Raw Materials from Halophytes

«SaliChem» Project at Half Time

As a participant in the CORNET Project «SaliChem», PFI Biotechnology is pursuing the goal of total material and energetic valorization of salt-tolerant plants known as halophytes. The work is being conducted in close collaboration with the Belgian Celabor Research Institute. This article marks the "half-time" point of the project by reporting preliminary results of thermal/chemical digestion of Spartina maritima by thermal pressure hydrolysis, a process developed by PFI.

In the SaliChem Project, various halophyte species are examined for their content of cellulose and other extractable substances. These species include *Beta maritima*, *Crambe maritima*, *Salsola soda*, *Spartina maritima*, and *Suaeda maritima* (Fig. 1).

Fig. 1: From left to right: Beta maritima, Crambe maritima, Salsola soda, Spartina maritima, Suaeda maritima

Spartina maritima, a herbaceous perennial cordgrass, grows along Europe's western and southern coasts. Apart from its higher tolerance for saline soil, *S. maritima* showed a similar chemical composition to the straw of wheat, maize, and rice in laboratory studies conducted at PFI. The three most important constituents with regard to their use as raw materials are cellulose, hemicellulose, and lignin, accounting respectively for 42, 28, and 20 percent of the material obtained from *S. maritima*.

Cellulose is a polysaccharide made up of glucose units. In order to obtain this glucose the material has to be subjected to preliminary thermal/chemical treatment (Fig. 2) and subsequent enzymatic hydrolysis. The goal of Thermal Pressure Hydrolysis (TPH) is chemical cleavage of hemicellulose into its constituents and breakdown of the lignin fraction which encases the cellulose. The main component of hemicellulose from *S. maritima* is xylan, a polymer made up of xylose units.

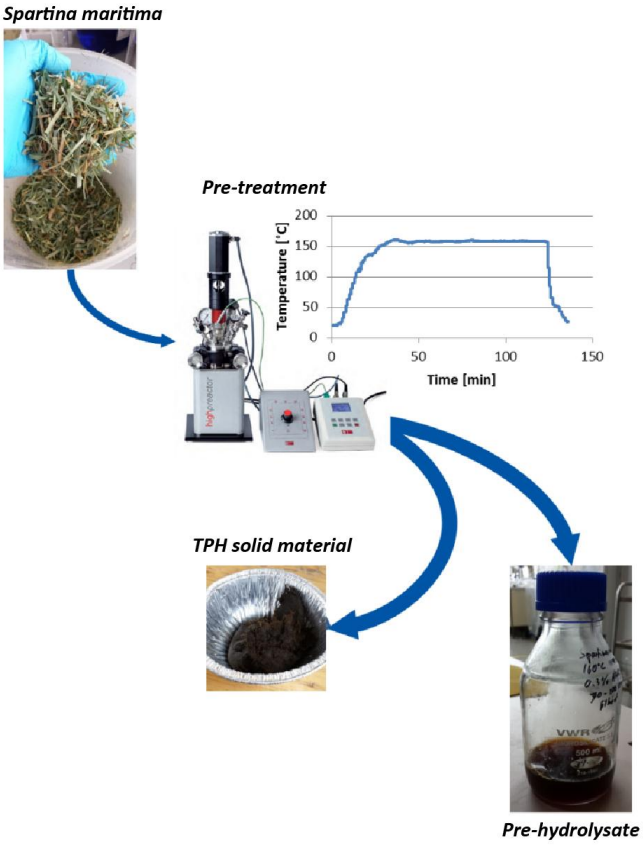

Fig. 2

The mode of action of TPH can be deduced from the chemical composition of the solids after digestion and the sugar concentration (mainly xylose) in the pre-hydrolysate. During process optimisation it was possible to significantly increase the sugar concentrations while simultaneously minimising the formation of undesired degradation products (see Fig. 3).

Differences in the solid material obtained on TPH digestion are already apparent on visual examination: The harsher the digestion conditions, the darker the solid material (Fig. 4). This is due to degradation reactions of the liberated sugars and presumably phenolic compounds of the lignin fraction. Analysis of the chemical composition reveals how xylan is degraded under increasingly harsh conditions and how the relative amounts of cellulose and lignin increase (Fig. 5).

The next process step of enzymatic hydrolysis with the aim of breaking down cellulose into glucose is currently being investigated. Another topic of study is the possible effect of prior extraction to obtain secondary plant materials on the hydrolysis process. Pertinent experiments will be conducted in the second half of the project.

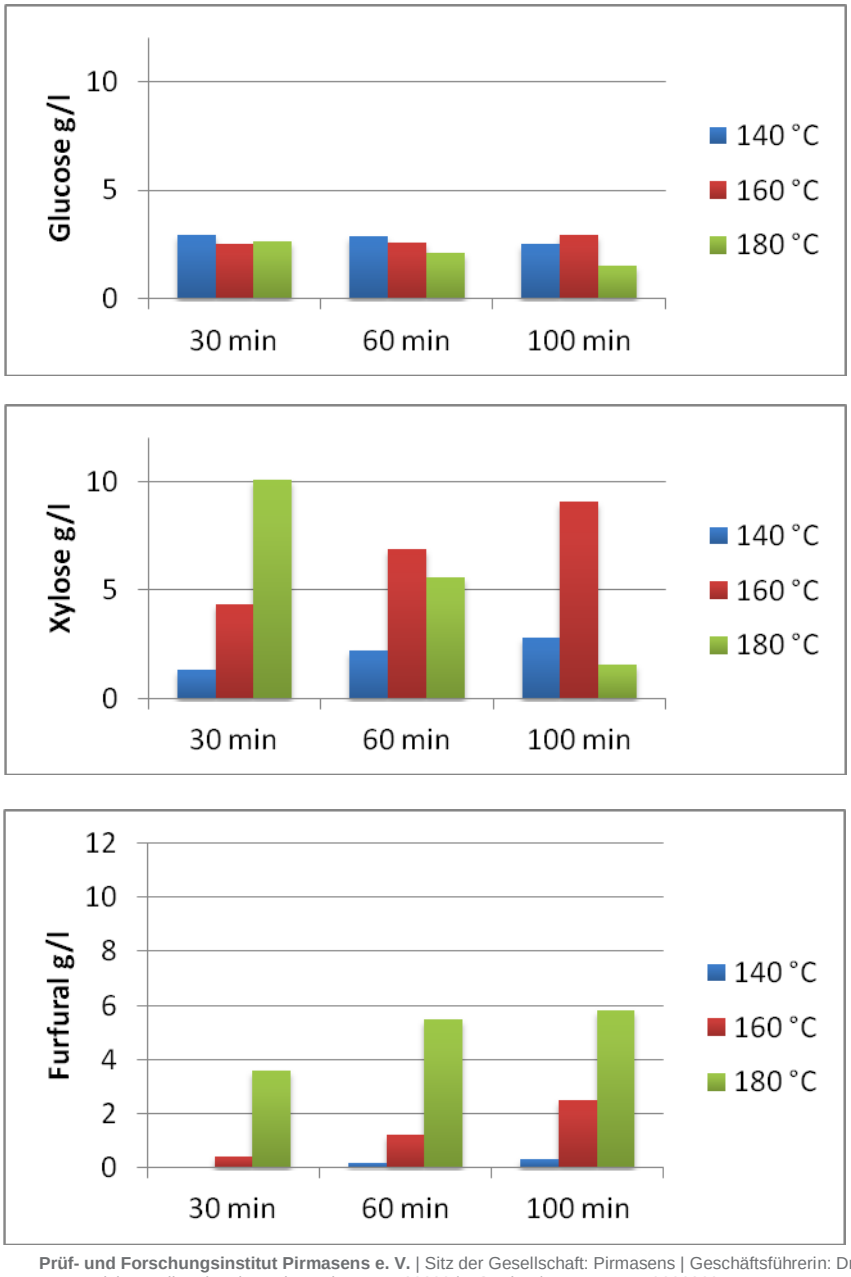

Fig. 3: Concentrations of glucose, xylose, and furfural in the pre-hydrolysate, digested at various temperatures and after various residence times

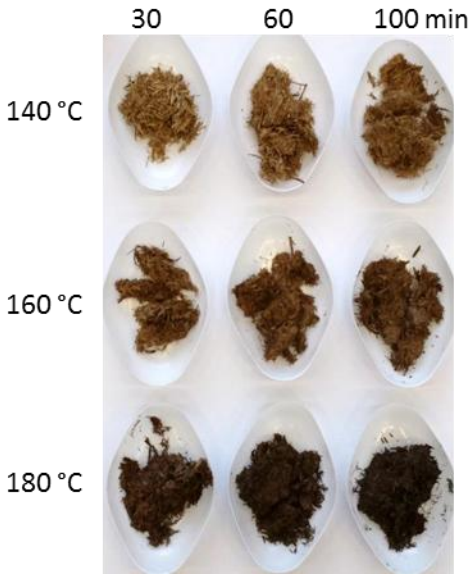

Fig. 4: Spartina maritima / solids digested at various temperatures and after various residence times

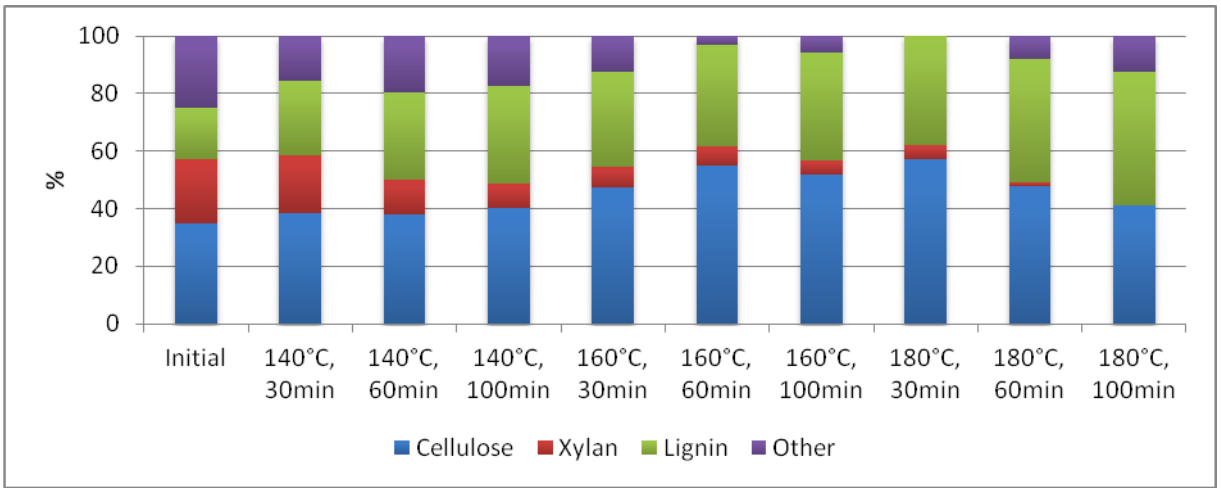

Fig. 5: Chemical composition of solids after TPH digestion at various temperatures and after various residence times

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