Spartina maritima as Biorefinery Feedstock

In February 2016 we reported preliminary results of thermochemical digestion of* Spartina maritima *obtained in connection with the CORNET project SaliChem. The project was concluded in December 2016. The halophyte* Spartina maritima *was identified as a highly promising raw material for the extraction of phytochemicals and for use as biomass for biorefineries and biogas plants. These results prompted PFI Biotechnology and the Belgian research institute Celabor to develop a biorefinery concept based on* Spartina maritima*.

New salt-tolerant plant raw materials for the production of secondary plant products, fermentable hydrocarbons, and energy were identified during work on the SaliChem project. In particular, the halophyte *Spartina maritima* displayed great potential for the production of lutein and anticollagenase. Obtained by lipophilic extraction, these substances can be used in cosmetics, for example in skin creams. Moreover, *Spartina maritima* has high contents of cellulose and hemicellulose, from which the fermentable sugars glucose and xylose can be produced. Optimal digestion condition for production of xylose from hemicellulose by thermal pressure hydrolysis (TPH) were 100 minutes at 160 °C, as already reported in February 2016.

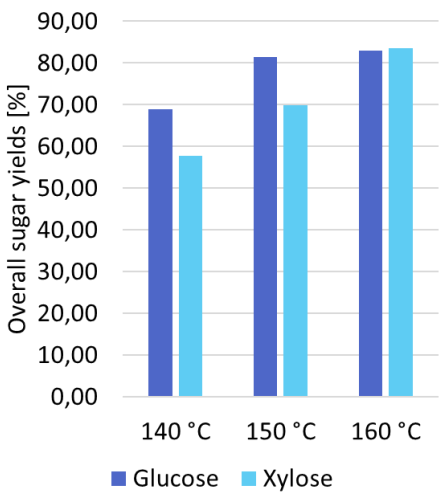


Figure 1: Glucose and xylose yields obtained on enzymatic hydrolysis of* Spartina maritima *after treatment by TPH for 100 minutes at 140, 150, and 160 °C

The cellulose could subsequently be converted in high yields exceeding 80 % into glucose by enzymatic hydrolysis. This was accomplished by use of the enzyme preparation CelliC CTec 2 from Novozymes, Denmark, which was specifically developed for the hydrolysis of lignocellulose. In combination with TPH total conversion rates of 83.4 % and 85.2 % could be obtained for glucose and xylose, respectively (Fig. 1). The biogas potential of *Spartina maritima* was also comparable with that of typical fermentation substrates such as grass silage.

Utilisation of Synergy Effects

The combination of extraction and sugar production or biogas production generates synergy effects. Extraction with supercritical carbon dioxide ($scCO_2$) meant that the yield of xylose obtained by TPH in the next step could be increased by 57 %. And the biogas potential could be enhanced by 18 % and 33 %, respectively, by prior $scCO_2$ extraction or hydrodistillation with KOH. These findings can be used in the development of a biorefinery concept, as depicted in Fig. 2.

Synergy effects can be effectively utilised on linking the process steps together. The cost effectiveness can be further enhanced by isolation of high-priced extracts. This could also have distinct environmental advantages because halophytes, unlike traditional plants, grow on saline soils, thus permitting use of greater areas for sustainable production of biomass.

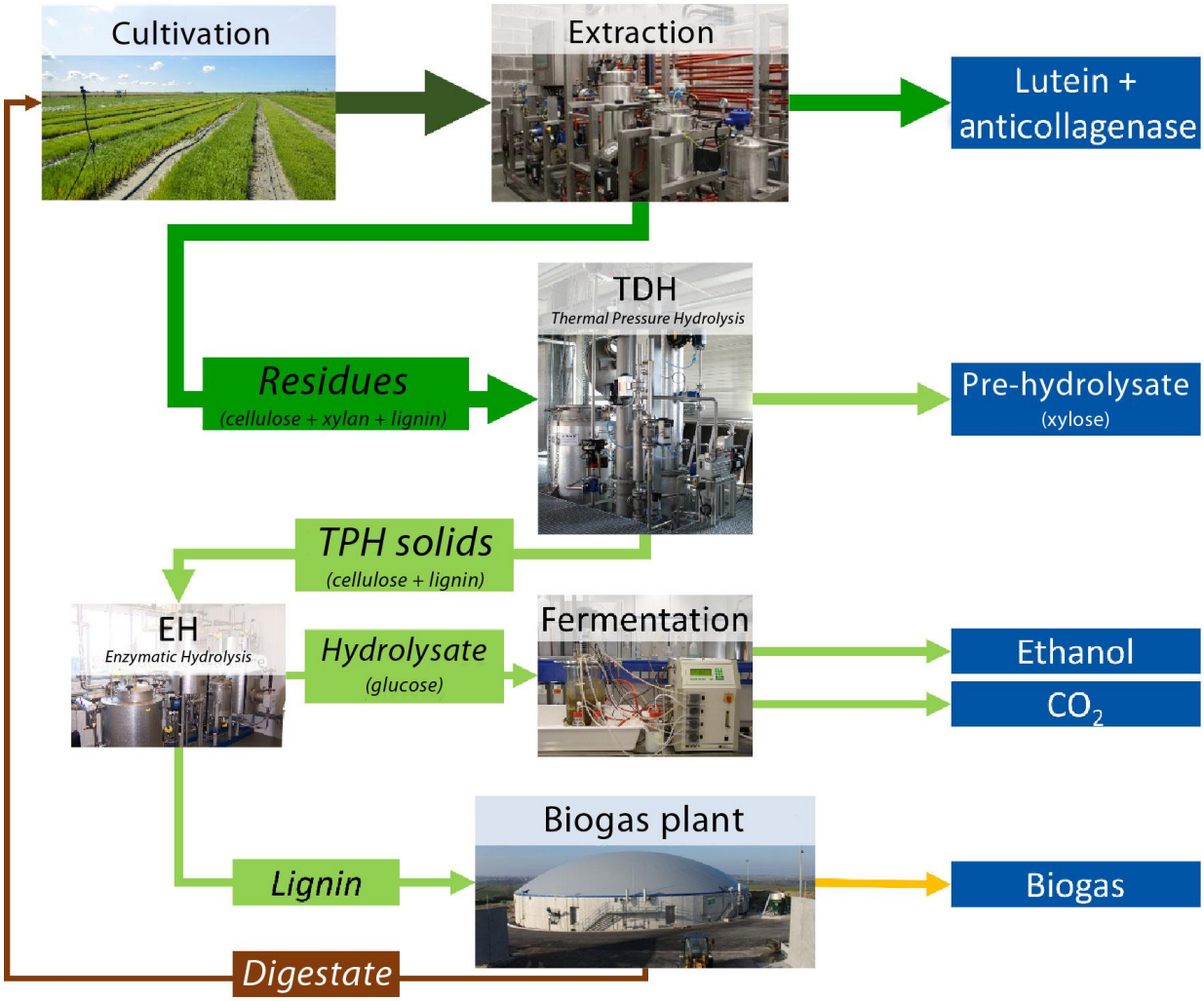
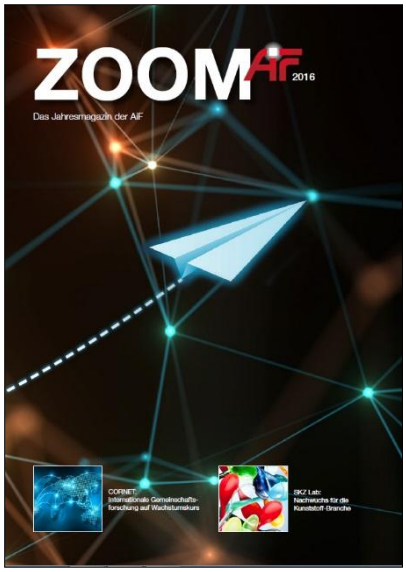


Figure 2: Biorefinery concept for* Spartina maritima *consisting of a combination of extraction, thermal pressure hydrolysis, enzymatic hydrolysis, fermentation, and anaerobic digestion in a biogas plant

SaliChem was selected as a success story by AiF/CORNET. Moreover, an article about the SaliChem project has also been published in the AiF Annual Magazine ZOOM.



SaliChem is one of the projects selected for presentation on 18 May 2017 at the SME Innovation Meeting in Berlin. At this event, Dr. Michael Müller, Project Manager at PFI Biotechnology and Microbiology, demonstrated the valorisation chain of *Spartina maritima* with the aid of tangible exhibits. There was keen interest in this project.

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SaliChem project information

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Project duration: 01.01.2015 to 31.12.2016
Project partner:

www.celabor.be

Funding agencies:

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