Biorefineries – A sustainable Approach of Utilizing Brewers' spent Grains

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Abstract

Biorefineries have been a recurring part of discussions in industry, society, politics and research for many years. A wide range of chemicals, bioplastics and biofuels are produced in large quantities from different sources of biomass. Traditionally, first generation feedstock like starch, sugar or plant-oils are deployed in large-scale applications. Due to the competition with the direct use of these agricultural products as food or feed, the focus of attention switched to the use of lignocellulosic feedstock as raw material for biorefineries, so called second-generation feedstock. These are mainly (soft-) woods, short rotation coppice, like poplar or switchgrass and other agricultural by-products, for example wheat straw. However, it is questionable whether deploying lignocellulosic feedstock has a smaller influence on the food sector than deploying first-generation feedstock. The upcoming debate in this case is no longer whether agricultural products serve as a food or as an industrial crop, but rather a competition for farmland and the best economic value. In addition, resource efficiency has to be considered a relevant factor, since first-generation biorefinery feedstock achieve higher yields of fermentable sugars per cultivation area, than lignocellulosic agricultural products do, due to long lasting farming expertise and ongoing technological progress. One way to overcome this dilemma is the use of byproducts or waste streams as feedstock for biorefineries. The Interreg project Bioval is focusing on developing a biorefinery-concept based on brewery residues, so-called brewers' spent grains (BSG), in order to generate value by utilizing all process streams. Approximately 39 million tons of BSG, that mainly consist of structural carbohydrates, proteins and lipids, are generated worldwide per year. BSG is predominantly used as animal feed, which is distributed with a market value of approximately 35 € per ton [1]. Additionally to low economic value, there are studies that show a possible negative effect on meat and milk quality when feeding grains [2, 3]. A partial switch to grass feeding could lead to high amounts of potentially available BSG. Especially, the contained structural carbohydrates in BSG can be converted into fermentable saccharides for microorganisms after suitable pretreatment steps. This allows, for example, the biotechnological production of drop-ins for existing (petro) chemical synthesis pathways and the fabrication of biofuels. The focus of this research lies on hydrothermal pretreatments with subsequent enzymatic saccharification. These pretreatments have been deployed because of the use of nontoxic, inexpensive and readily available solvents, like ethanol and water. In addition to a maximum yield of fermentable sugars, it is essential that the formation of hydrothermal degradation products is kept low, since these can act as inhibitors in subsequent fermentations. This leads to an optimization task that has to be solved.

[1] Mussatto S. (2014): Brewer's spent grain - a valuable feedstock for industrial applications.
[2] Dalexy C., et al.: A review of fatty acid profiles and antioxidant content in grass-fed and grain-fed beef.
[3] Leiber F., et al.: Implications of feed concentrate reduction in organic grassland-based dairy systems: a long-term on-farm study.

This project is financially supported by EFRE-Interreg (EU-Interreg-Project 018-4-09-021)