Diese Maßnahme wird mitfinanziert mit Steuermitteln auf Grundlage des von den Abgeordneten des Sächsischen Landtags beschlossenen Haushaltes.

Enrichment of microbial communities for the conversion of lignocellulose into medium-chain carboxylic acids

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Introduction

- Production of medium-chain carboxylic acids from sustainable feedstocks such as agro-industrial wastes and residues is limited to biomass with high ethanol/lactic acid content, or electron donors have to be added to the substrate
  → limited substrate range or high costs
- Lignocellulose is a renewable, abundant and cheap alternative substrate

→ **Two metabolic bottlenecks:**

- Efficient microbial hydrolysis of cellulose
- Internal production of lactate as essential electron donor for chain elongation

Goal: Enrich hydrolytic bacteria that convert lignocellulose to precursors for chain elongation

Methods

Inoculum:

- Marshland soil (depth: 15-30 cm)
- Cow manure
- Compost + digestate from AD

Medium:

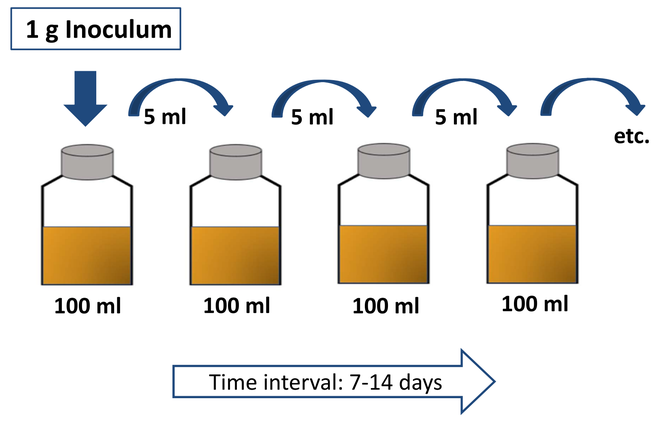
- Minimal medium: SynCon1 and 2

Substrate:

- Hemicellulose: xylan
- Cellulose: PASC (amorphous) and Avicel® (crystalline)

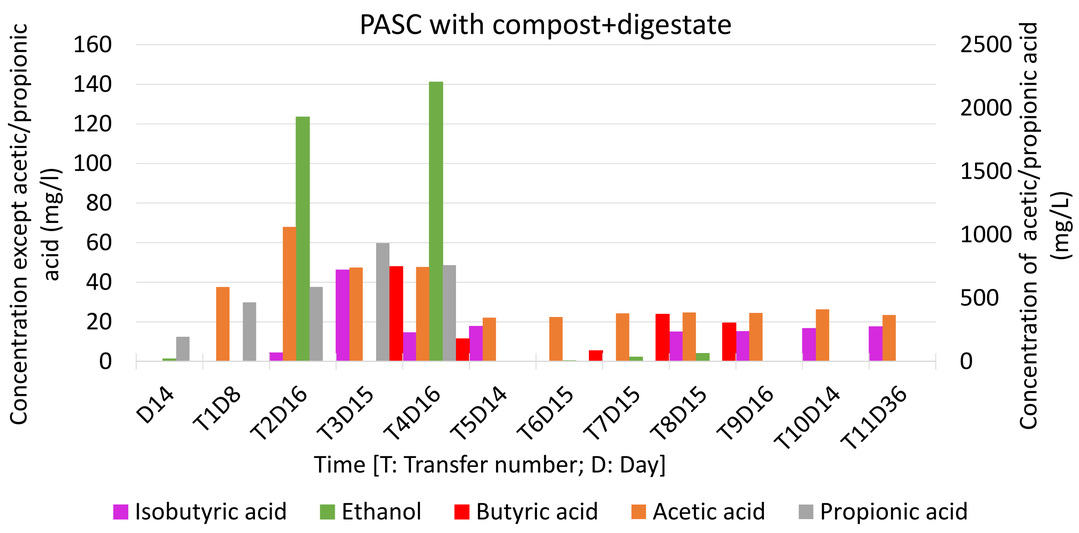
Analyses:

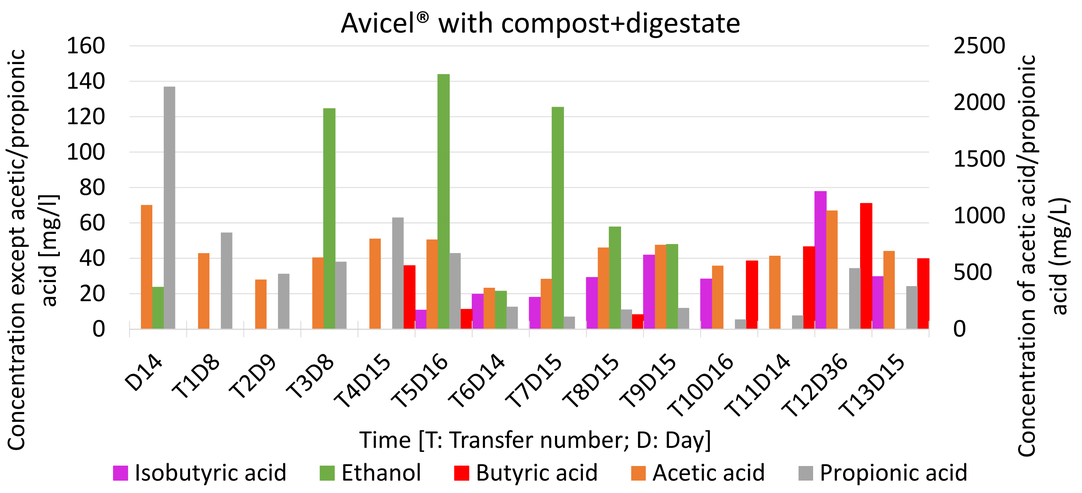
- Gas products: CH_4, CO_2, H_2 (GC)
- Liquid products (HPLC/Ester-GC)

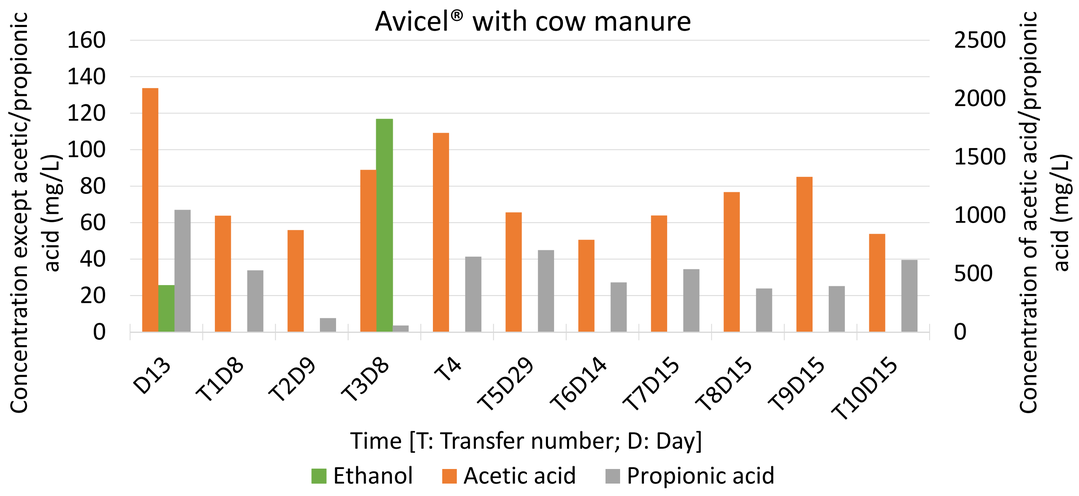


Results

Cellulose enrichment cultures

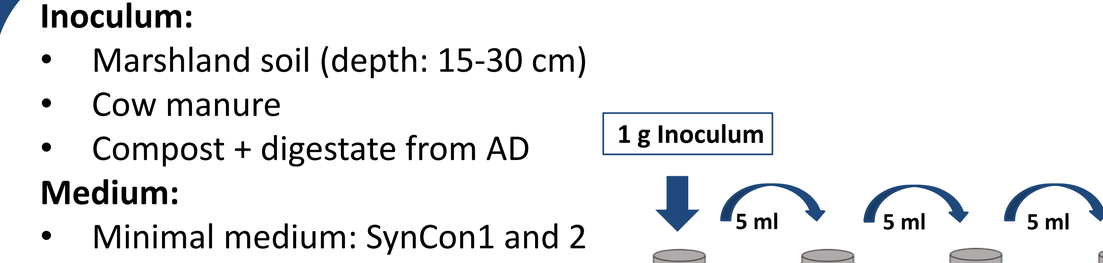


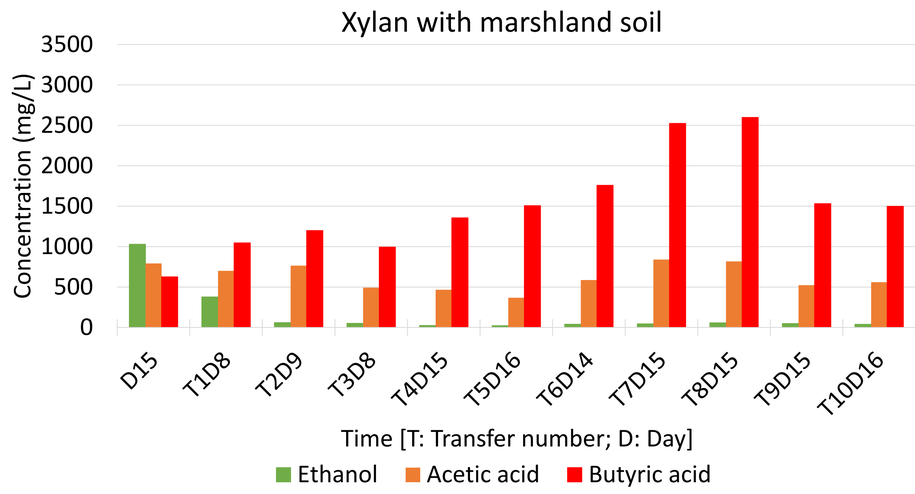


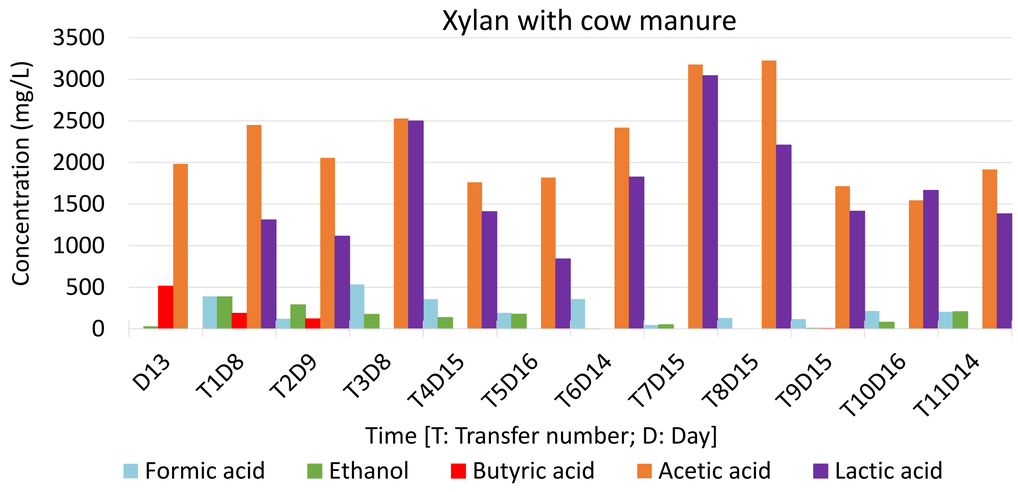


Gas products: CO_2

Hemicellulose enrichment cultures







Gas products: CO_2 & H_2

Conclusions and Outlook

Enrichment cultures with the most efficient production of precursors for chain elongation: compost + digestate on PASC, Avicel® and xylan; cow manure on Avicel® and xylan; marshland soil on xylan

- Ability to hydrolyze cellulose or hemicellulose → hydrolysates can be used by lactic acid bacteria to produce lactic acid
- Production of electron donors (ethanol, lactic acid) and electron acceptors (acetic acid, propionic acid and butyric acid)
- Production of caproic acid and lactic acid → source for isolation of chain-elongating and lactic acid bacteria

Next steps:

- Assess community composition and dynamics based on 16S rRNA gene amplicon sequencing
- Determine the functional potential of the communities with metagenome sequencing
- Quantitative analysis of cellulose/hemicellulose in cultures
- Enrichment cultures will be used in consortia with lactic acid bacteria and chain elongator strains, in order to produce medium-chain carboxylic acids