Whey Rich Dairy Waste – A Biorefinery Feedstock

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Investing in Opportunities
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INTERREG IVB

Dairy waste

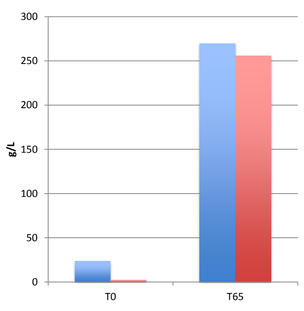
Whey, a cheese making by-product, is a major economical and environmental challenge for the world's dairy industry. Over 200 million tons of whey is generated annually. In this case study, we view whey as a valuable source of carbohydrates for production of valuable biochemicals and solvents.

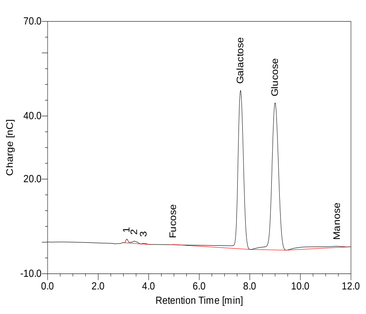
Enzymatic hydrolysis

Enzymatically treating the waste whey prepares it as a valuable feedstock for biorefining processes.

The typical Composition of an acid Whey product includes 30% carbohydrate.

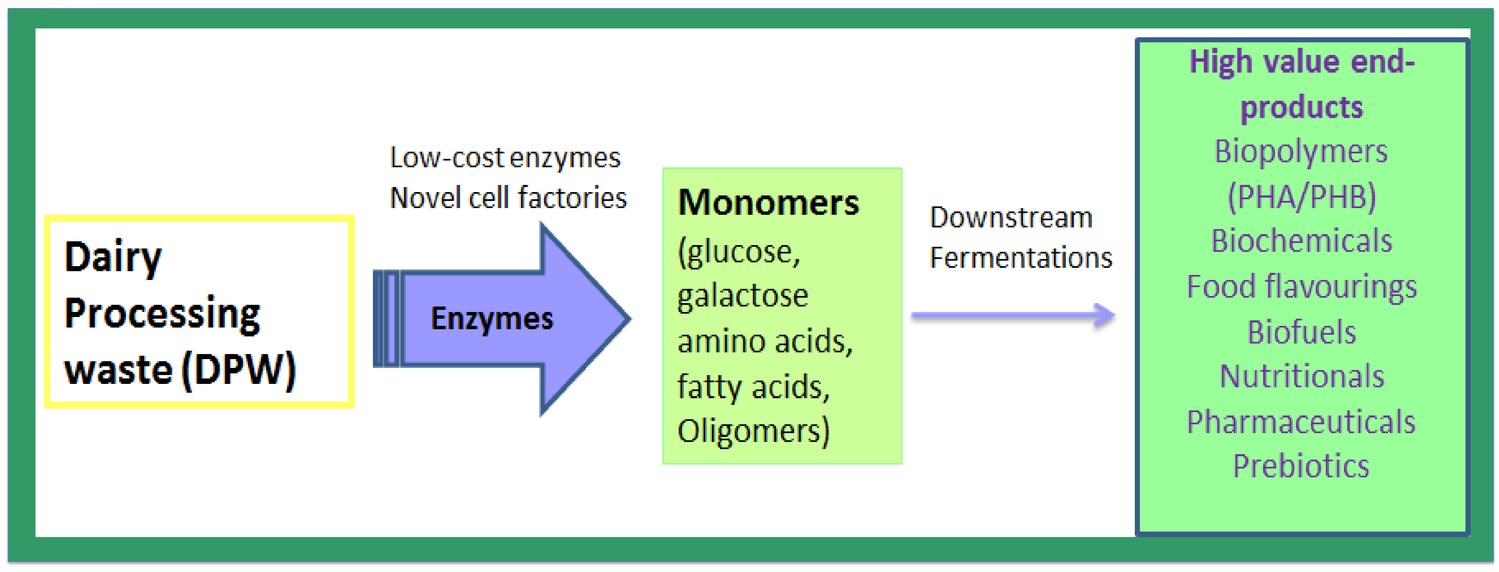
The carbohydrate portion consists mainly of the disaccharide lactose. Enzymatic hydrolysis of lactose using a β-galactosidase enzyme-rich preparation releases the free simple sugars galactose and glucose. In this study, maximum yields of simple sugars were detected after 65 h incubation.





Yield: 135 g galactose & 128 g glucose per Litre waste whey.

This equates to 90% conversion of the total sugar available in the whey product.

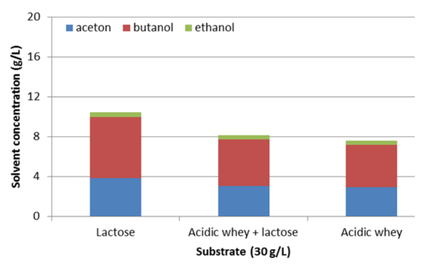


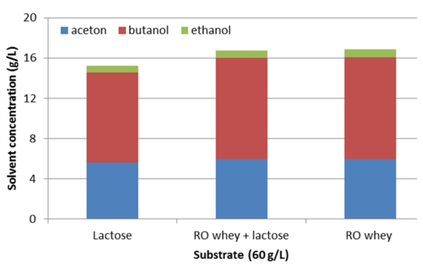
Fermentation to biochemicals and biofuel

BUTANOL PRODUCTION

Inhibition tests in shake flasks:

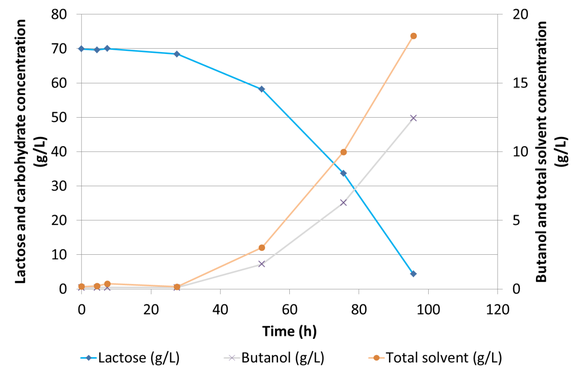
- Solvent production on various whey hydrolysates is comparable to lactose
- High solvent production on lactose shows that no enzymatic hydrolysis is required
- Enzymatic treatment sometimes results in lower solvent levels.





Fermentor tests on concentrated whey:

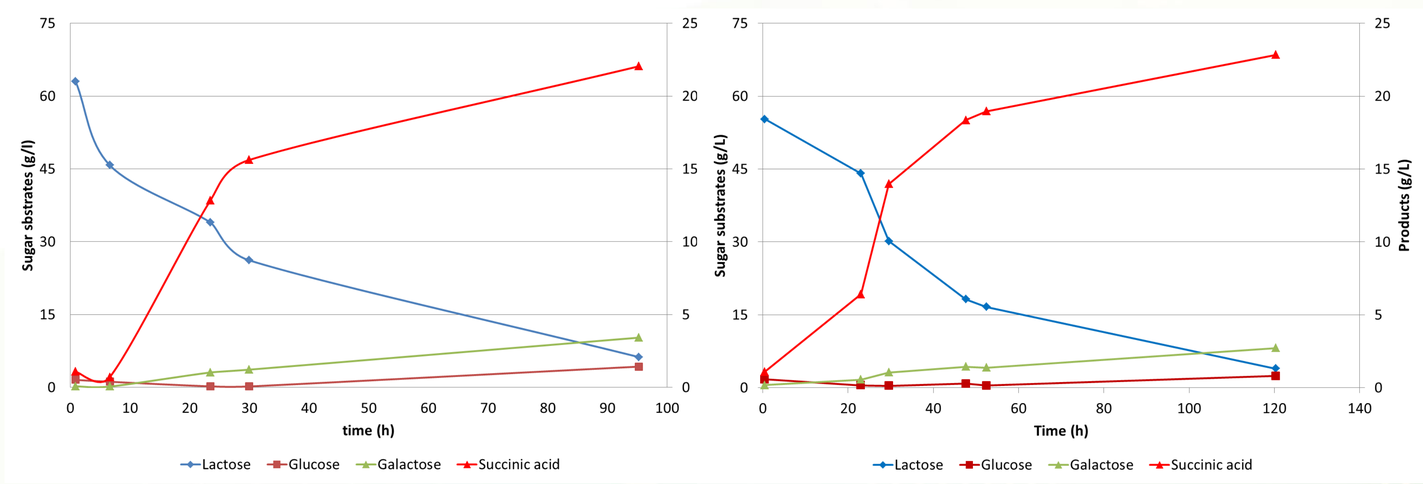
- Lactose is completely converted to solvents (without need for enzymatic pretreatment)
- Total solvents (acetone-butanol-ethanol) concentration reaches 18 g/L, which is the maximum for this bacterium.



SUCCINATE PRODUCTION

STEP 1: Preliminary trials showed that no enzymatic hydrolysis of lactose in whey was required prior to succinate fermentation.

STEP 2: Process performance on various whey types was compared to performance on lactose in fermentor set-ups. Trials showed similar results on pure lactose (left graph) and e.g. concentrated whey (right graph). The tested whey streams did not show any inhibition effects to the process.



STEP 3: Continuous fermentations were run with integrated membrane technology (electrodialysis) for *in-situ* succinate recovery.

Conclusions

The poster illustrates results of a trans-national case study in which dairy whey, a readily available by-product from cheese production and dairy processing is valorized in various ways:

- by applying a low cost enabling enzyme technology resulting in a feedstock with potential for production of high value nutraceuticals or biochemicals or
- by directly fermenting it to biochemicals or biofuels.

Trials have shown that production of succinate and butanol is possible from non-hydrolyzed wheys.

Some wheys contain high levels of non-sugar components (e.g. calcium, sodium,); recovery of these ions is of value and is likely to improve fermentation efficiency.

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