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A biorefinery for the Øresund region based on local renewable resources

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Abstract

The demands of modern society are increasing pressure on natural resources while creating the need for a wider range and larger amounts of products. As the global population expands, so does the production of waste and the necessity for efficient land-use. With this, the need for local solutions for providing the population with energy, food and other products as well as efficient handling of waste is apparent. The Øresund region is a transnational area, centered on the cities of Malmö (in Sweden) and Copenhagen

(in Denmark). The region has a strong profile in terms of biotechnology, with established large and smaller industries, 3 universities and a rich agricultural tradition and is supported by regional authorities in promoting sustainable technologies and cross sector collaboration towards the biorefinery concept. The Øresund Biorefinery project draws on the wealth of resources in the region in an initiative encompassing the entire biorefinery concept from selection and cultivation of biomass feedstocks through process design and towards scaled-up efficient production guided by life cycle assessment.

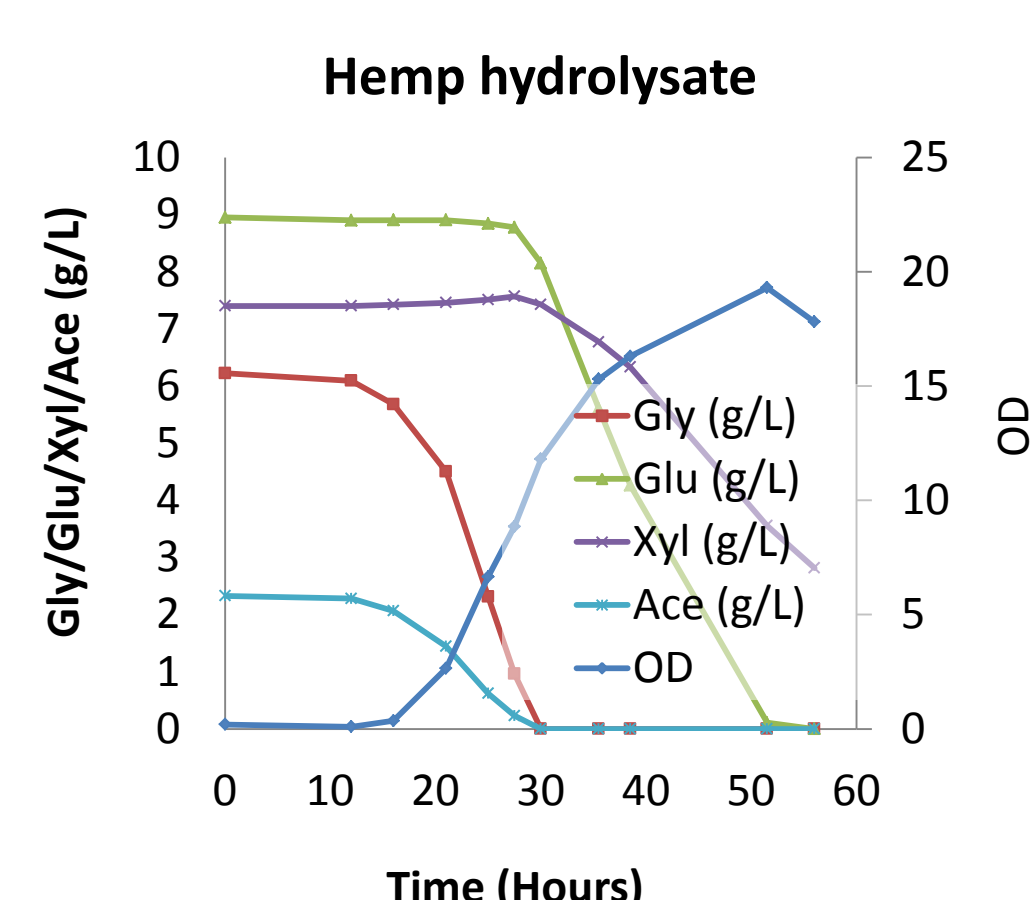


Figure 1: *Y. lipolytica* is able to utilise all the available sugars found in hemp hydrolysates after acid pretreatment.

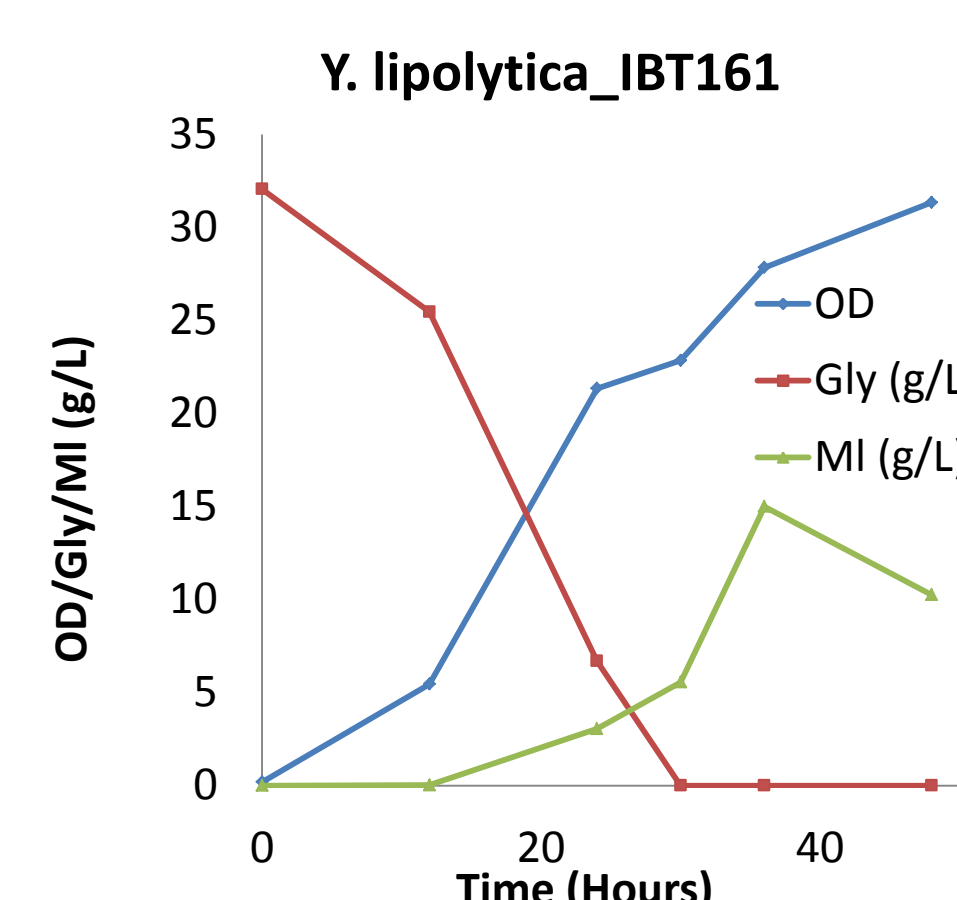


Figure 2: *Y. lipolytica* produces mannitol from glycerol under oxygen limited conditions. This is being optimised as one of the case production processes of the biorefinery.

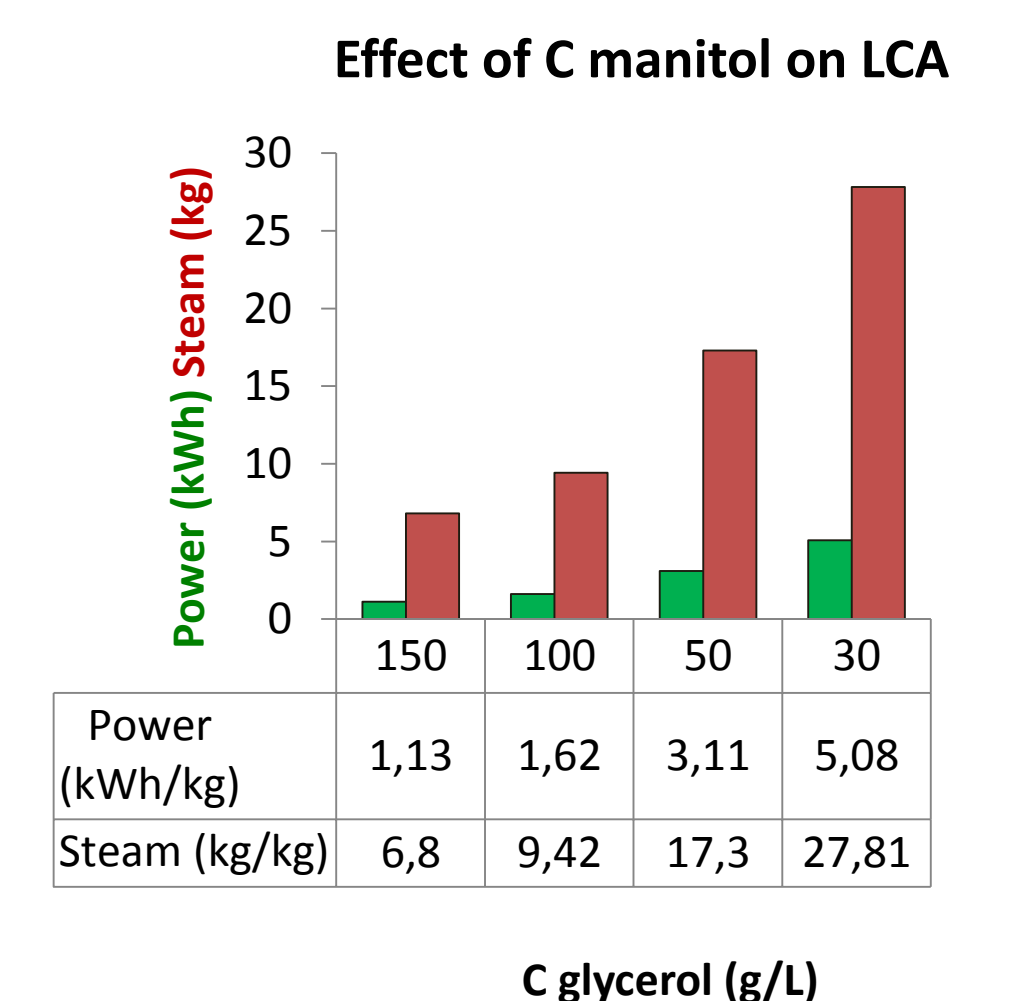
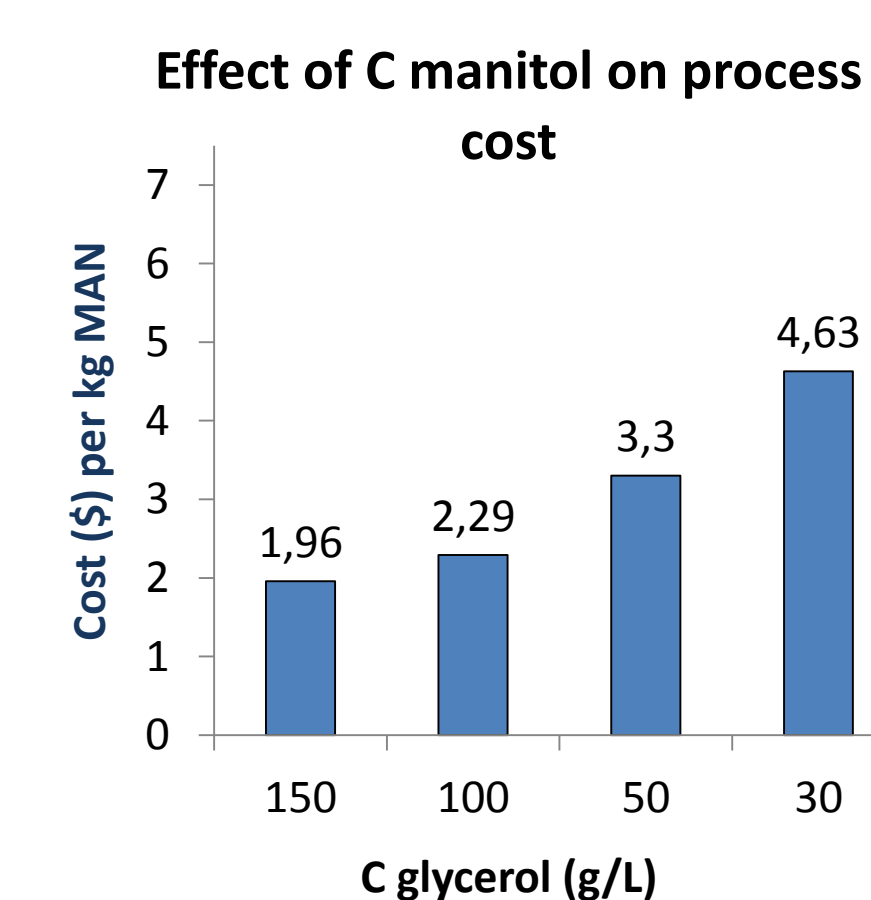
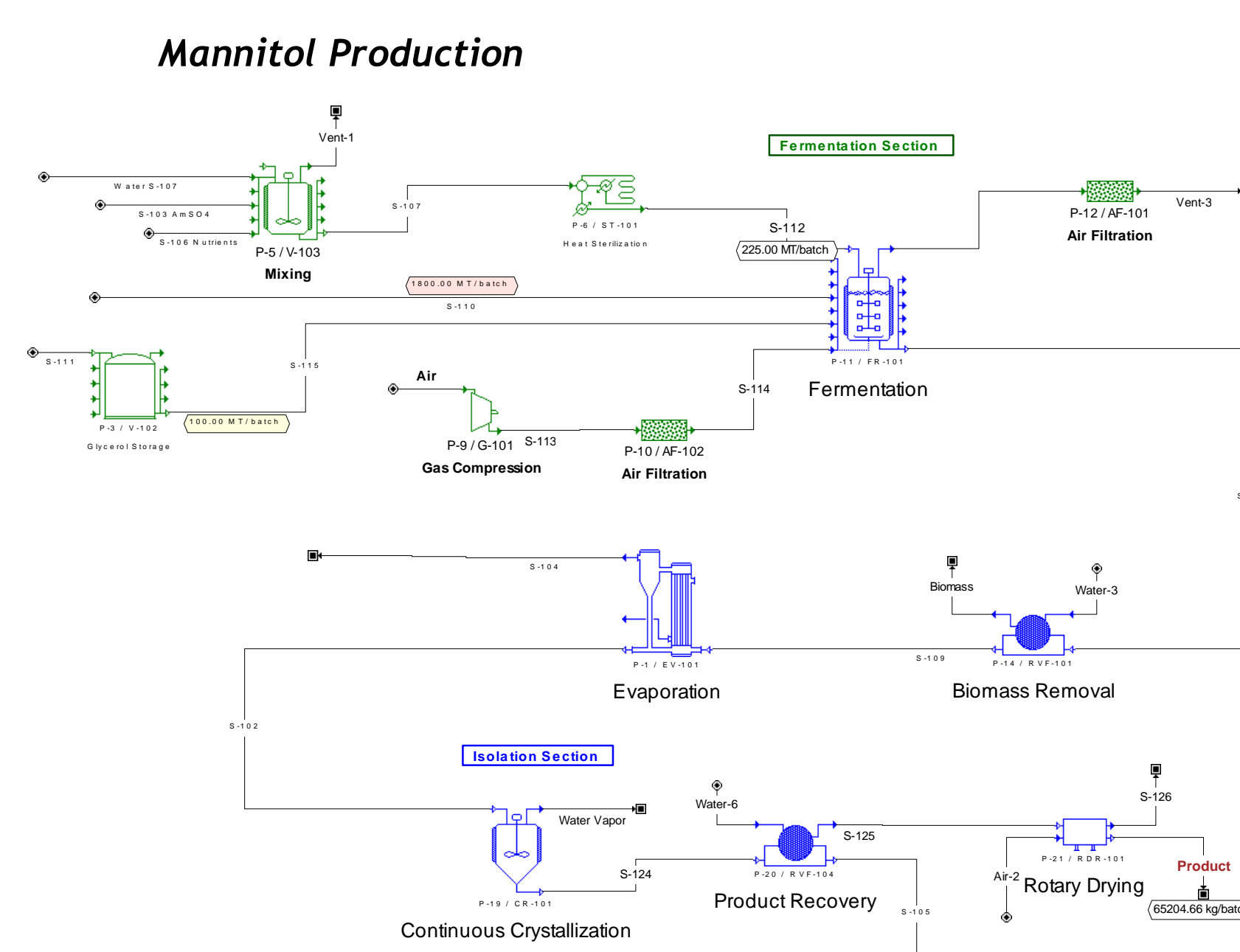


Figure 3 a and b: The final concentration of product in the fermentation broth has a high impact on both production cost (left) as well as on the environmental performance (energy use) (right)

Renewable resources

Crops native to the region are selected and cultivated Hemp, chicory and Jerusalem artichoke tubers and stems have been employed as substrates.

Pretreatment

Plant biomass hydrolysates are used as the substrates for submerged bioprocesses. Crude glycerol (the biodiesel production by-product) is also attractive as a sole carbon source or supplement to the plant hydrolysates.

Sustainable bioprocesses

Characterisation and improvement of cell factories for biorefineries is a vital step in the process. The yeast *Yarrowia lipolytica* has been applied due to its versatility in substrate use (Figure 1) and product formation.

Bioprocess assessment

Bioprocess design and product selection is guided by simultaneous life cycle assessment, determining the economic and environmental viability of the proposed processes. Production and yield targets are then set in order to drive the development of sustainable processes, not just in terms of feedstocks but also the environment and economy.

Optimisation and scale-up

A pilot scale test biorefinery (total capacity > 25m³) has been established, creating a solid foundation for development and implementation of biorefineries in the region. Processes developed within the project will be scaled up in this facility, providing improved process knowledge and pilot scale data for LCA.

Summary and Conclusions

By bringing together project partners covering all aspects of biorefinery processes, the project has facilitated expansion and diversification of the knowledge base on biorefineries, their environmental benefits and growth potential for the Øresund region.