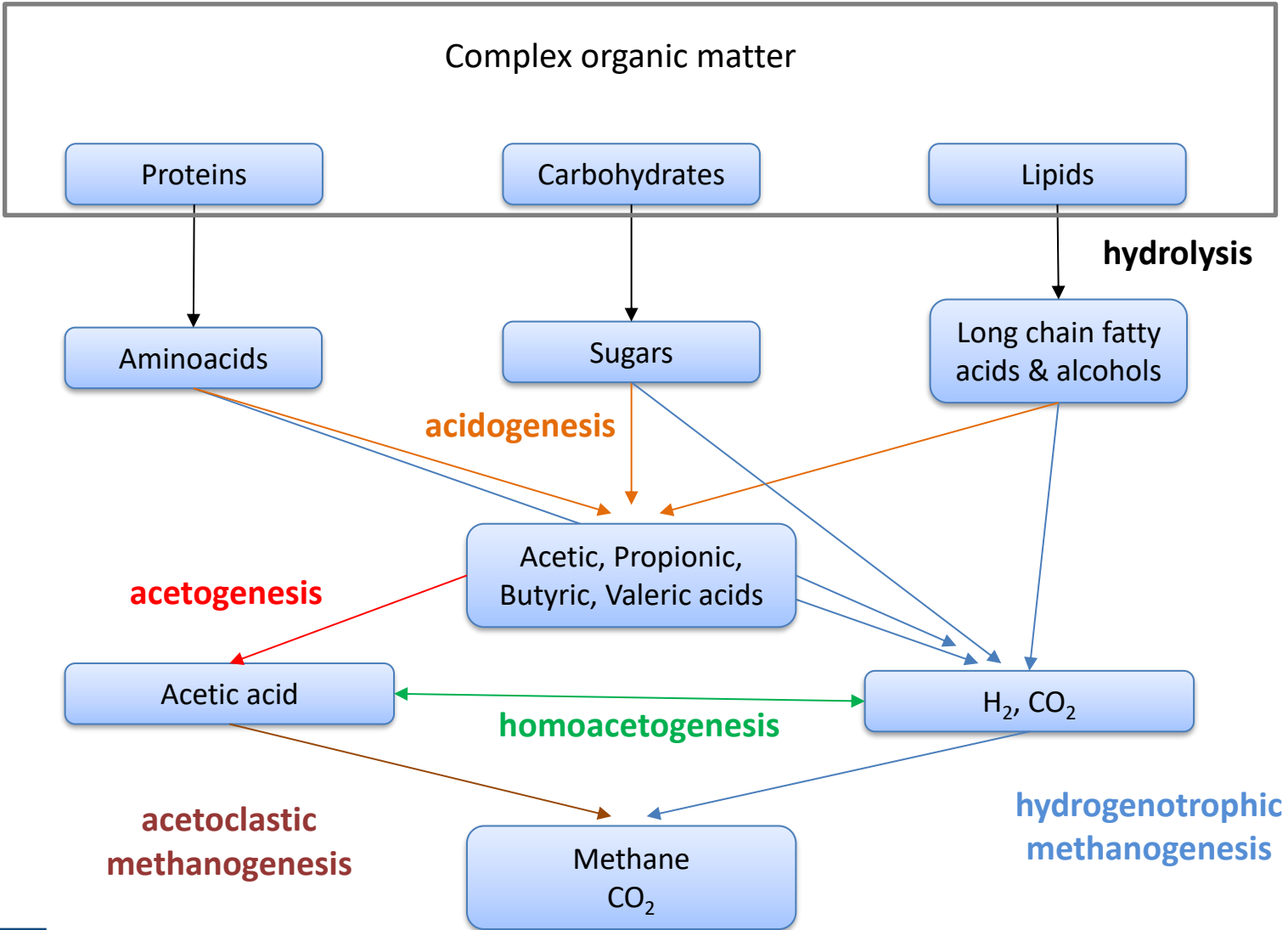
There are several benefits of resource recovery from wastes: as a waste management procedure, to reduce the raw materials used in production, decrease the need of foreign resources, lower environmental impact...



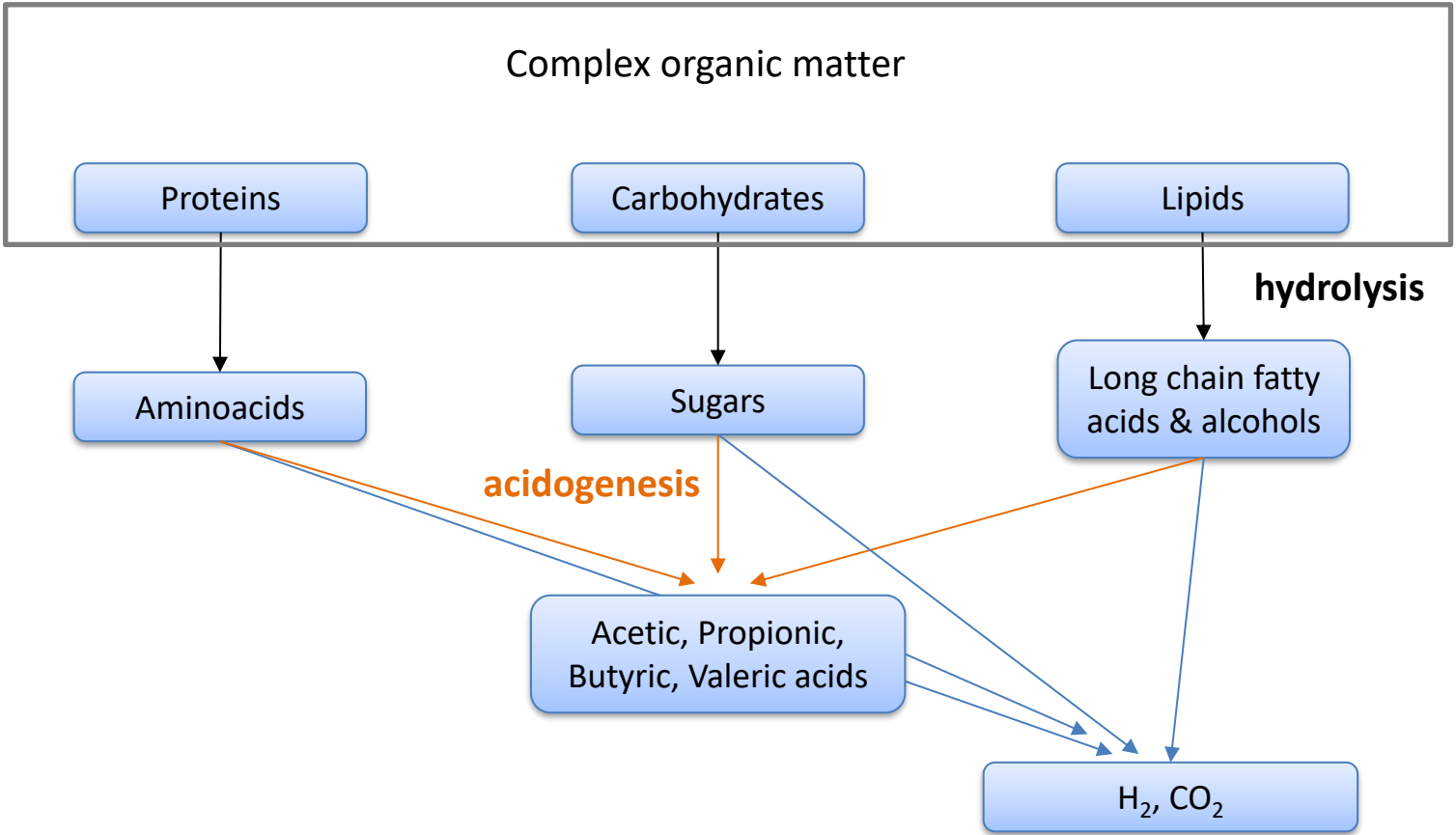
# Anaerobic digestion is the most established solution to recover organic carbon from organic wastes and wastewater



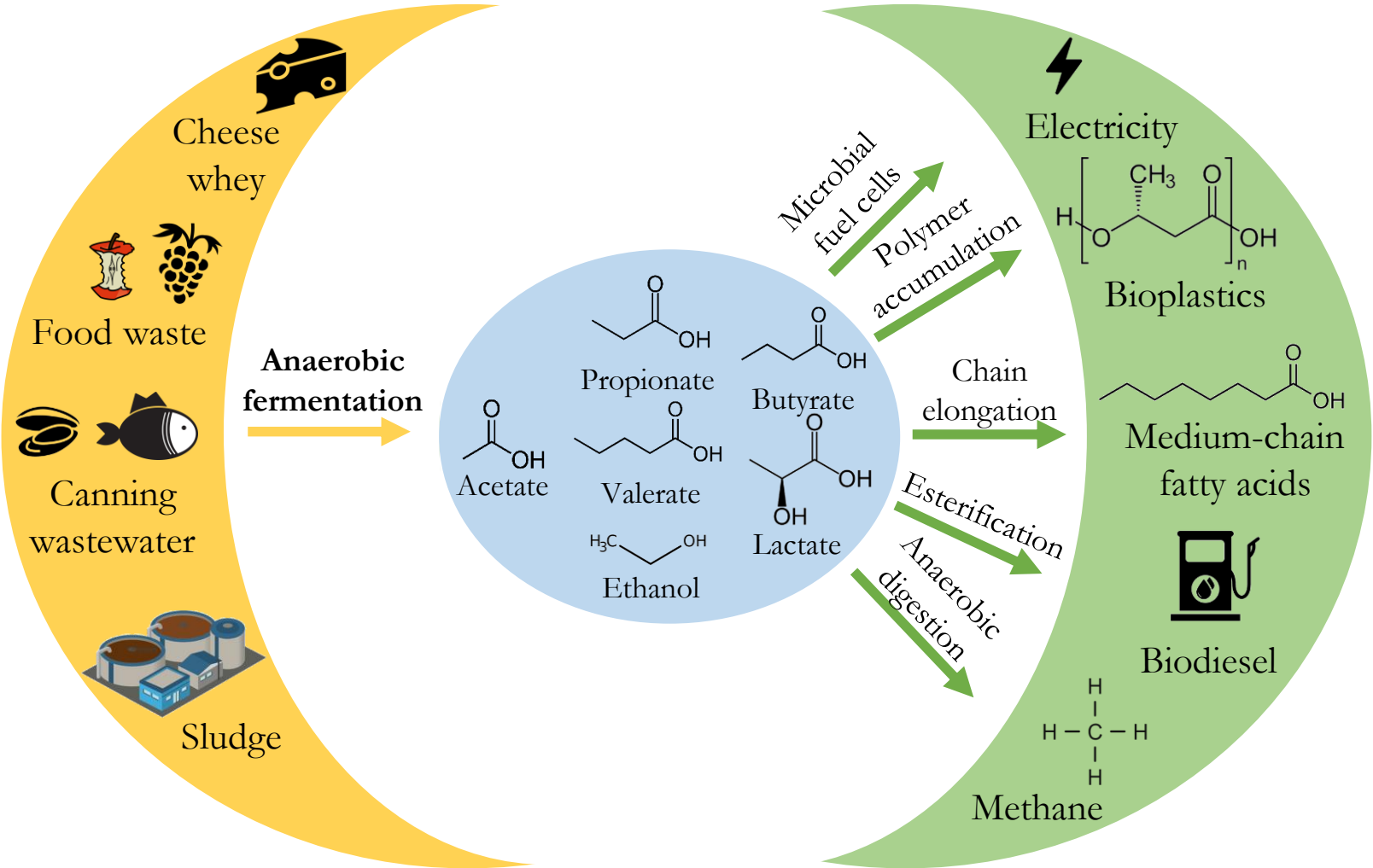
# Anaerobic digestion is complex process with several steps



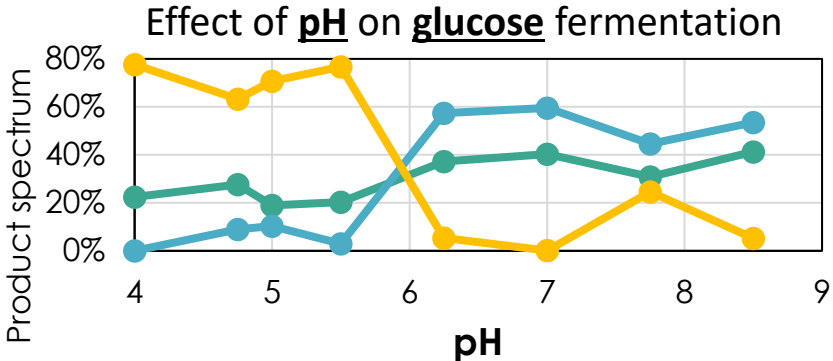
# In anaerobic fermentation, methanogenesis is suppressed and the substrate carbon is converted into volatile fatty acids



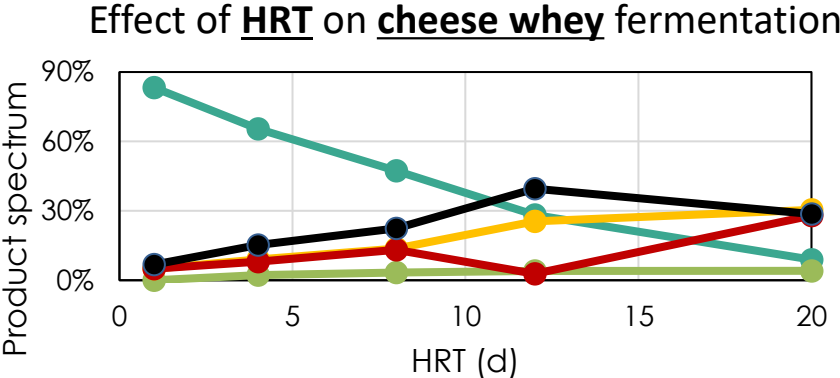
# Volatile fatty acids are platform chemicals -> they can be further processed to produce many other chemicals and resources



# The goal of ERA CoBiotech Project Cell4Chem is to integrate lignocellulosic biomass into the carboxylate platform to produce médium chain fatty acids



Temudo et al. (2007). Biotechnol. Bioeng. (98)



Jankowska et al. (2018). Chem Eng J. (345)

■ Acetate ■ Propionate ■ Butyrate ■ Valerate ■ Caproate ■ Ethanol

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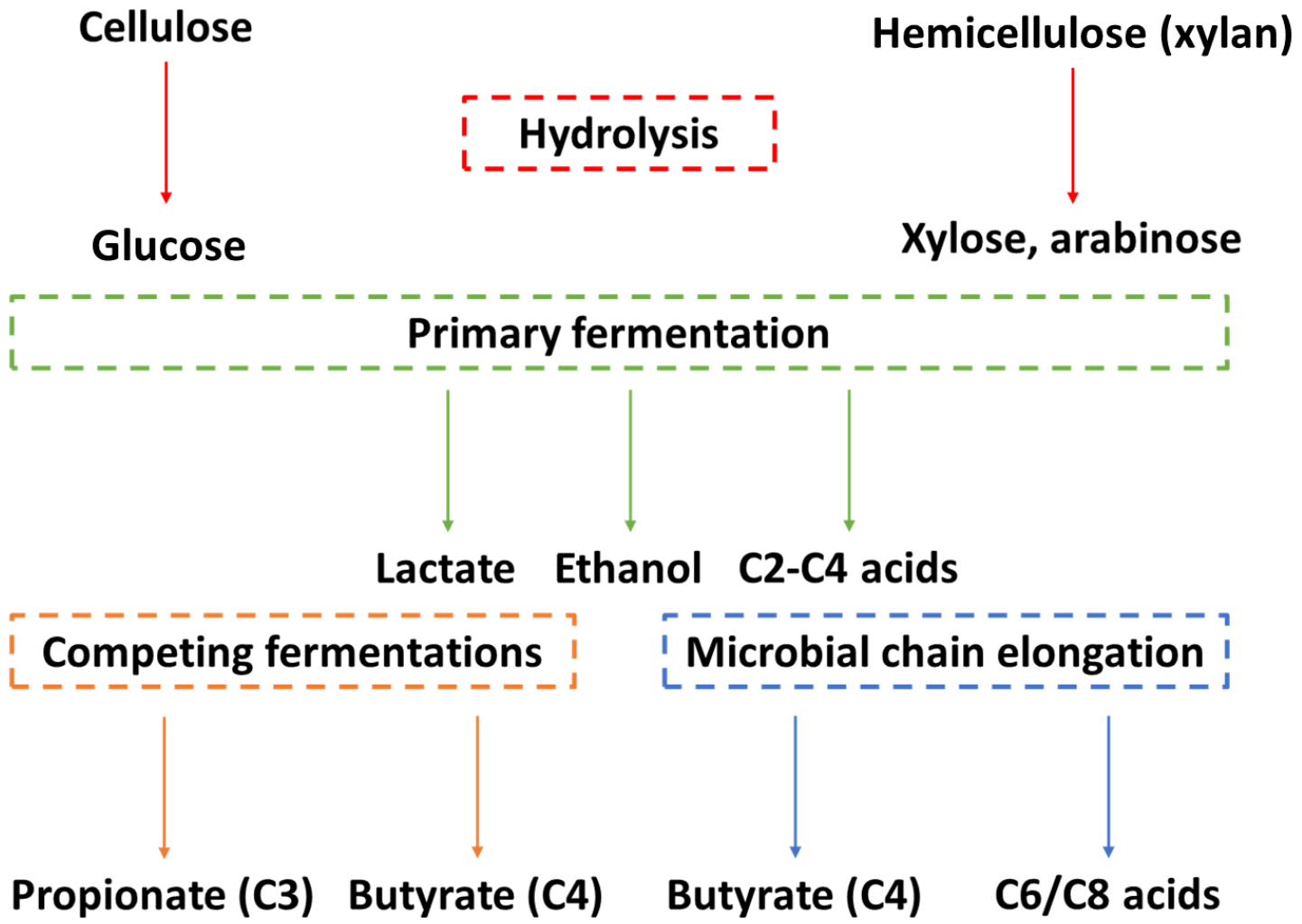
**Cell4  
Chem**

**ERA CoBioTech**

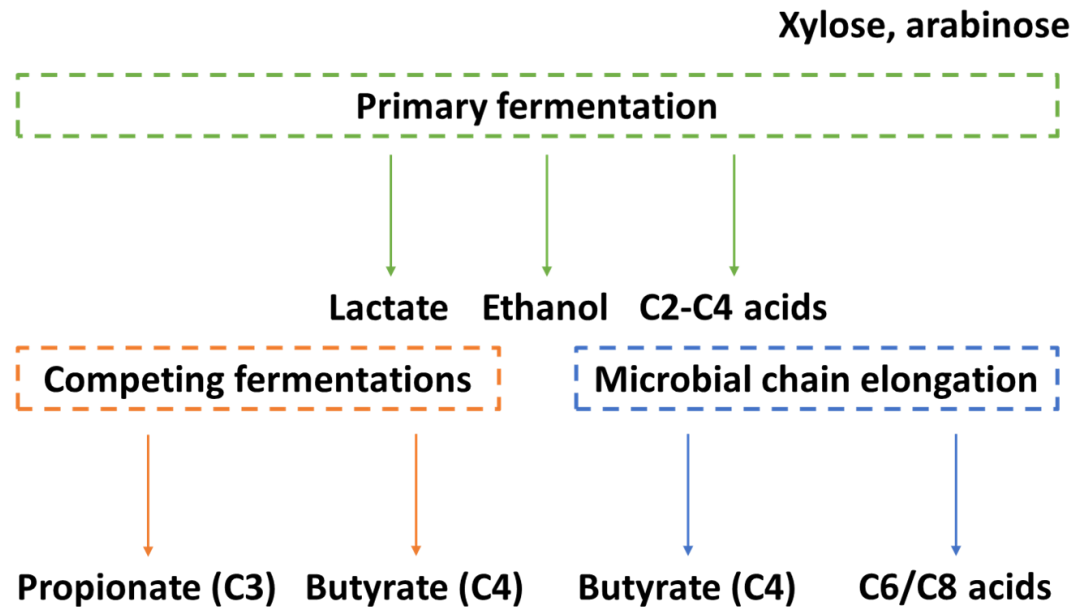
**How can we steer xylose fermentation towards desired products by changing pH, residence time and substrate blends?**

**How can we ensure high xylose conversion to VFA?**

# The behaviour of cellulose and glucose in anaerobic fermentation is much better known than xylose and xylan



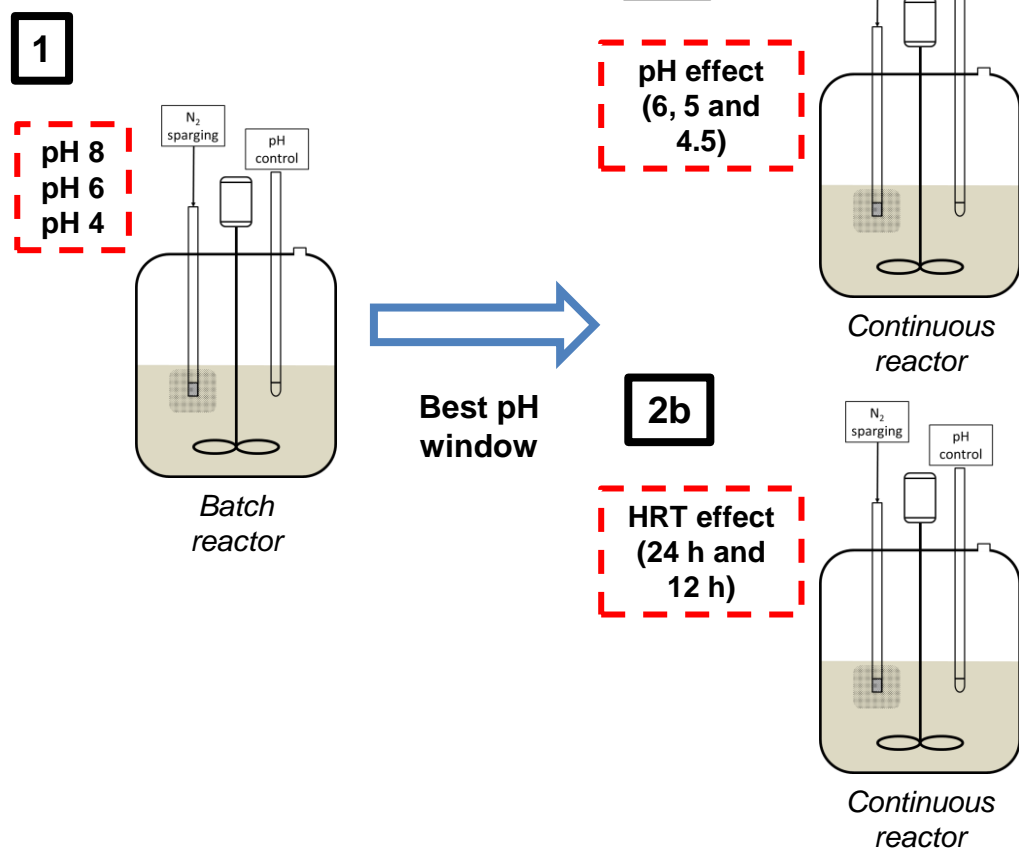
# The behaviour of cellulose and glucose in anaerobic fermentation is much better known than xylose and xylan



## Operational parameters

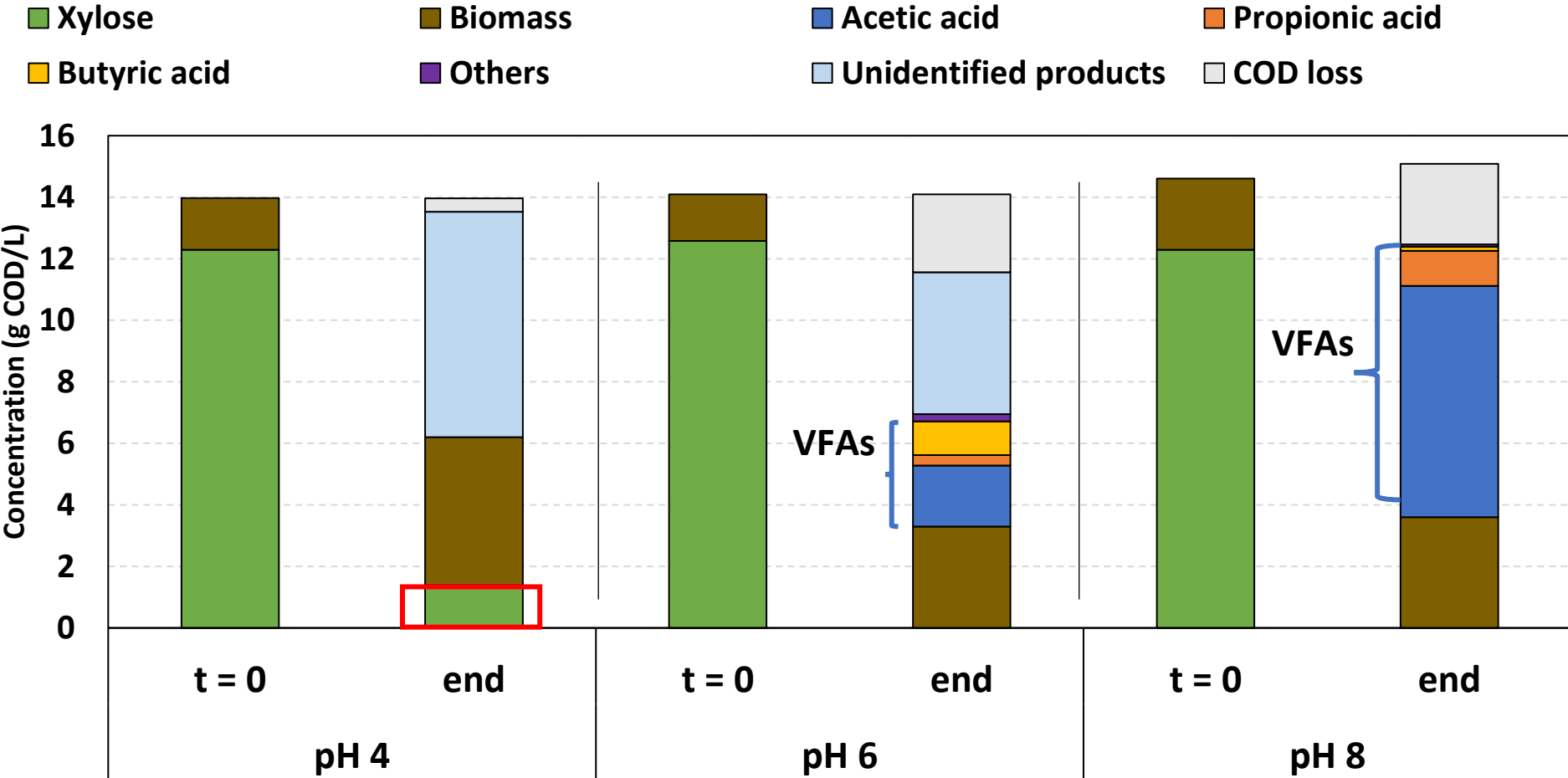
- pH ?
- Residence time?
- Loading rate?
- Cosubstrates?

# Experiments in batch reactors and CSTR to test pH and residence time

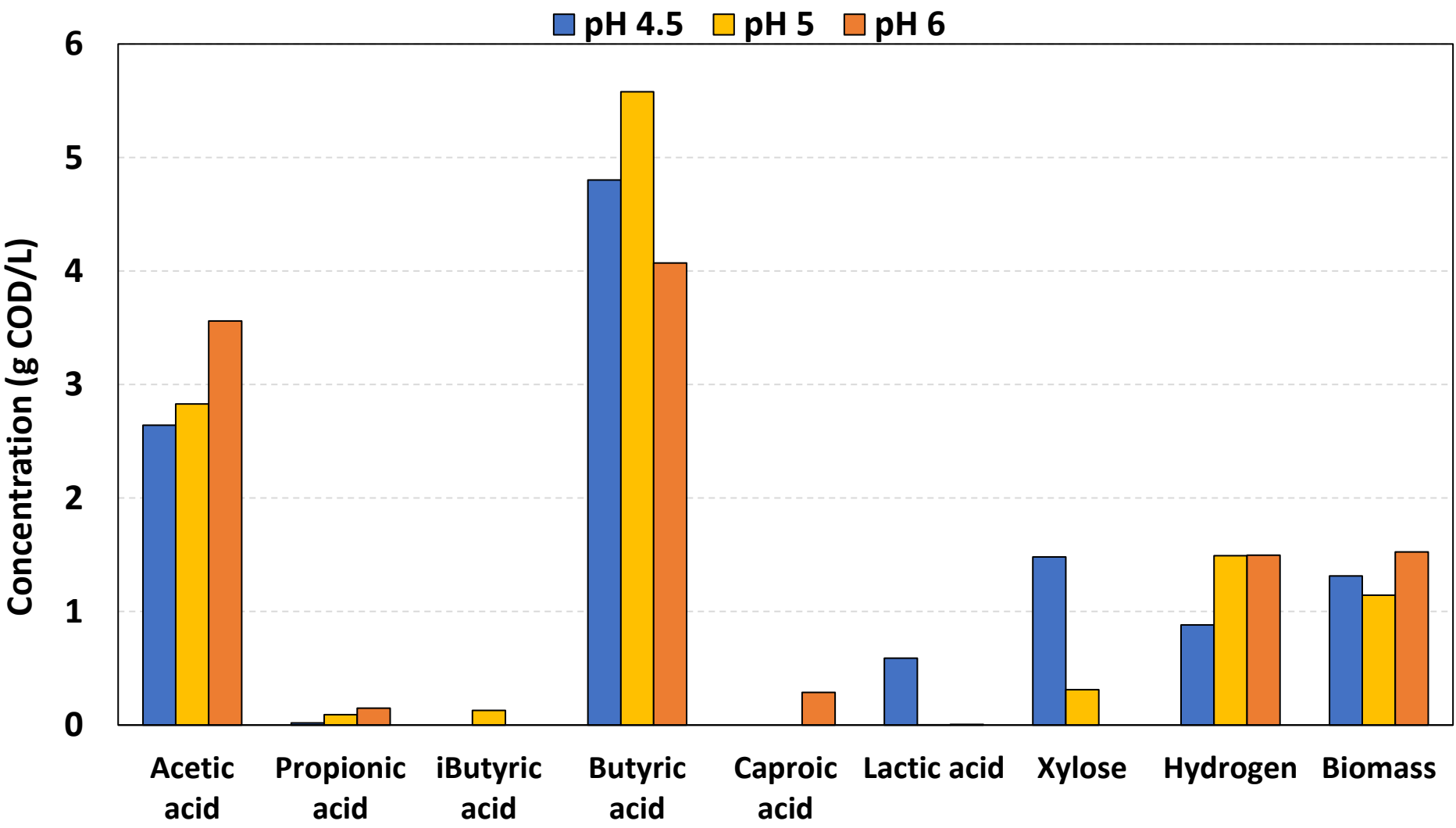


Parameter	Value
Working volume (L)	1.0
Temperature (°C)	36.7
Xylose concentration (g COD/L)	12-24
HRT (h)	12-24
<b>pH</b>	<b>8, 6, 4 and 4.5</b>

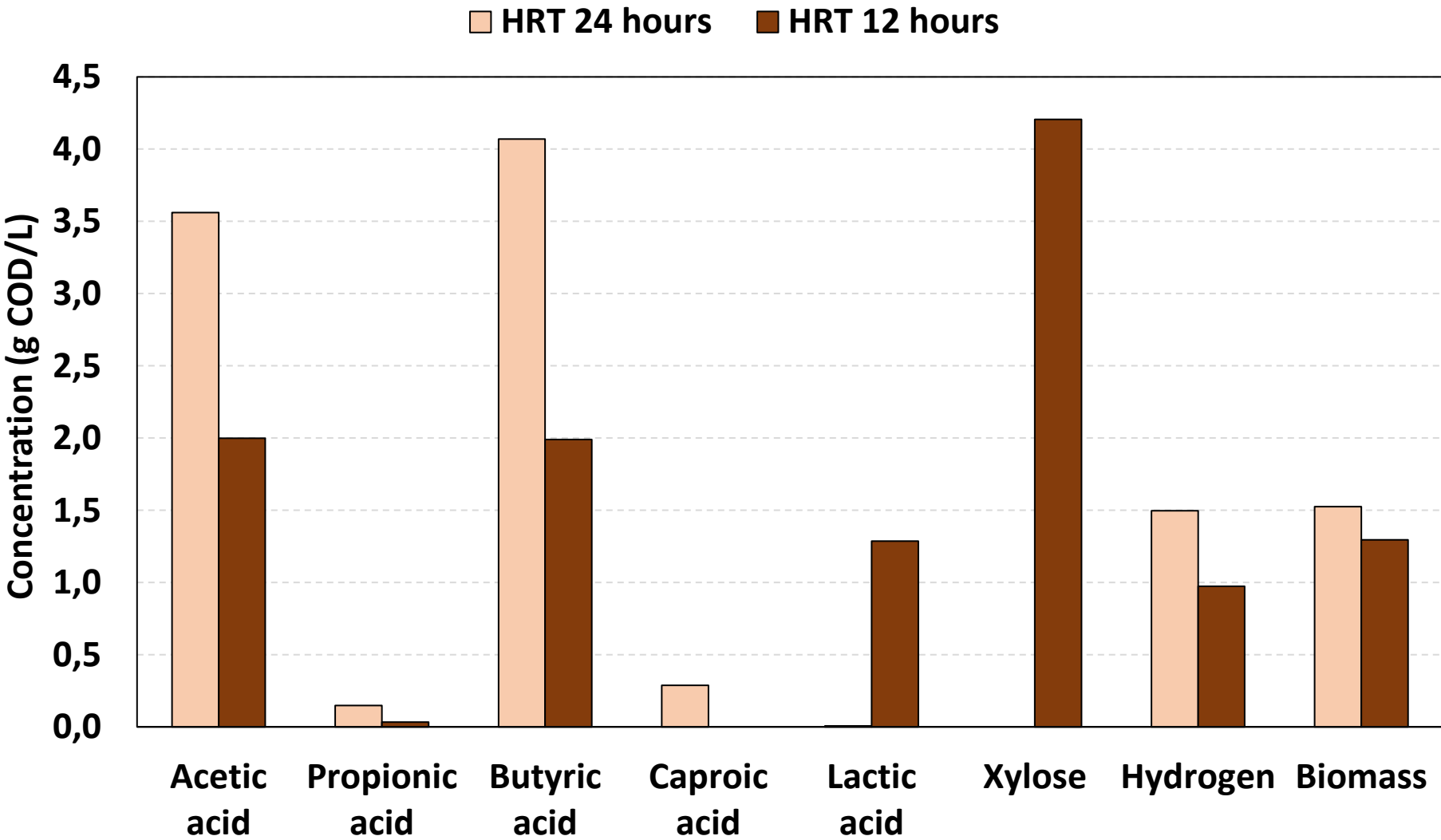
# Batch experiments show a big impact of pH from 4 to 8...



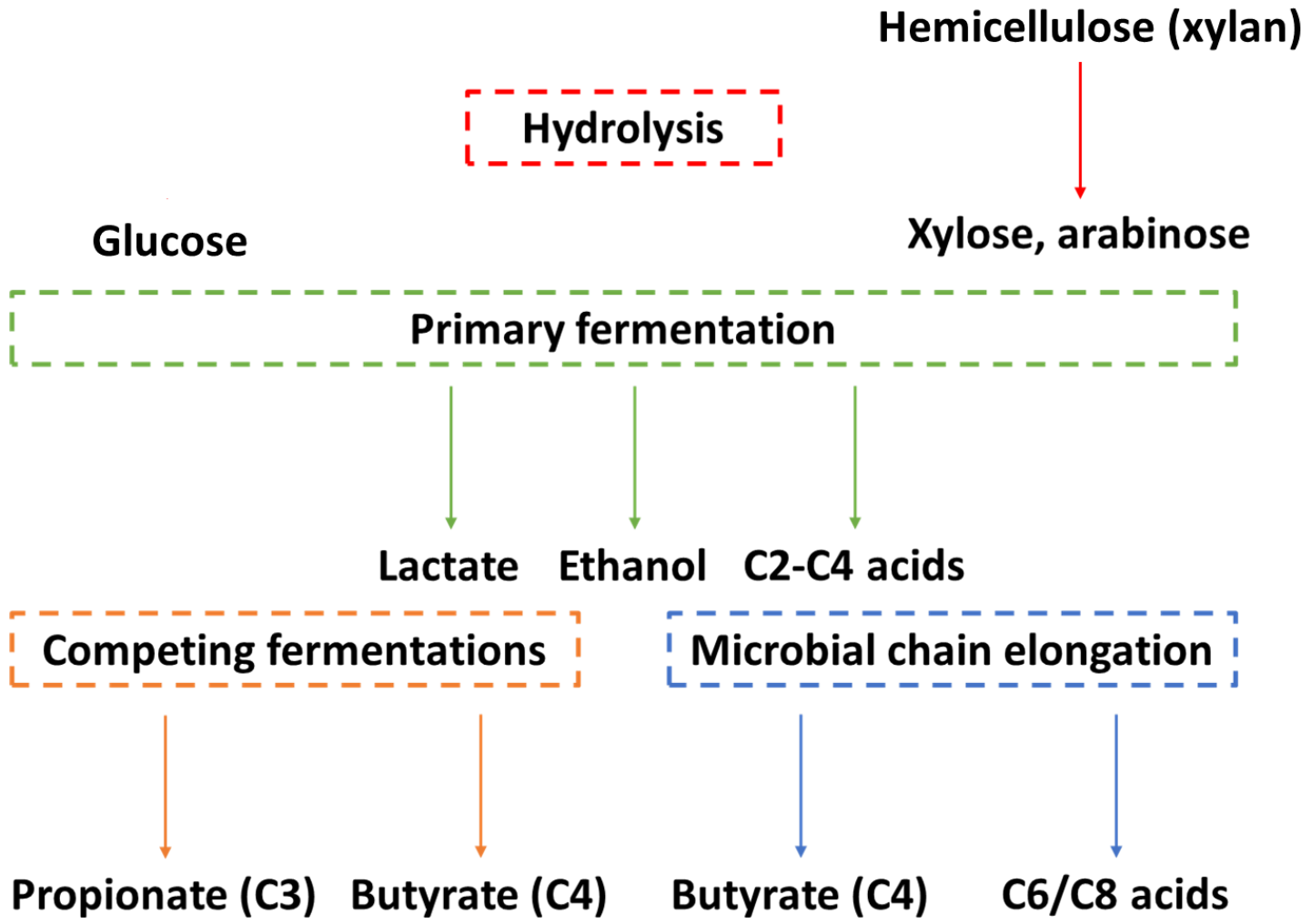
# ...but not so much between 4.5 and 6 at CSTR



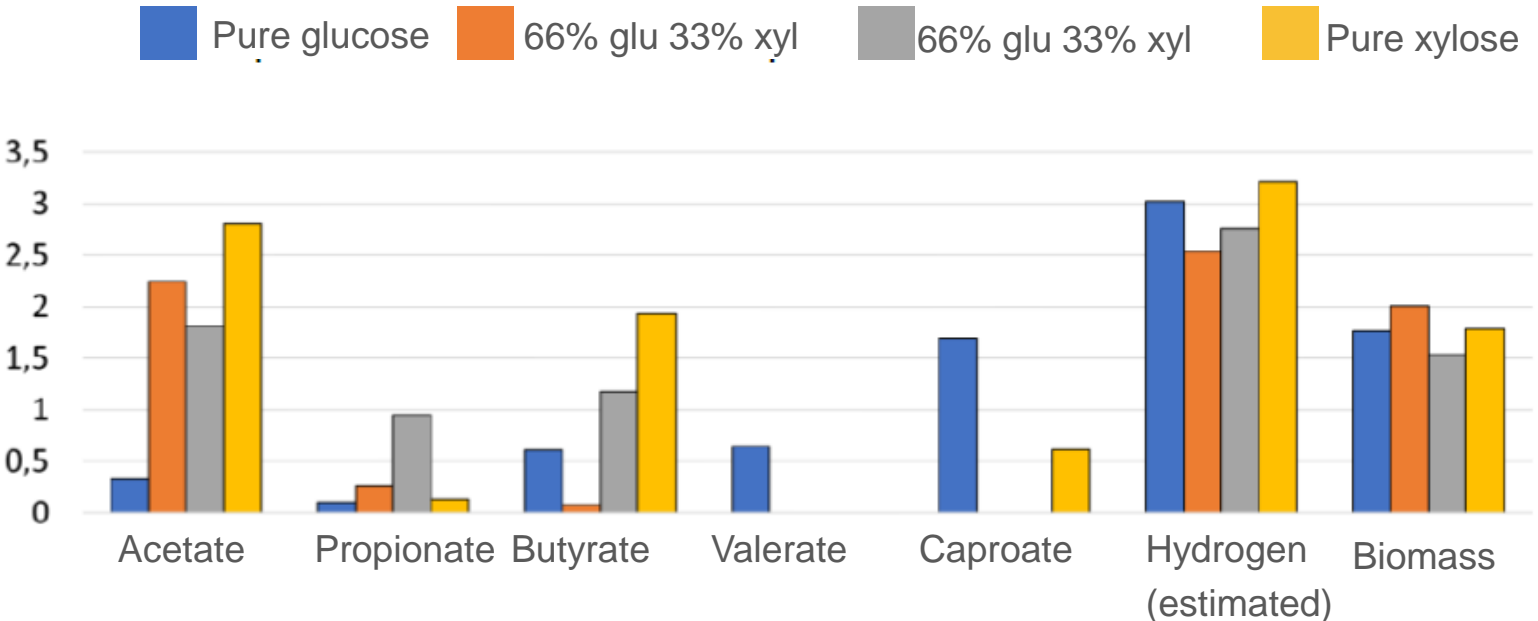
# Halving the residence time to 12h led to a straight decrease in conversion



# Other possible means to steer the fermentation include cosubstrates



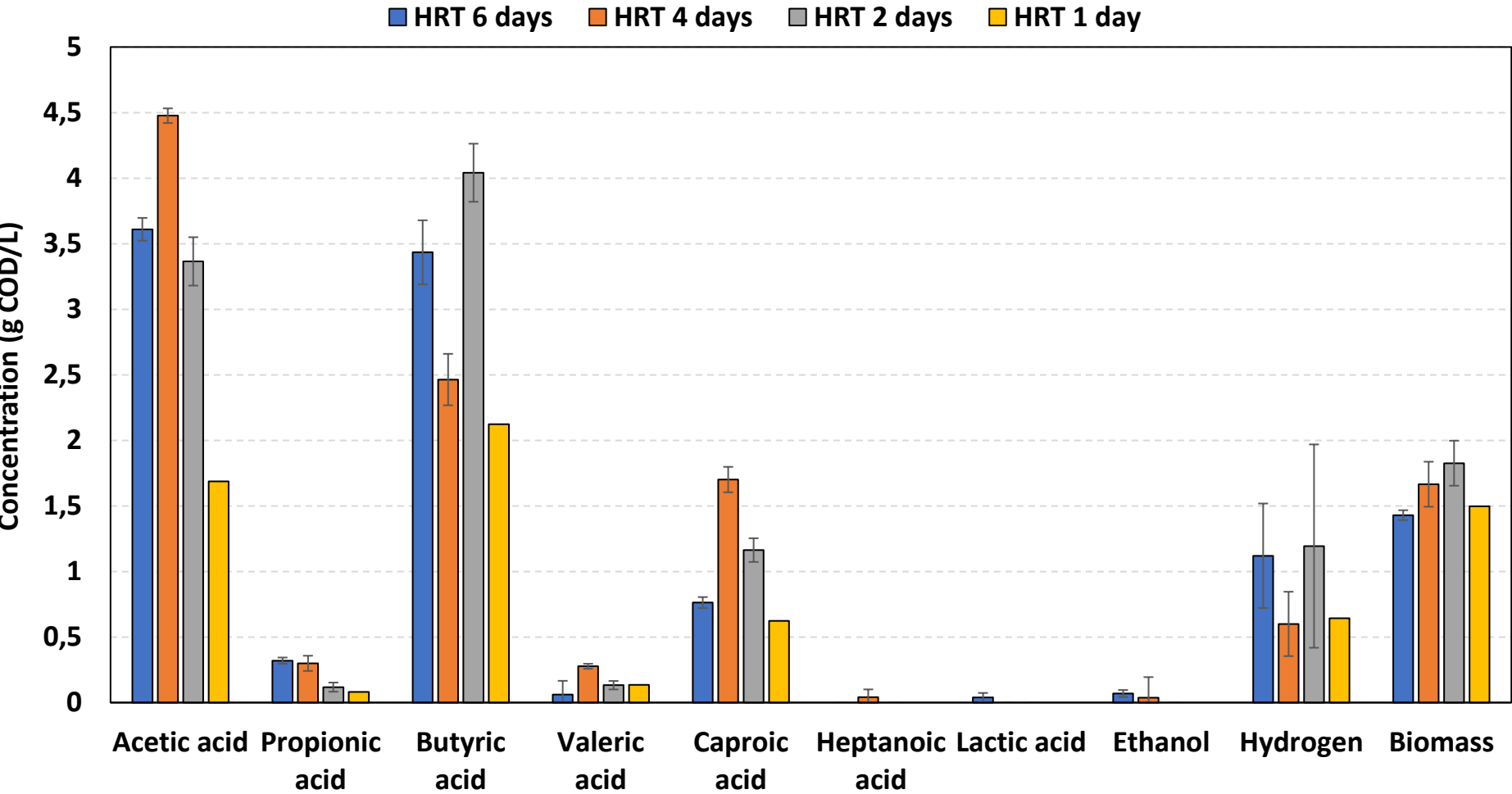
# Using a mix of glucose and xylose leads to spectrum changes



**No clear tendency when mixing the substrates**

# Xylan hydrolysis is not a limiting step

## It can be considered as xylose regarding pH and residence time



# Conclusions

- The anaerobic fermentation of xylose has been much less studied than glucose. However, it is relevant for lignocellulosic biomass
- pH is the operation parameter with the highest impact on the spectrum of VFA obtained. When targeting butyric or C6 acids, pH 6 is a good trade-off between conversion and selectivity. Higher pH leads to high acetate selectivity.
- Changing the residence time leads to poor conversion, with limited impact on spectrum
- The cofermentation with glucose has an effect on the spectrum but it is difficult to draw general trends
- Xylan is easily fermentable and the behaviour with respect to pH is similar to xylose

Thanks to AEI (Spain) for funding Cell4Chem project and many hard-working talented colleagues

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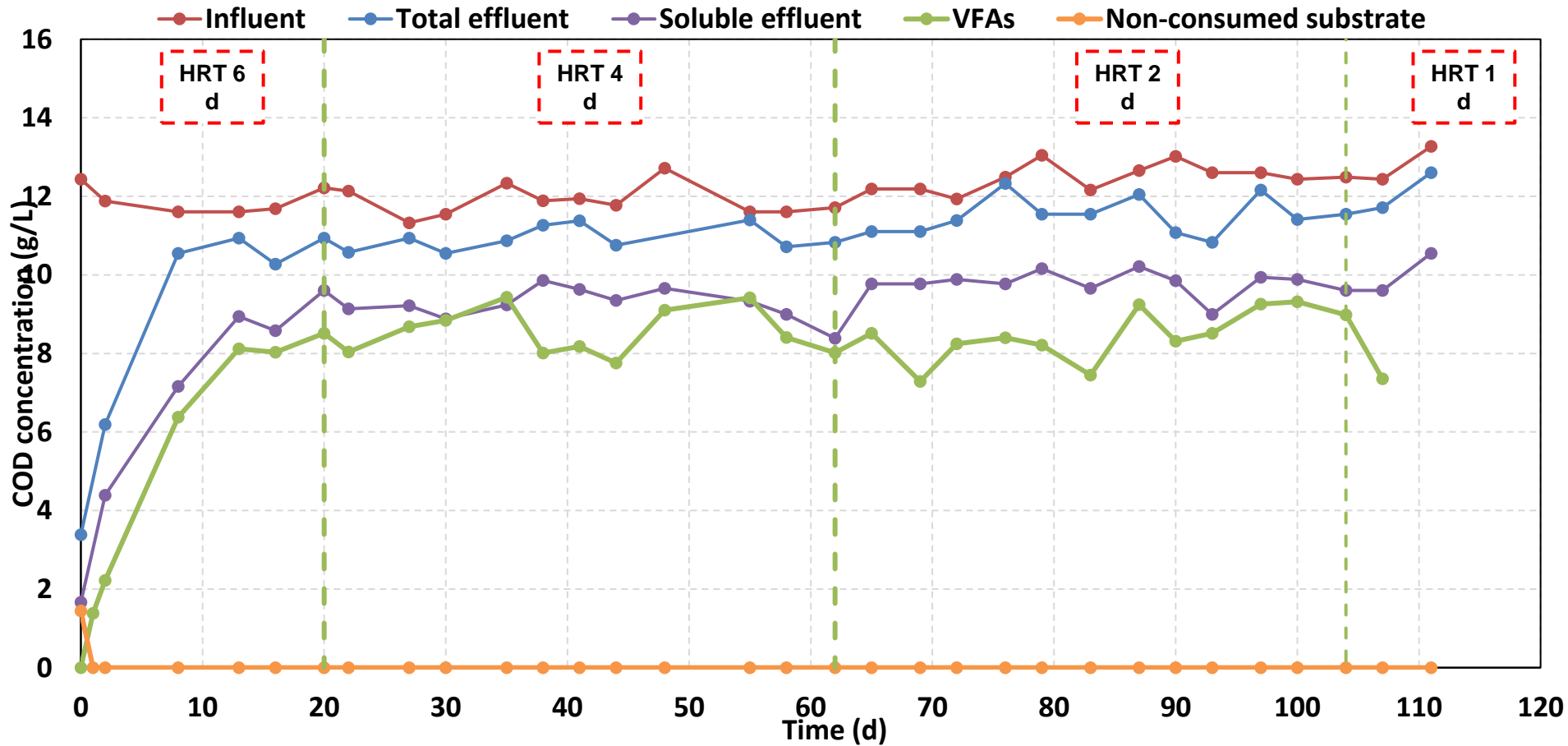
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# Xylan CSTR

From HRT 6 to 1 day the VFA production have not been greatly affected...



# Xylan CSTR

... but product distribution varied throughout the operation

