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Succinic acid production from Jerusalem artichoke tubers

Ingólfur B. Gunnarsson, Dimitar B. Karakashev and Irimi Angelidaki

Succinic acid

- Succinic acid is currently produced from petro chemicals.
- Has applications in agricultural, food, chemical and pharmaceutical industries.
- *A. succinogenes* 130Z produces succinic acid in large amounts during fermentation.
- Theoretically consumes 1 mol CO₂ per 1 mol succinic acid produced.
- Could contribute to the abatement of CO₂ emissions at a time when CO₂ levels in earth's atmosphere are at an all time high (>400 ppm).

Jerusalem artichoke tubers

- Root vegetables rich in inulin.
- Inulin is a D-fructose and D-glucose polysaccharide.
- Poor digestibility in humans.
- Investigate using Jerusalem artichoke tubers for producing succinic acid.



Results

Fermentation of pure sugars (batch bottles):

Succinic acid (SA) yield was 83% when D-glucose was the substrate compared to 72% yield SA when D-fructose was the substrate.

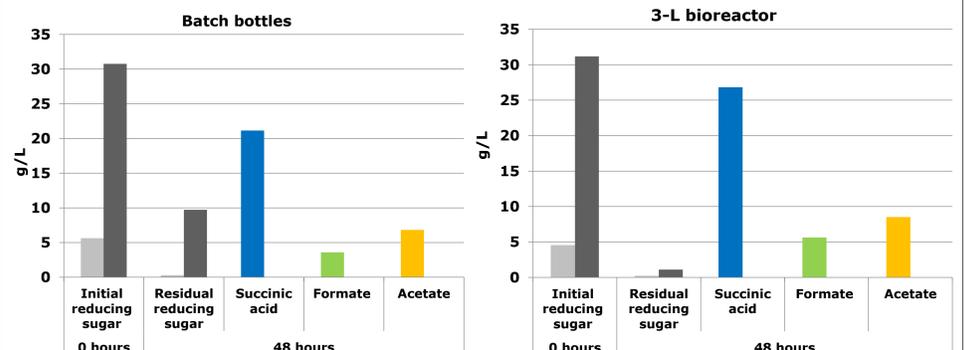
D-glucose utilization was 93% compared to 88.5% D-fructose utilization.

		Glucose	Fructose
0 hours	Initial reducing sugar (g/L)	48.0±0.5	46.2±0.3
48 hours	Residual reducing sugar (g/L)	3.4±0.2	5.4±0.1
	Succinic acid (g/L)	37.2±0.6	29.4±0.1
	Formic acid (g/L)	5.8±0.2	7.0±0.2
	Acetic acid (g/L)	8.2±0.1	7.2±0.5
	Sugar utilization (%)	93.0±0.5	88.5±0.2
	Succinic acid yield* (%)	83.0±1.3	72.0±0.5

Results

Fermentation of tuber hydrolysates:

SA yield was 80.2% in bottles compared to 77.9% in 3-L bioreactor. However the SA production was increased by 26.4% in 3-L bioreactor and the D-fructose utilization increased from 68.5% to 96.5%.



Conclusions

- This is the first report on the use of Jerusalem artichoke tuber hydrolysate as substrate for succinic acid production by *A. succinogenes*.
- Succinic acid was successfully produced, where the highest succinic acid concentration was 26.8 g/L and the highest succinic acid yield observed was 80.2%.
- *A. succinogenes* 130Z utilized both D-fructose and D-glucose in the tuber hydrolysates.
- The importance of pH control and its effect on D-fructose utilization during succinic acid production was clearly observed when results from batch bottles and 3-L bioreactor were compared.
- Jerusalem artichoke tubers as raw material for succinic acid production is a very attractive option compared to other types of biomass tested for succinic acid production.