CONVERSION OF ANAEROBIC DIGESTED GRASS INTO PHAs BY HIGH CELL DENSITY FERMENTATION STRATEGIES.

Federico Cerrone[1], Reeta Davis[1], Gearoid Duane[2], Santosh Choudhari[3], Eoin Casey[2], Ramesh Padamati[3], Kevin O'Connor[1].*

[1]School of Biomolecular and Biomedical Science, Centre for Synthesis and Chemical Biology, and Competence centre for Biorefining and Bioenergy, University College Dublin, Belfield, Dublin4, Ireland.
[2]School of Biochemical & Bioprocessing Engineering, University College Dublin, Belfield, Dublin4, Ireland.
[3]Materials Ireland, Polymer Research Centre, School of Physics, Trinity College Dublin, Dublin2 Dublin, Ireland

*federico.cerrone@ucd.ie

Grass biomass is a worldwide biome that covers 70% of the agricultural land. This biomass accounts for a 13 billion dried metric tons value. The average composition is 25-40% cellulose (C6 polymer), 25-50% hemicellulose (C5 sugar-rich with some C6 sugars) and 10-30% lignin. The ratio of cellulose/hemicelluloses/lignin can vary according to the grass species/maturity and seasonality of the same. The carbohydrates abundance makes it interesting for fermentation purposes. Grass biomass can be suitable for biofuel production (bioethanol/biobutanol and biomethane) and also for different biobased chemicals and polymers (e.g. PHA, PLA via lactic acid). The carbohydrate sugars can be obtained with different physical, chemical, and biological pretreatments. Fermentation strategies that use pretreated grass could be suitable substrates for bacterial fermentation to produce PHAs. However this has not been tested to date. An integrated approach that mixed primary treatment (intended as pressing/enzyme hydrolysis) and secondary (fermentation strategies) in a biorefining perspective was the basis of our study. In this sense we used fed-batch strategies to achieve both high cell density (50-72 g/L) (Figure1) and PHA production in a fermentation process with substrate coming from anaerobic digestion of grass. Mathematical models were applied to optimize the feeding profile of such a substrate and increase PHAs productivity. PHAs monomer composition was mostly (60-70%) made by (R)–3-hydroxydecanoic acid and (15-20%) of (R)–3-hydroxyoctanoic acid, with equal minor proportions of hydroxhexanoic and hydroxydodecanoic acid.

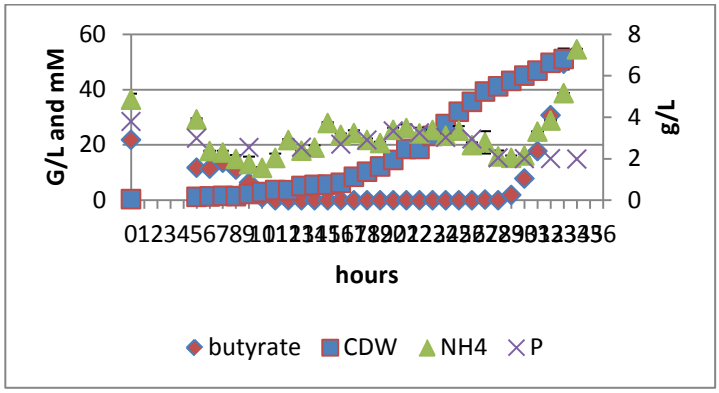

Figure1. Fed-batch for high cell density fermentation.