WAGENINGEN UNIVERSITY & RESEARCH

WUR Knowledge Base Programme

Circular and climate neutral society

KB34-3A-5. Biofuels Research Infrastructure for Sharing Knowledge II (BRISK2)

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Background

The vision of BRISK2 (Biofuels Research Infrastructure, www.brisk2.eu) is to establish a European Centre of Excellence in the field of biorefining by virtual coupling a 55 lab, pilot and demo facilities at 15 leading research institutes.

In parallel, a joint research programme is executed, dealing with biomass characterisation, digestion, fermentation, combustion, gasification, pyrolysis, catalytic conversion, process integration, biorefining and integral chain development, assessment and optimisation. The focus of Wageningen Food and Biobased Research within this R&D-programme is on the separation and valorisation of proteins from protein-rich raw materials.

Project objectives

Biomass contains a variety of components, which can be valorised for different applications. When biomass is processed into a biofuel, a part of the biomass is unutilized. As raw materials costs usually account for a large part of the production costs, these costs can be reduced by utilizing a larger part of the biomass for different products. The biorefinery of biomass into a product with a high added value (e.g. food protein) combined with the production of a biofuel (ethanol), increases not only the circular use of the biomass but also the economic potential of the products.

One of the experimentally explored downstream processing routes focused on the extraction of protein from two agri-food side streams: brewers spent grain (BSG) and palm kernel meal (PKM). A side stream from the protein extraction process is the press cake, containing mainly fibres. The fibres can be hydrolysed into sugars. The obtained sugar crude can be fermented into ethanol.

A conceptual process is designed for the integration of the protein extraction and the ethanol production in a biorefinery. The conceptual process is designed for an industrial scale biorefinery and is used to techno-economically analyse the performance. The results of the virtual biorefinery of both BSG and PKM are evaluated.

Results

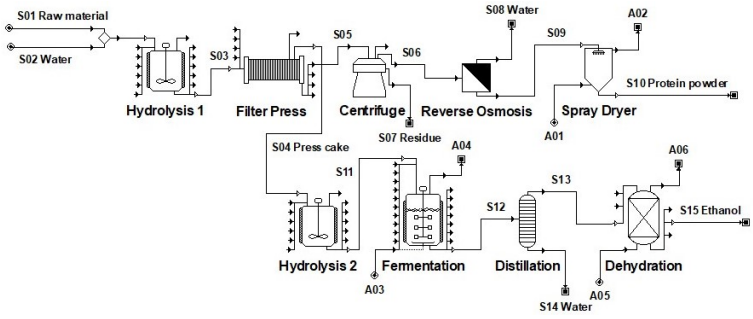

Figure 1 Simplified process flow diagram of the biorefinery of BSG and PKM

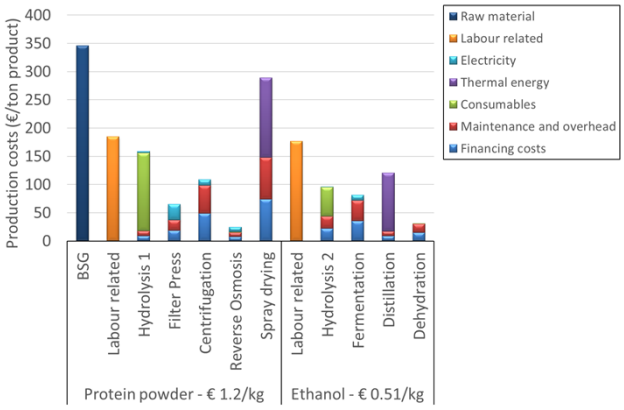

Figure 2 Estimated production costs of protein powder and ethanol from BSG

Table 1 Revenues, costs, and economic indicators of the biorefinery of BSG and PKM

	BSG	PKM
Revenues and costs (M€/y)		
Main product revenue	12.9	8.1
By-product revenue	4.5	6.5
Raw materials cost	2.5	4.0
Thermal energy cost	1.8	1.8
Electricity cost	0.4	0.5
Consumables cost	1.4	1.5
Labour related costs	2.7	2.7
Maintenance and overhead	1.8	1.8
Cash cost of production	6.0	5.8
Fixed capital (M€)	17.6	17.9
Economic indicators		
Average cash flow (M€/yr)	5.2	2.1
Simple pay-back period (y)	3.4	8.3
Net present value (M€)	29.6	1.4
Internal rate of return	29%	3%

Conclusions

In both biorefineries, the raw material costs have a significant contribution to the production costs. The raw material costs of PKM are higher compared to BSG.

The techno-economic evaluation shows that for the biorefinery of BSG the revenues of both the protein powder and the ethanol are higher compared to the production costs. In the biorefinery of PKM the production costs of the protein powder are higher compared to the revenue. The margin on the ethanol production however is larger for PKM compared to BSG.

Overall, the economic performance of the biorefinery of BSG is much better compared to the biorefinery of PKM. With an internal rate of return of 29% the biorefinery of BSG has a high economic potential. Despite the high raw material costs, the biorefinery of PKM makes a small profit.

The presented virtual biorefineries demonstrate the economic potential of integrating the production of a high added value product, like protein powder for food applications, with the production of a biofuel, like ethanol, from the remaining biomass. The biorefining of a larger part of the biomass of the raw material into different products generates more revenues with the same raw material costs, which makes the biorefinery overall profitable.

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