Cascade strategies for the full valorization of ley grass towards edible protein extraction and biofuel production

XANTHAKIS E. (1), ELIASSON L. (2), DEL PILAR CASTILLO M. (2), JOHANSSON E. (3), GUNNARSSON C. (2)
1 Cyprus University of Technology, Limassol, Cyprus
2 RISE Research Institutes of Sweden, Uppsala, Sweden
3 RISE Processum, nskdsvik, Sweden

Abstract

Ley (different species of grass and leguminous plants), is widely grown on the arable land of many north & central European countries. Although ley is important for crop rotation and landscape diversity, it is an underutilized resource which is still a promising raw material for food, feed and energy production. In this project, based on a zero-waste circular economy concept we studied an agricultural biorefinery system using ley by combining extraction of high-value components such as proteins with biofuel production. In the first step ley was fractionated into liquid and solid streams. The liquid stream went for protein extraction, the solid fraction was directed for ethanol and biooil production and the remaining organic matter was tested for biogas production.
Fresh and ensiled timothy ley after screw pressing were characterized, and valuable components for food applications were identified. Methods to increase yield and quality of the protein concentrate were also evaluated. The crude protein yield in the liquid fraction found to be higher for ensiled timothy compared to fresh but showed lower levels of true protein due to polypeptide chain degradation into smaller peptides and free amino acids during the ensiling process. The amino acid composition of both ensiled and fresh timothy was similar to that of soya beans. Protein precipitation of the liquid fraction from fresh ley using heat coagulation and isoelectric precipitation resulted in similar protein content in the concentrate. Enzymatic treatments combined with pressing increased the protein yield of the process.
The solid fraction after screw pressing was tested for ethanol and/or biooil production through HTL, hydrothermal liquefaction. The process found to be stable and the bio-oil produced was of high quality with high energy value and low ash content.
The potential to utilize the organic matter remaining in the residual water fractions after protein extraction (brown juice) and biooil production was tested for methane production in lab tests. The biogas production from the brown juice was fast showing that the remaining carbon was easily available.

Acknowledgements
The project was funded by the Swedish Energy Agency.