# Development of a process for the utilization both the carbohydrate and the lignin content from lignocellulosic materials of annual plants for the production of valuable products

Project acronym: Products from lignocellulose
Project no: EIB.10.013


## Project aim

The general aim of the project is the development of a process for the material utilization of both the carbohydrate and the lignin content from lignocellulosic materials of annual plants, particularly wheat or maize straw.

## General project approach

The investigations basically concern

(i) the development of a pre-treatment process, which allows the separation of both the lignin and the carbohydrate content of lignocellulosic raw materials,

(ii) the development of a *Penicillium verruculosum* enzyme complex optimized for the saccharification of the carbohydrate content of lignocellulose in a simultaneous saccharification and fermentation (SSF) process,

(iii) investigations on the SSF-process, using model microorganism-strains for the production of platform chemicals, like fermentation alcohols, and

(iv) the modification of the separated lignin for the production of fibre-reinforced biopolymers as well as for the production of fine chemicals.

## Partner 1, coordinator

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## Activity in the project

- Optimization of the fermentation process for the production of the *P. verruculosum* cellulase complex related to its application in the SSF-process up to pilot scale
- Production of lignin-modifying enzymes for the modification of straw-lignin
- Investigations on straw pre-treatment according the Natural Pulping-process to supply pulp and lignin

## Partner 2 a

Dr. Martina Bremer
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## Activity in the project

Chemical and structural characterization of the wheat straw lignin in comparison between modified and unmodified lignin (functional groups, spectroscopic methods)

Determination of VOCs of the starting and modified lignin as well as the processed materials

Investigations on formation of basic chemicals from lignin

## Partner 2 b

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## Activity in the project

Modification of wheat straw lignin and NP-cellulose as well as other reference fibers for the production and characterization of composites

Production of polymer test samples for injection moulding and quality tests (in cooperation with TUC as subcontractor)

## Partner 3

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## Activity in the project

Investigation and optimisation of the SSF process employing the SIAB enzyme complex and development of a process converting the primary product ethanol further.

# Partner 4

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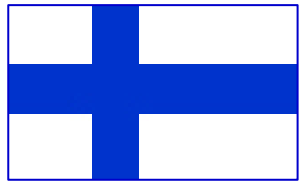

## Activity in the project

Develop optimized enzyme mixtures for the pretreated biomasses *via* comparison of *Penicillium verruculosum* and *Trichoderma reesei* (hemi)cellulases

Develop chemo-enzymatic treatments of lignin, aiming at laccase-induced activation followed by functionalization to improve lignin's material properties for composite applications.

## Partner 5

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FOOD & BIOBASED RESEARCH
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## Activity in the project

- Exploring the enzymatic modification of lignin in non-conventional media,
- Enzymatic coupling of lignin to hydrophilic oligomers like functionalized carbohydrates and peptides for application in bio-plastics

## Partner 6

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## Activity in the project

- Pre-treatment of lignocellulose: Separation of lignin in annual plants using supercritical conditions with a capacity from 100 ml up to 5 l for supercritical fluids.
- Economical evaluation for the utilization of straw for valuable products in Romania

## Partner 7

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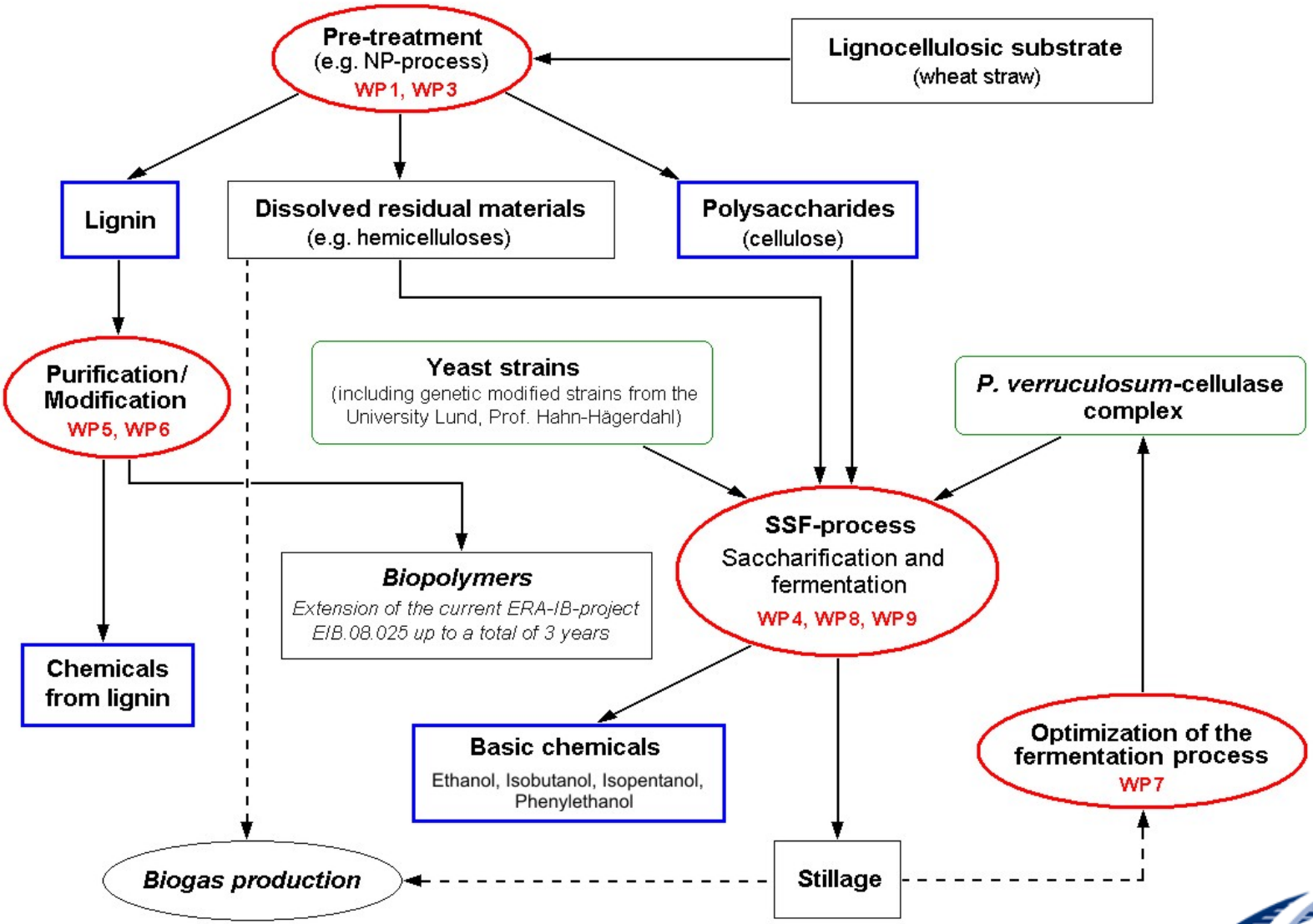
## Activity in the project

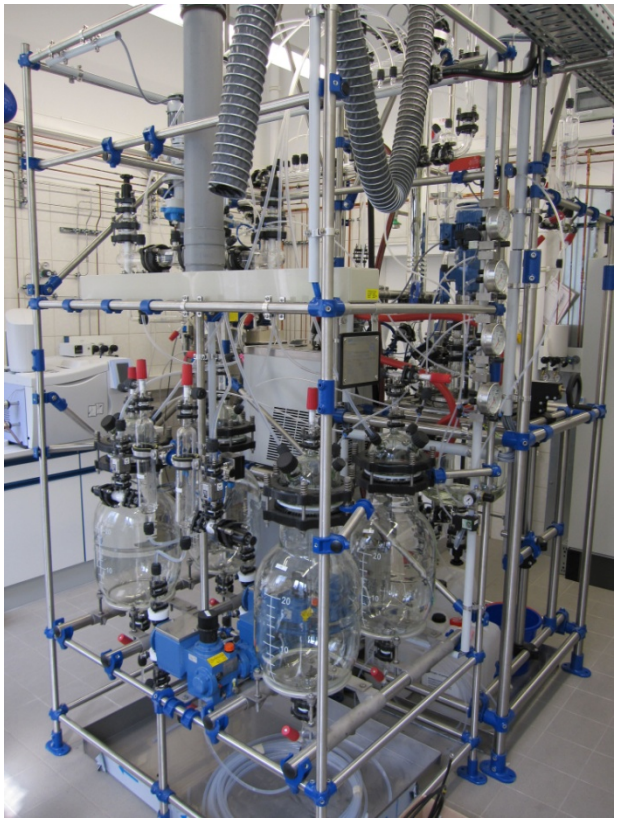
Delignification pre-treatments using e.g. formic acid (and hydrogen peroxide) and acetosolv processes in combination with hydrothermal processes (autohydrolysis) for the hydrolysis of hemicelluloses and xylo-oligosaccharides (XOS) production.

Delivery of XOS-rich liquors as well as the expected delignified solids for investigation on induction of enzymes


Pre-treatment
(e.g. NP-process)
WP1, WP3
Lignocellulosic substrate
(wheat straw)
Lignin
Dissolved residual materials
(e.g. hemicelluloses)
Polysaccharides
(cellulose)
Purification/
Modification
WP5, WP6
Yeast strains
(including genetic modified strains from the
University Lund, Prof. Hahn-Hägerdahl)
P. verruculosum-cellulase
complex
SSF-process
Saccharification and
fermentation
WP4, WP8, WP9
Biopolymers
Extension of the current ERA-IB-project
EIB.08.025 up to a total of 3 years
Chemicals
from lignin
Basic chemicals
Ethanol, Isobutanol, Isopentanol,
Phenylethanol
Optimization of the
fermentation process
WP7
Biogas production
Stillage


**Bioreactor with 25-Liter working volume, sampling**

**Bioreactor with 400-Liter working volume for enzyme production and SSF-process in pilot scale**



**Miniplant**
**(system for lignocellulosic pre-treatment)**

**Separated pulp after pre-treatment**

**Lignin after extraction from wheat straw**

Haake Minijet
(injection moulding machine)

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**Fibre-reinforced biopolymers** ➔

Tensile test bars containing 35% lignin; produced by injection moulding.