Butyric acid fermentation with in-situ products separation

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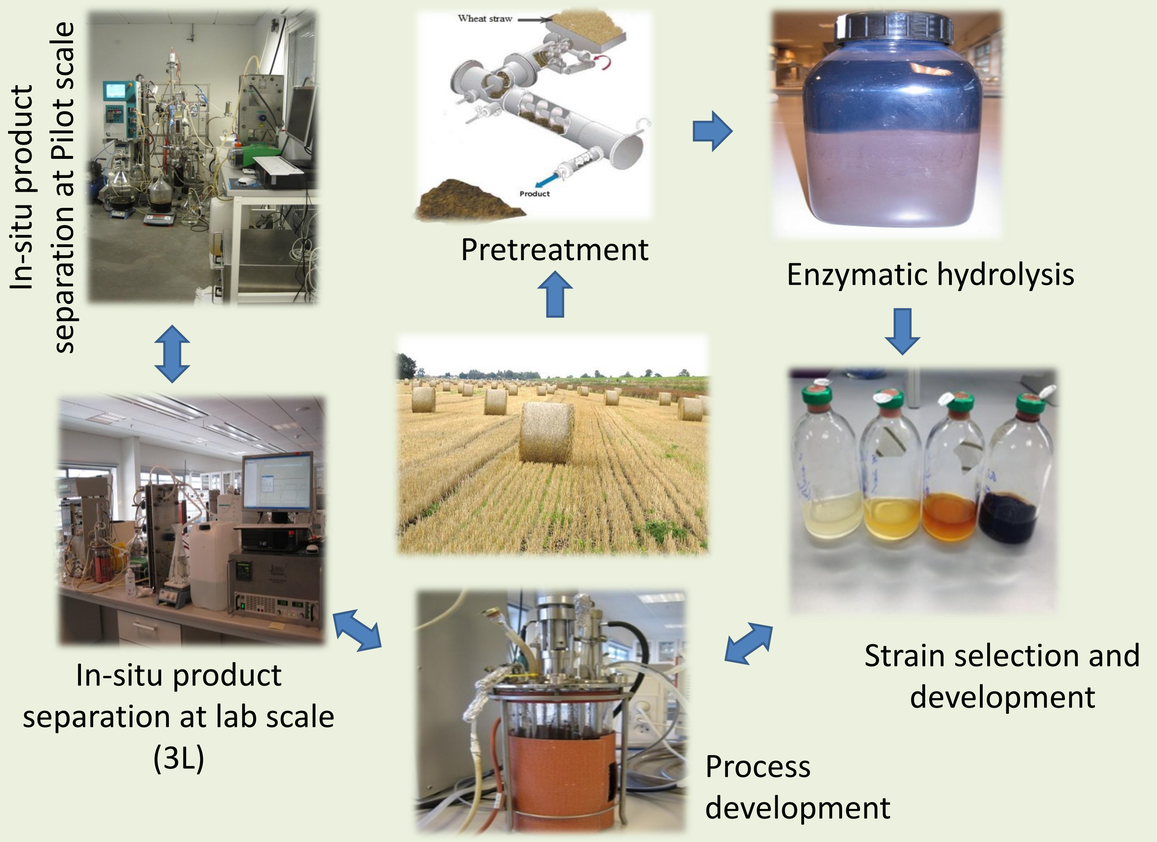
Background

Butyric acid and its esters are used as food supplements, as artificial flavours, as solvent and even its potential beneficial effects in intestinal and extra intestinal diseases and sickle cell disease have been reported. Another potential use of butyric acid is to produce butanol via catalytic hydrogenation. The demand of the butyric acid is approximately 50,000 ton/year.

The main **bottlenecks of commercialization** of biological production of acids (in overall) are:

(1) utilization of cheap feed stocks
(2) Proper strain selection &/or improvement
(3) Process development for higher productivity
(4) Downstream processing

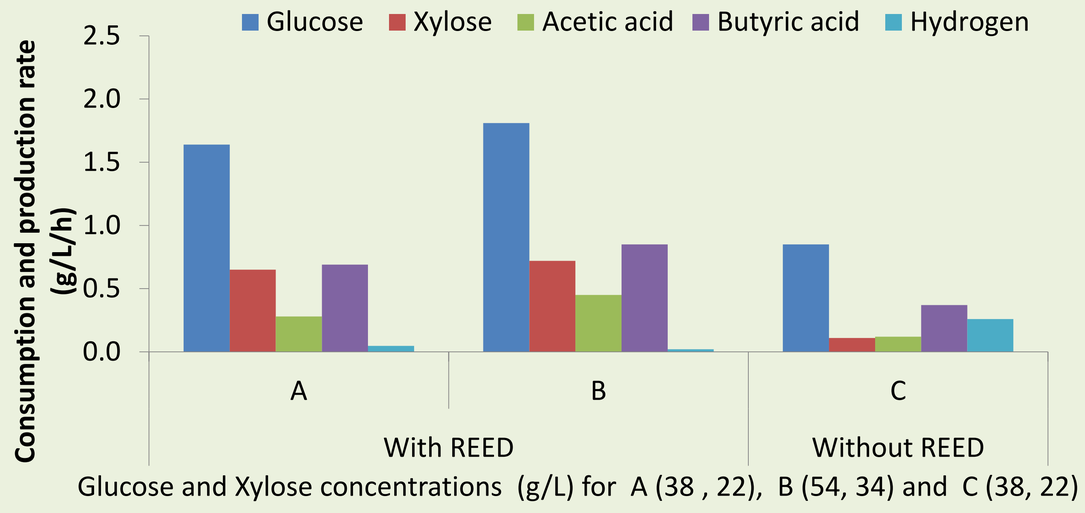
The first three aspects were successfully considered for biological butyric acid production from pretreated and hydrolysed wheat straw (PHWS) by *C.tyrobutyricum*. Continuous fermentation and in-situ separation of butyric acid increased C6 and C5 consumption and butyric acid production rates compared to batch fermentation without in-situ products removal. The process efficiency was verified in pilot-scale as well. However, further improvement of downstream process required.



Process model of butyric acid production from wheat straw

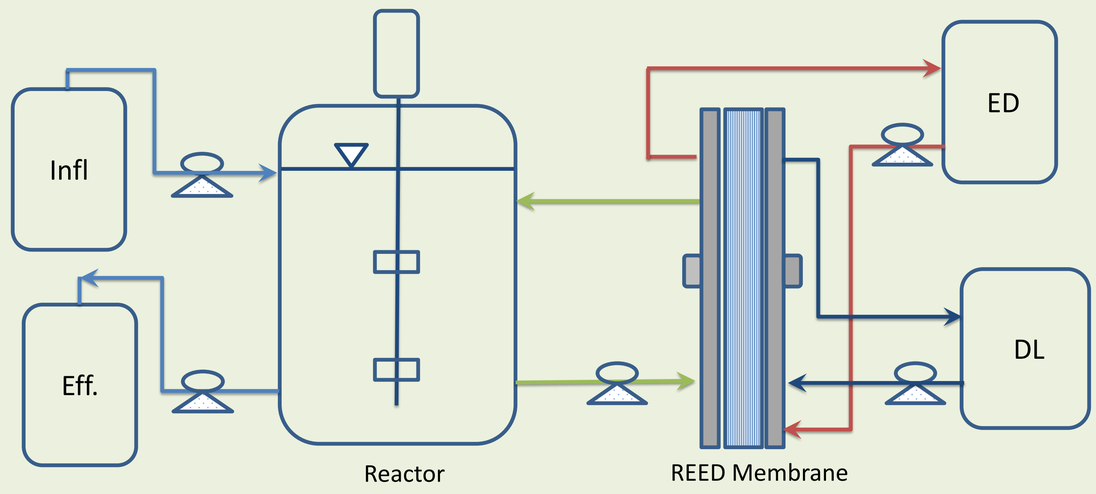
Results

Rates of synthetic medium (mixed glucose and xylose) based fermentation with and without in-situ acids separation by REED at HRT 1 day



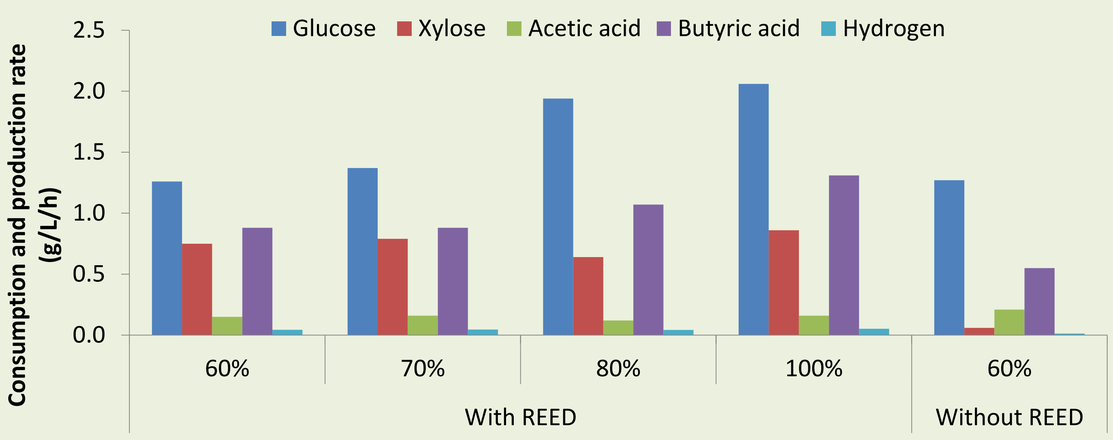
Glucose and Xylose concentrations (g/L) for A (38 , 22), B (54, 34) and C (38, 22)

Schematic diagram of the experimental setup



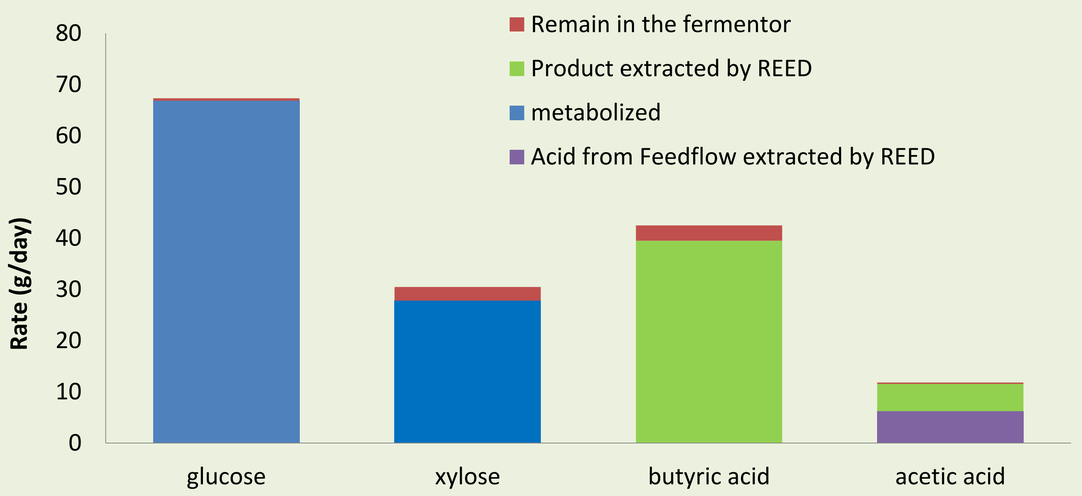
Infl = Inflow; Eff.= Effluent ;ED = Electrolyte; DL= Dyalyzate

Rates of PHWS based fermentation with and without in-situ acids separation by REED at HRT 1 day



% (v/v) PHWS in a medium with

Continuous fermenation of 100% PHWS with REED



Conclusion

- Fermentation coupled with REED in-situ separation of PHWS with the adapted *C. tyrobutyricum* gave a higher (**28 to 58%**) butyric acid yield compared to synthetic medium fermentation.
- Continuous fermentation exhibited much higher (**>600%** for 60% PHWS) sugars consumption rates compared to batch fermentations
- With REED in-situ acid seperation results higher sugars consumption rate and C4 production rates (**> 46%**)
- Fermentation coupled with REED in-situ separation of **100% PHWS** continued unhindered with just urea and K_2HPO_4 added reaching a productivity of **1,31 g/l/h** butyric acid production and **97%** sugars utilization

Acknowledgement

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