Targeting medium chain carboxylates in the cofermentation of cellulose and xylan

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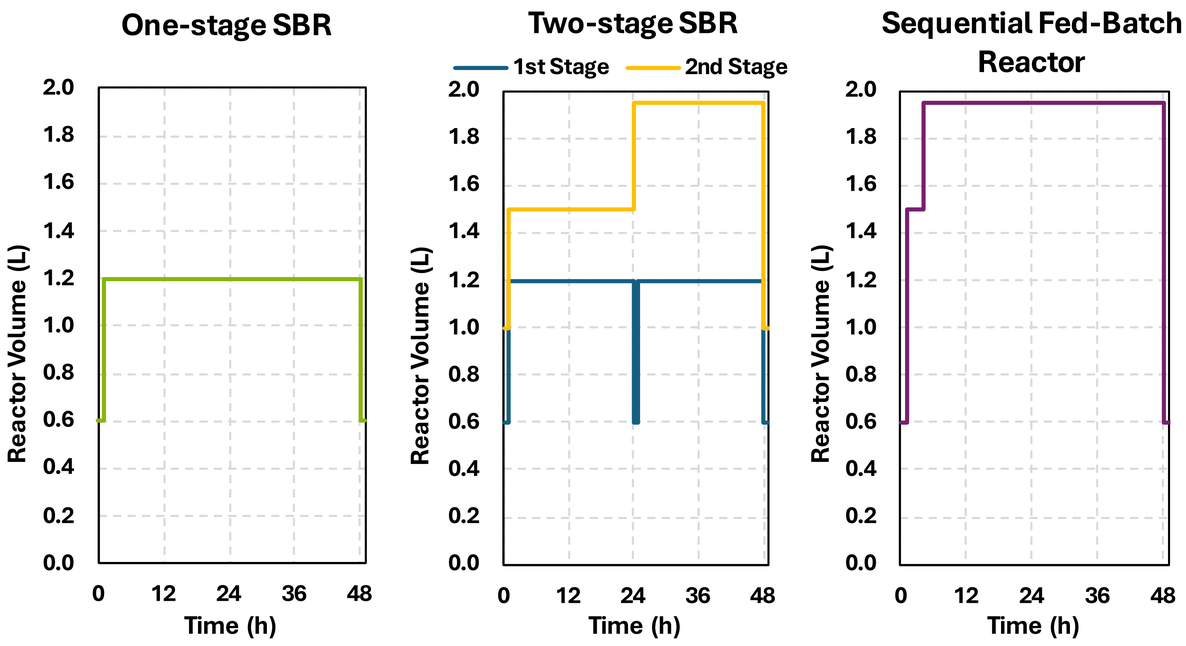
Introduction

This study aims to reach higher medium chain carboxylate (MCC) yields from lignocellulosic biomass by tailoring the reactor configuration to reach both a higher in situ production of the electron donor and its consumption in chain elongation. Despite the significance of cellulose and xylan as the two primary polymers of lignocellulosic biomass, no studies have mechanistically investigated their fermentation using model substrates.

Experimental setup

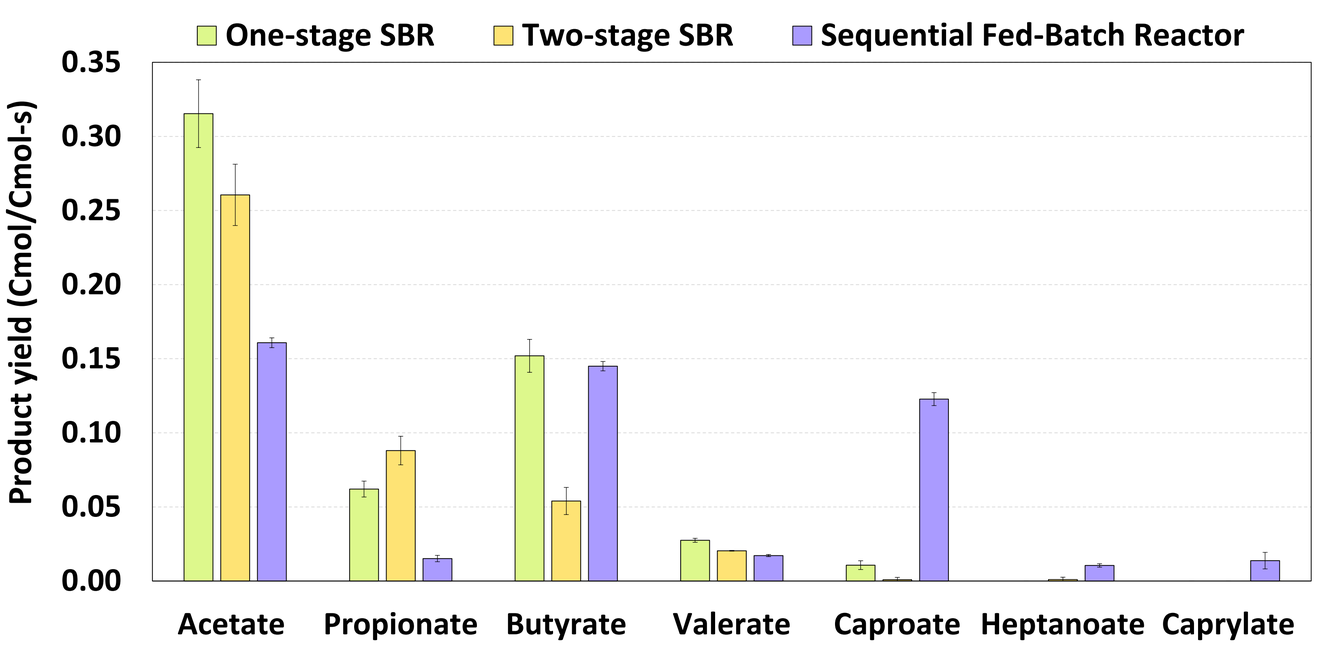
Three different reactor configurations were assessed in mesophilic conditions (37ºC).



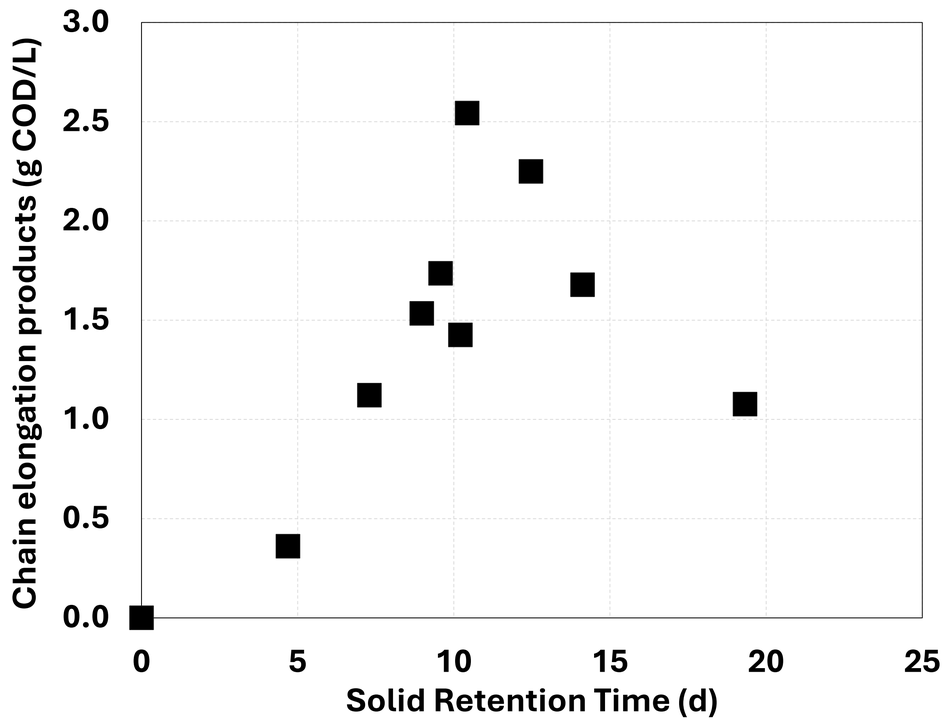
Parameter	One-stage SBR	Two-stage SBR		Sequential Fed-Batch Reactor
		1st stage	2nd stage	
pH	6.0	5.0	6.0	5.5
Working volume (L)	2.0	1.2	1.5 - 2.0	1.5 - 2.0
VER (%)	70	50	-	70
HRT (d)	3.0	2.0	4.0	3.0
OLR (g COD/L·d)	4.0	6.0	-	4.0

HRT: hydraulic retention time; OLR: organic loading rate; VER: volume exchange ratio

Results & Discussion



- One-stage SBR promoted lactate elongation towards butyrate
- Two-stage SBR shifted lactate consumption towards more propionate and less acetate and butyrate
- Sequential Fed-Batch Reactor yielded the highest caproate production



Controlled Solid Retention Time to 8 – 12 days in Sequential Fed-Batch Reactor yielded the highest medium chain carboxylate production

Conclusions

- One-stage SBR improved butyrate yields but limited caproate due to low lactate accumulation.
- Two-stage SBR promoted higher lactate accumulation, but did not steer its consumption towards medium-chain carboxylate production.
- Sequential fed-batch reactor maximised medium chain carboxylate production.
- Controlled SRT and pulsed feeding strategies favour chain elongation processes.

Acknowledgements

This research was framed in CELL4CHEM project (PCI2021-121989, ERACoBioTech 3rd call) funded by MICIU/AEI/10.13039/501100011033 and the European Union NextGenerationEU/PRTR. The authors belong to a Galician Competitive Research Group (ED431C-2021/37).