Eco-friendly Production of Succinic Acid from Biofuel Waste Using a Consortium of Metabolic Engineered E.coli Strains

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INTRODUCTION

In the search for decreasing our CO2 footprint, the compass often points towards biofuel as the Holy Grail. However, the biofuel production results in by-product formation which there is a need to dispose of. One of these major by-products is hemicellulose which is currently not value creating or usable in the industry or elsewhere. This idea presents a solution to this problem.

THEORY

The idea involves the use of a consortium of metabolic engineered E.coli strains for the eco-friendly production of succinic acid (and other acids) from biofuel waste, since this job cannot be done using only one strain. A compound such as succinic acid, which have world wide application ranging from food flavours to corrosion inhibitors, can be produced using genetically modified E.coli. Succinic acid is a bulk chemical with a global production rate of 30,000-50,000 tonnes per year and an estimated market of $180,000,000-450,000,000 per year. Today succinic acid is mainly produced by chemical synthesis with the use of fossil fuels. This project could be used not only to help the biofuel industry with its by-product waste problems, but also contribute to the succinic acid production industry with a green alternative. With the use of hemicellulose a problem arises, since no single organism, genetically modified or wild-type, has been found to efficiently utilize both glucose and xylose, the building blocks of hemicellulose, for growth or production of a single compound. By using multiple organisms each strain can be genetically optimized to use solely one carbon source, hereby enabling a consortium of strains to utilize different carbon sources for the production of succinic acid. This requires advanced knowledge within fermentation technology and microbiology. In this case succinic acid is a very desirable compound to produce from a waste product, since it is fairly easy to produce in E.coli, and easy to recover and purify, while regulations are less strict for bulk chemicals than for biopharmaceuticals.

METHODS AND RESULTS

In this project a literature study has been conducted in order to establish knowledge regarding the genetic modifications needed and a cultivation strategy. Furthermore a tremendous amount of work has been put into the modelling of metabolic pathways and the genetic modifications to these, while also designing the fermentation strategy.

CONCLUSION

E.coli is a very suitable organism for this type of industrial application, since it is very easy to genetically modify, cheap to cultivate, and very well-known. Using genome scale metabolic modelling, advanced molecular biological tools and analysis methods, two strains can be developed and co-cultivated in the same fermentor, producing eco-friendly succinic acid from biofuel waste.