

# A Novel Process to Highly Improve the Bioethanol Production

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In 2007 the bioethanol-industry produced 24.5 billion liters of ethanol and 15.4 billion kg of distillers dried grain with solubles (DDGS) – a left-over which can be used for livestock feeding. This co-product does however contain enough carbohydrates to increase the total bioethanol production by 12.2%, thus giving it a huge potential impact on the process economy.

The current application of DDGS is associated with a series of problems (high content of fibers, sulfur, phosphorous, possible presence of mycotoxins and high batch variation), that reduces its market value. To avoid some of these problems and to increase the bioethanol production, I have developed a novel protease-based process for simultaneous pretreatment of fibers and protein extraction. This new method can also be used for non-corn derived DDGS.

The pretreatment increased the yield of C5/C6-sugars during an enzymatic hydrolysis with a factor of 3.3 and 1.7, respectively.

By screening eight different commercial enzyme products, three were chosen for the hydrolysis of pretreated fibers. Different reaction conditions, i.e. enzyme ratio, pH, temperature, enzyme dosage and reaction time were evaluated with response surface and ternary mixture designs. Using optimal conditions, a total sugar yield of 58% was obtained.

The hydrolyzed DDGS was readily fermented with *Saccharomyces cerevisiae* giving approx. 94% yield based upon fermentation of glucose derived from cellulose.

The proteolysate enhanced the hydrolysis of the pretreated fibers, resulting in approx. 87% sugar yield, which is very promising for future development. Next step is to characterize which substance (s) is/are responsible for this effect.