



BERA/EERA

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Acidogenic fermentation of organic residues for
the production of “green” chemicals & new biofuels

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Theoretical background

Anaerobic digestion

Hydrolysis

Break-down of organic macromolecules into soluble monomers by extracellular enzymes

Acidogenesis

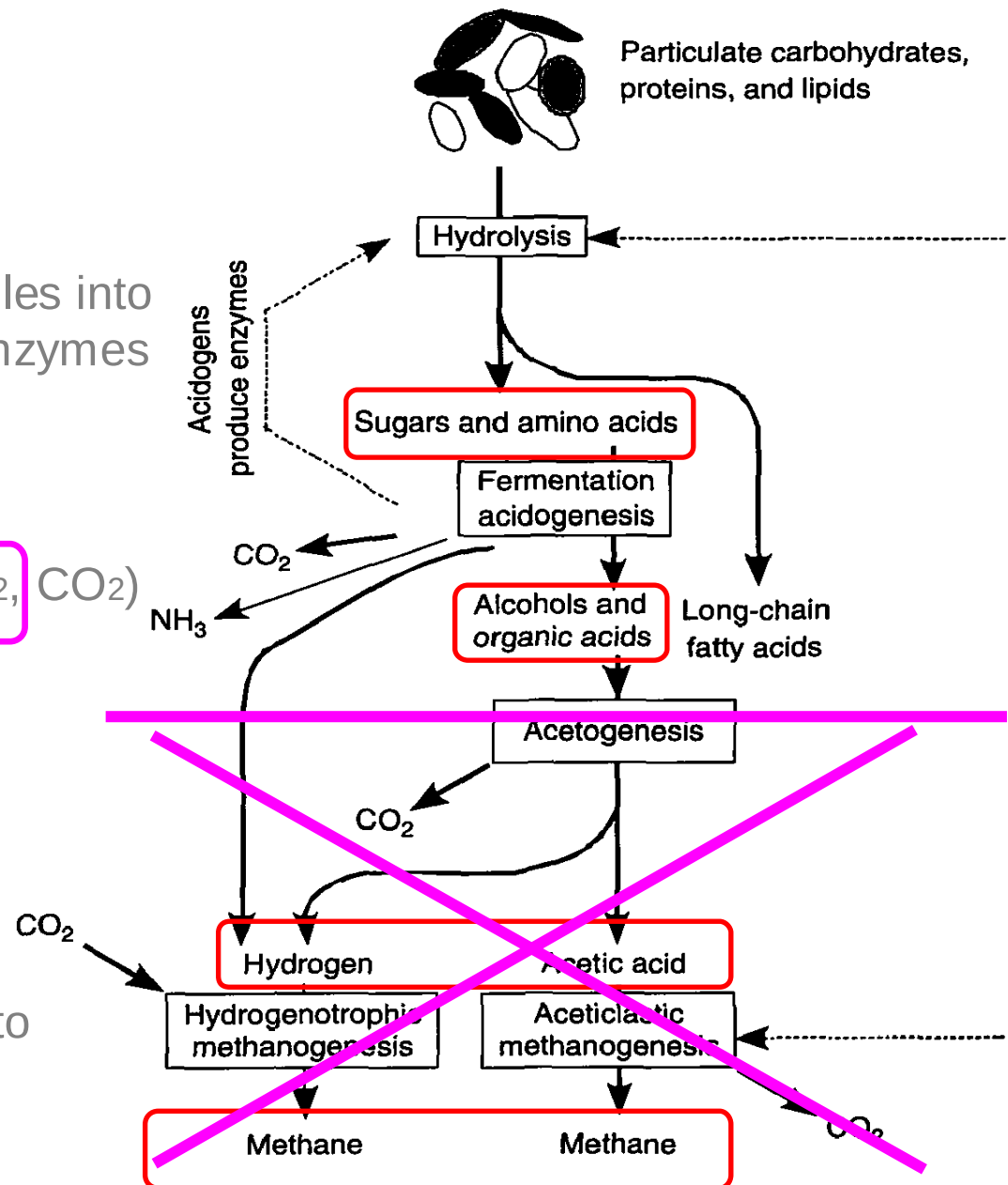
Conversion of monomers into simpler molecules (organic acids, ethanol, H_2 , CO_2)

Acetogenesis

Conversion of previous molecules into acetic acid, H_2 , CO_2

Methanogenesis

Conversion of previous molecules into CH_4 and CO_2



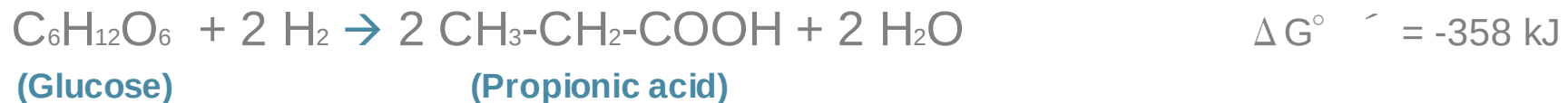
Source: Batstone and Jensen (2011)

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Theoretical background

Acidogenesis - some reactions *(on the basis of glucose as monomeric substrate)*



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Theoretical background

Acidogenic fermentation :

- Studied mainly as intermediate step for the optimisation of methane production
- Could be part of a biorefining concept for the production of “green” chemicals (e.g., volatile fatty acids (VFA))

VFA could be used :

- As monomers for the chemical industry (e.g., solvents, aromas)
- For the production of bioplastics (e.g., polyhydroxyalkanoates (PHAs))
- For biological nutrient removal
- For the production of biofuels



Theoretical background

Substrates

- Agro-industrial organic residues
 - Fruit pulps (e.g., pear, date, apple)
 - Brewery residues (e.g., spent grain, spent yeast, trub)
 - Residues from fungal processes
- Creating added value from residual biomass fractions
- Respecting limited availability of primary biomass resources
- Supporting the biorefinery concept (i.e., multiple marketable products from multiple biomass sources through integrated processes)
- Reducing environmental load of organic residues
- Reducing costs of elimination



Objectives

Main objectives

- Identify crucial parameters that influence the profile of acidogenic fermentation (e.g. pH, T, substrate composition, metabolite concentration)
- Master and direct acidogenic fermentation towards a specific product

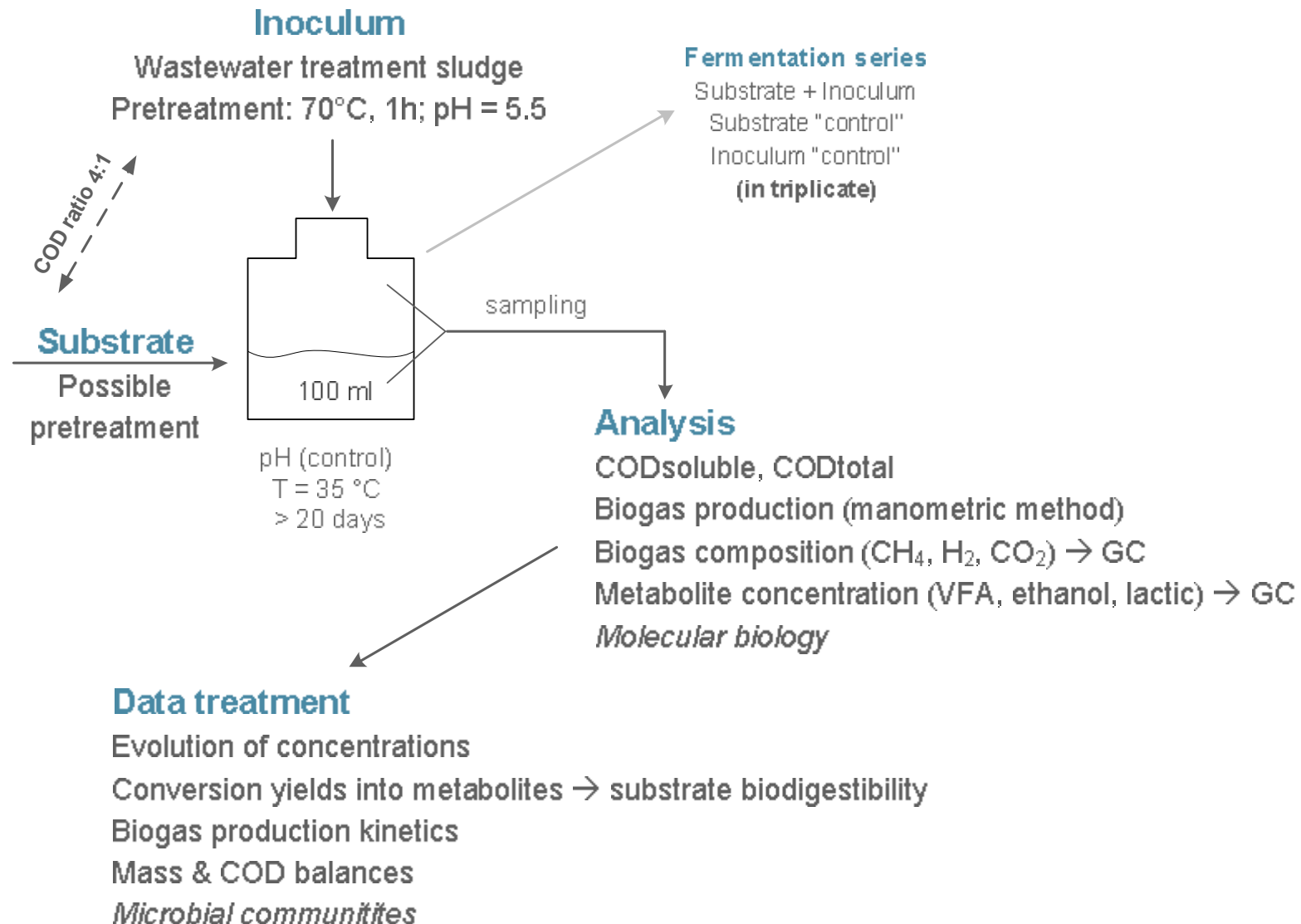
Main challenges

- Complex substrate matrix (e.g., lignocellulosic structure)
- Complex microbial communities
 - Mixed culture fermentation → competing and/or synergistic effect between microorganisms → variety of metabolic pathways



Experimental part

Experimental set-up (example in the context of project WAL-AID of the Walloon Region)

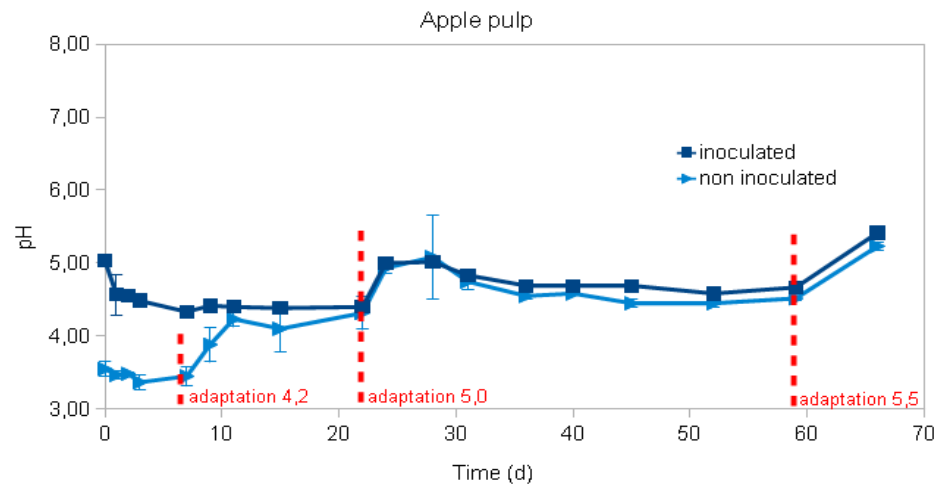


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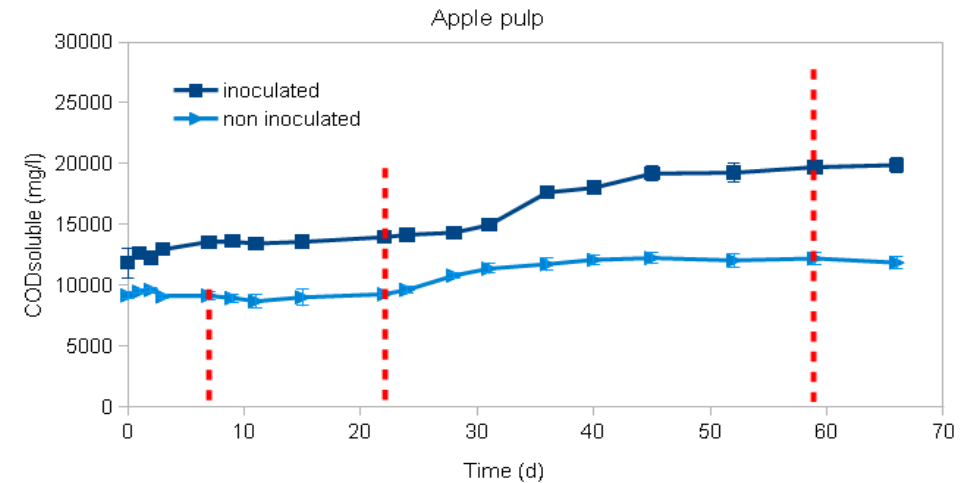


Results

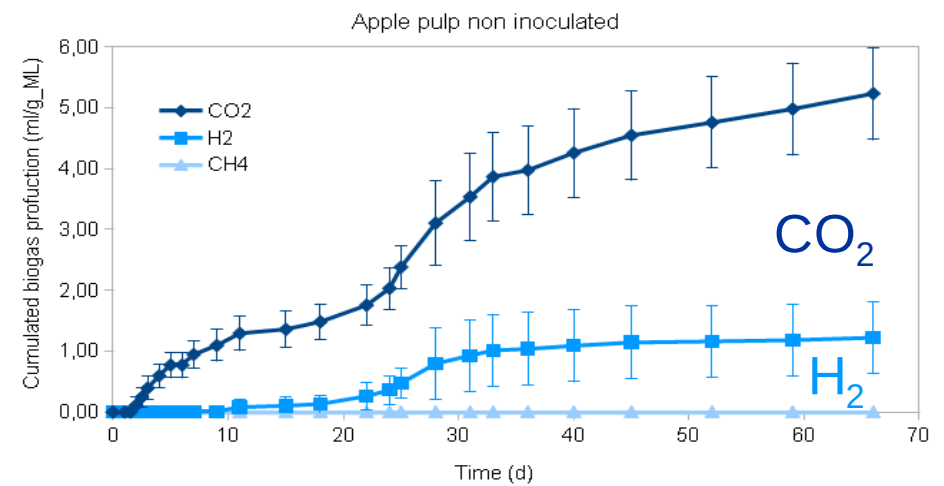
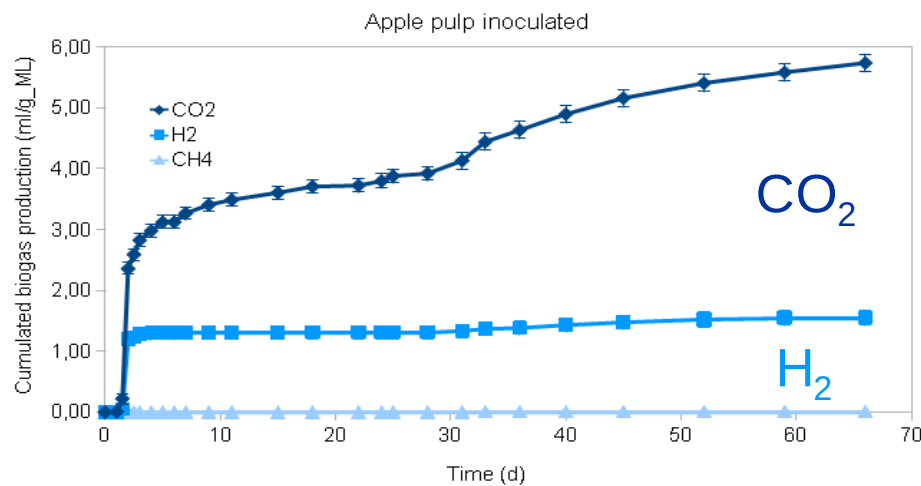
pH



soluble COD



Biogas production



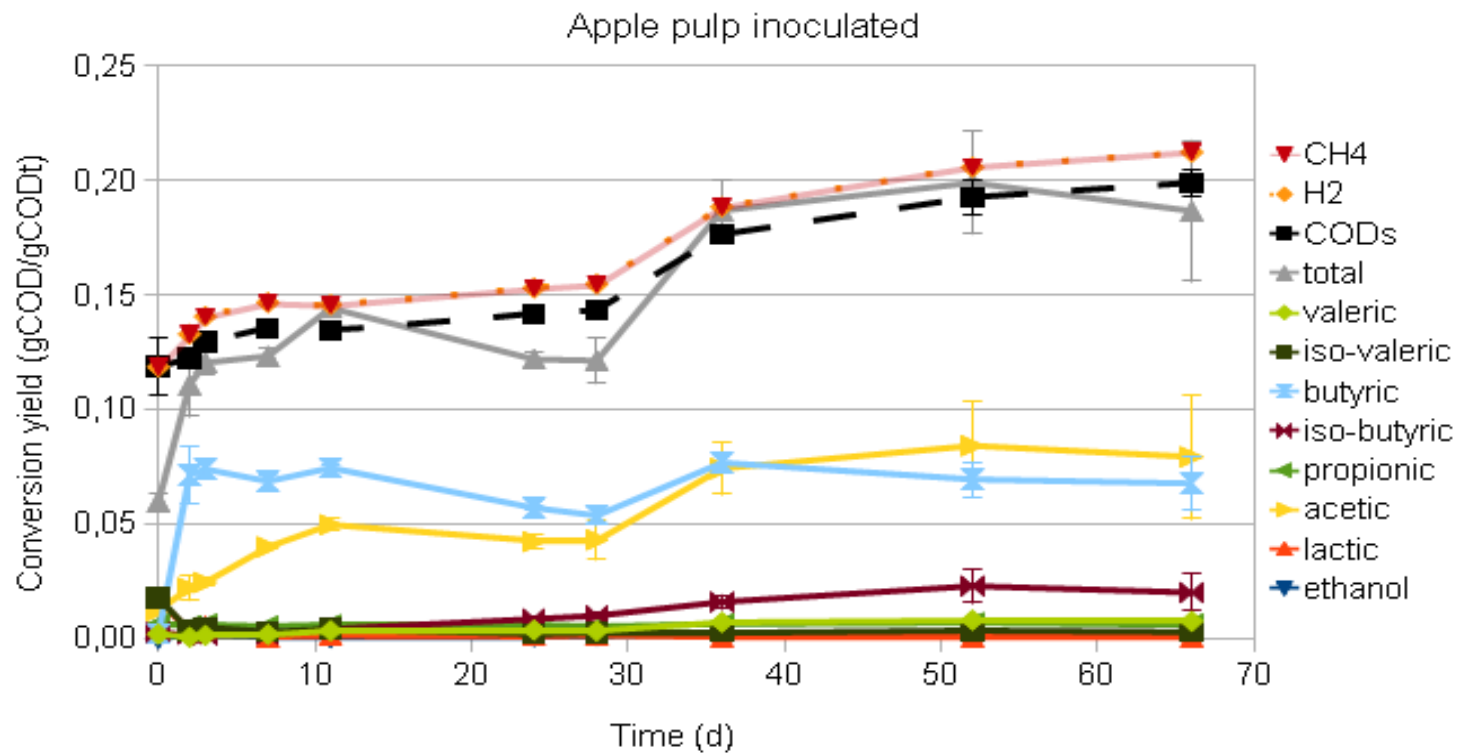
ML: Mixed liquor

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Results

VFA



	Maximum concentrations (gCOD/kg_ML)
Acetic acid	~ 7.0
Butyric acid	~ 6.2
tVFA	~ 16.2

ML: Mixed liquor ; tVFA: total VFA

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Conclusions & Perspectives

Conclusions :

- So far tVFA highest concentrations : ~ 20 gCOD/kg_ML
- So far highest conversion yields into tVFA : ~ 25 -30%
- Predominantly acetic and butyric acid

Perspectives :

- Identify optimal experimental conditions
- Test more substrates $\rightarrow$ correlation between product and substrate composition (if possible)
- Investigate margin of optimisation of concentrations before inhibition appears
- Examine microbial population $\rightarrow$ correlation between product and microorganism (if possible)