ATB
Leibniz-Institut für
Agrartechnik und Bioökonomie

Process engineering challenges of producing bio-based products

J. Venus

BE-Rural

BE-Rural Mid-Term Conference

"Exploring the bioeconomy as a central pillar of regional recovery plans during and after COVID-19"

Leibniz-Gemeinschaft

Tuesday, 8 September 2020, 14:00 – 17:15 CEST

Our mission:

Our research is aimed at sustainable intensification. We analyze, model and evaluate **bio-economic production systems**. We develop and integrate new technologies and management strategies for a knowledge-based, **site-specific production of biomass**, and its **use for food, as bio-based materials and fuels** - from basic research to application.

Research Program „Material and energetic use of biomass “

Coordination: Dr. Joachim Venus

Consideration of the entire value chain – System‘s approach

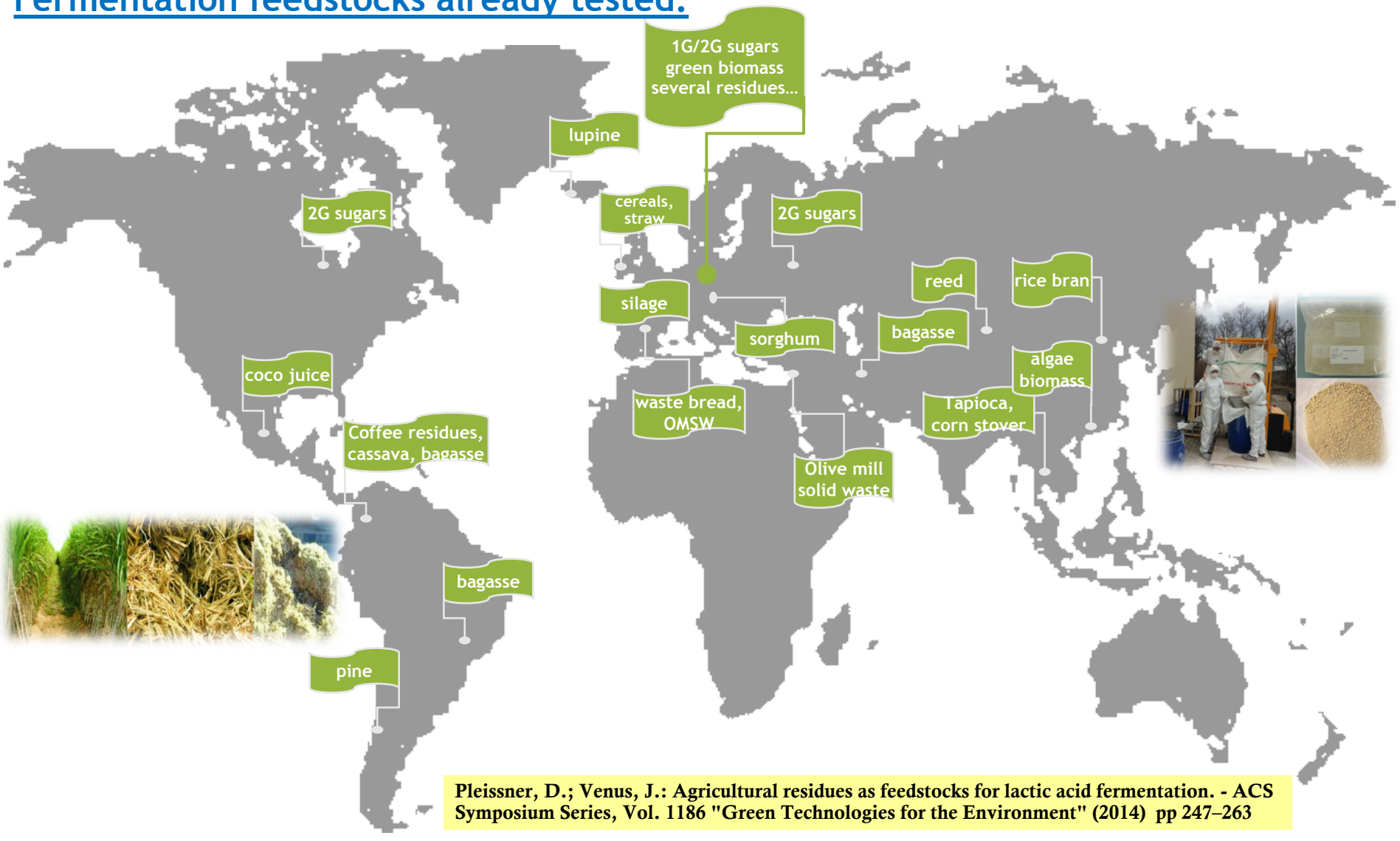
Biomass provision
(Cultivation, harvest, storage… e.g. short rotation wood, hemp)

Chemicals & Materials
➲ biotechnological products

Energetic use
(Biogas, wood pellets, biochar)

Valorization of residues, sidestreams etc.

Fermentation feedstocks already tested:



Pleissner, D.; Venus, J.: Agricultural residues as feedstocks for lactic acid fermentation. - ACS Symposium Series, Vol. 1186 "Green Technologies for the Environment" (2014) pp 247–263

- *Starchy materials (cereals, industrial grade corn/potatoe starch, tapioca)*
- *Green biomass (alfalfa, grass juice, lupine, sweet sorghum, forage rye, silage, coco juice)*
- *Lignocellulosics (wood/straw hydrolysates, 2ndG sugars, bagasse, reed)*
- *Residues & By-products (oilseed cake/meal, thick juice, molasses, whey, coffee residues, waste bread, waffle residues, algae biomass, fruit residues, rice bran, meat & bone meal, OMSW, AD digestates, corn stover…)*

Chemicals from Biomass: A Market Assessment of Bioproducts with Near-Term Potential

Mary J. Biddy, Christopher Scarlata, and Christopher Kinchin - *National Renewable Energy Laboratory*

Data Gaps

Scale-up of lactic acid production would require **clean, cheap sugars from lignocellulosic biomass** to compete with commodity sugar and starch substrates. There is a **lack of data about lactic acid production and purification from biomass hydrolysates, including issues of C5 sugar** utilization, although it appears work has started to address some of these issues.

This report is available at no cost from the National Renewable Energy Laboratory (NREL) at www.nrel.gov/publications
Technical Report NREL/TP-5100-65509 - March 2016/Contract No. DE-AC36-08GO28308

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The processes for producing lactic acid from biomass/residues include the following 4 main steps:

(1) **Pretreatment - breaking down the structure of the feedstock matrix**

(2) Enzymatic hydrolysis - depolymerizing biopolymers like starch, cellulose etc. to fermentative sugars, such as glucose (C6) and xylose (C5), by means of hydrolytic enzymes

(3) Fermentation - metabolizing the sugars to lactic acid, generally by LAB

(4) **Separation and purification of lactic acid - purification of lactic acid to meet the standards of commercial applications**

Pilot plant facility for lactic acid fermentation at Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB Potsdam)

“The most demanding efforts are to make the processes economical, with the production cost as low as possible.”

Biofuels, Bioprod. Bioref. (2020); DOI: 10.1002/bbb.2104

- Advanced pretreatment methods for breaking down the recalcitrant lignocellulosic structure
  - sugar release ↑
  - inhibitory compounds ↓
- Application of mixed microbial cultures & multi-substrate processes
- Increase of the microbial conversion performance per volume of the bioreactor
  ➲ space-time yield
  - Number of active microbes ↑
  - Specific activity of the microbes ↑
- Establish of optimal process conditions for the biocatalyst
- Development of application-specific bioreactor systems and process analytical techniques (PAT)
- Advanced strategies such as simultaneous saccharification and co-fermentation (SSF), develop continuous mode fermentation processes
- Improved DSP (incl. integrated/in-situ product recovery) for high-quality products
- Etc.

Pilot plant facility for bioprocess development & scale-up at ATB Potsdam

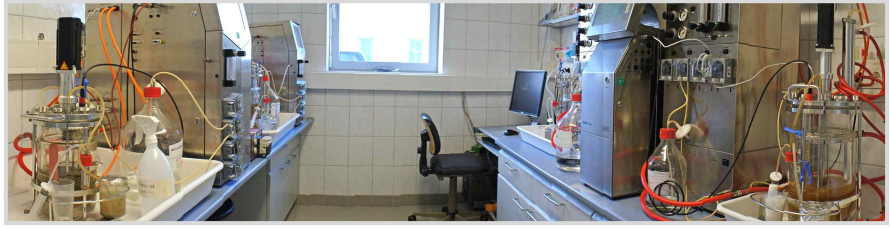
Pilot fermentor Type P, 450 L (Bioengineering AG)

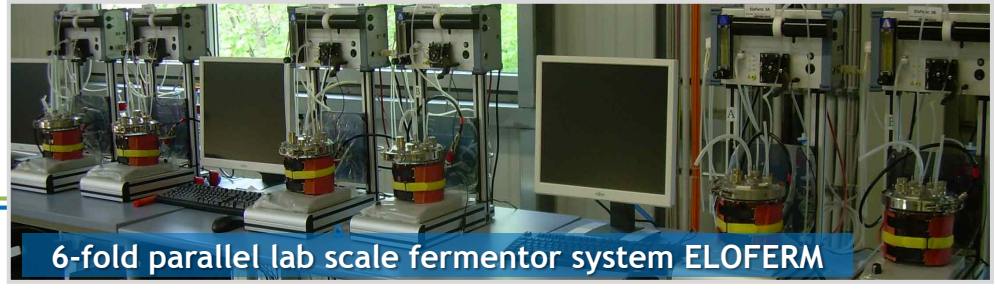
Bioprocess Scale-up

BIOSCREEN

BIOSTAT® Bplus (1-10 L)

Biostat® UD (50 L)





6-fold parallel lab scale fermentor system ELOFERM

Current/starting BBI projects

- PERCAL - Chemical building blocks from versatile MSW biorefinery, 07/2017 - 12/2020
- CAFIPLA will improve the sorting of biowaste to be used as biomass to produce various biodegradable components that can be turned into everyday products, such as packaging or insulation material - 06/2020 - 05/2023
- BeonNAT will use underexploited woody species to obtain eight bioproducts, including bioplastics, wood paper, essential oils, and absorbents - 07/2020 - 06/2025

Thank you for your attention!

Please go for a quick virtual tour until we can meet again f2f...

https://youtu.be/JnkB0WRIO-o

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