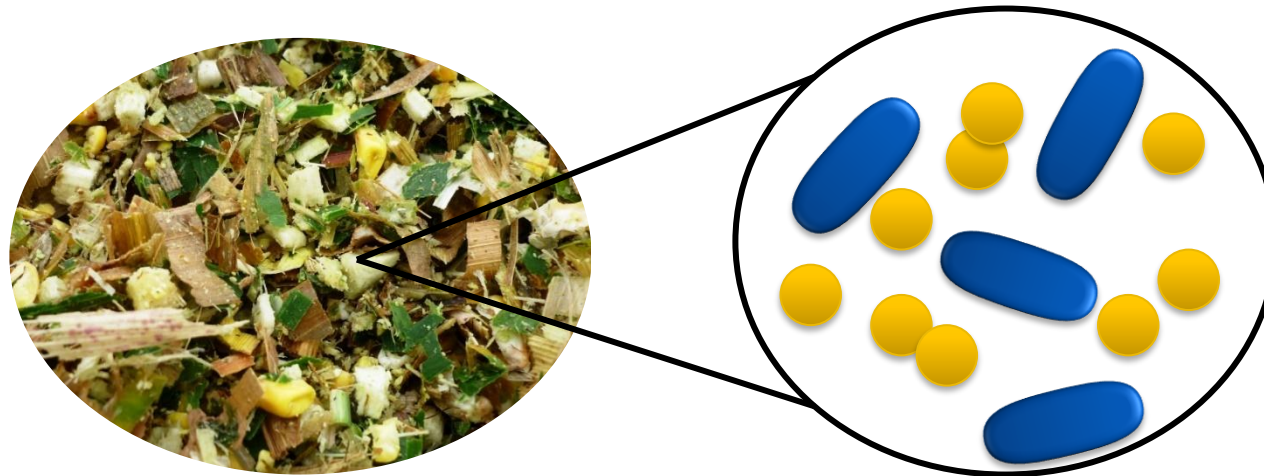


MICROBIAL DYNAMICS AND COOPERATIVE FERMENTATION: INSIGHTS FROM REAL-TIME MONITORING OF SILAGE PROCESSES

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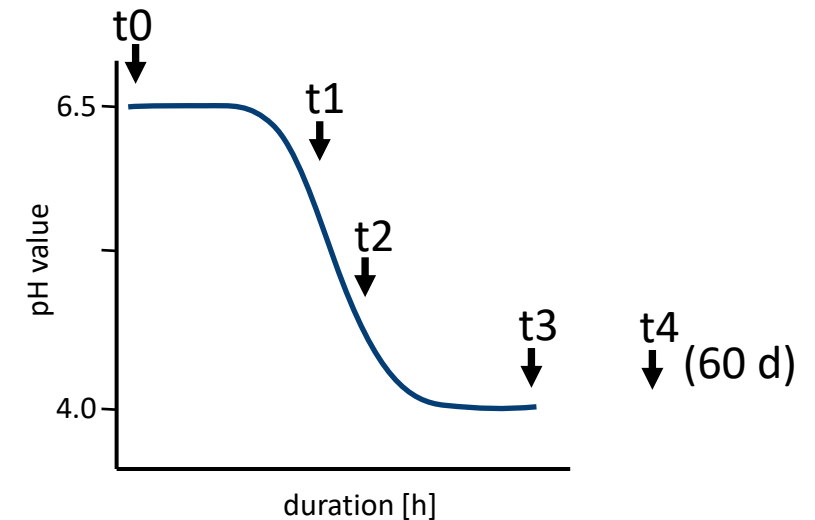
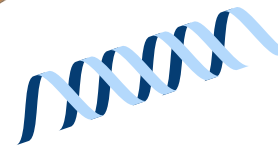
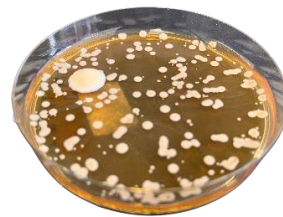
²Institute for Agricultural Engineering, University of Bonn, Bonn, Germany

PART 1: MICROBIAL DYNAMICS

- Ensiling of grass, alfalfa, and maize
- real-time pH-monitoring in mini-fermenters (Sun et al. 2024)
- Sampling according to pH curves

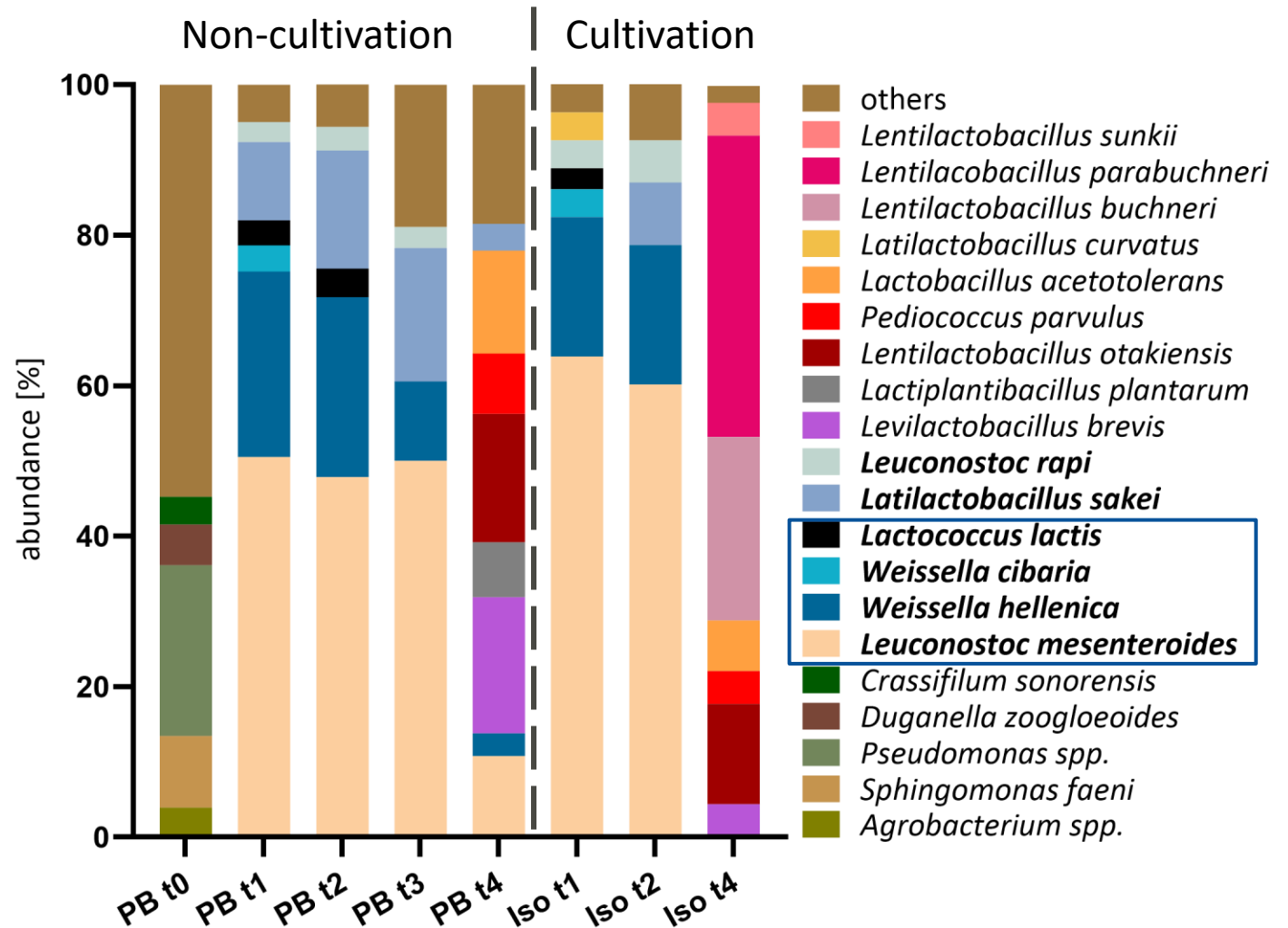
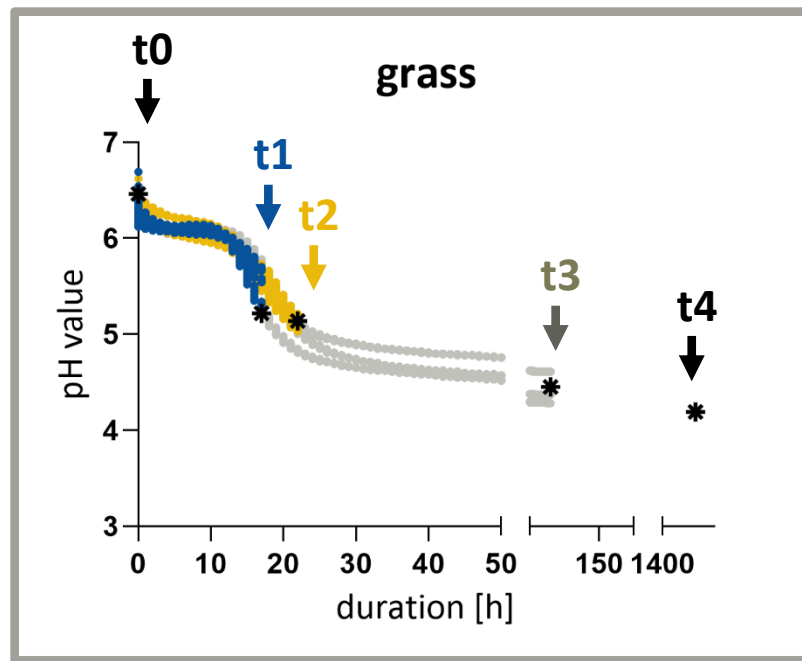
- Microbiome analyses:

- Cultivation-dependent
- Cultivation-independent NGS
 - Long-read sequencing method (PacBio)



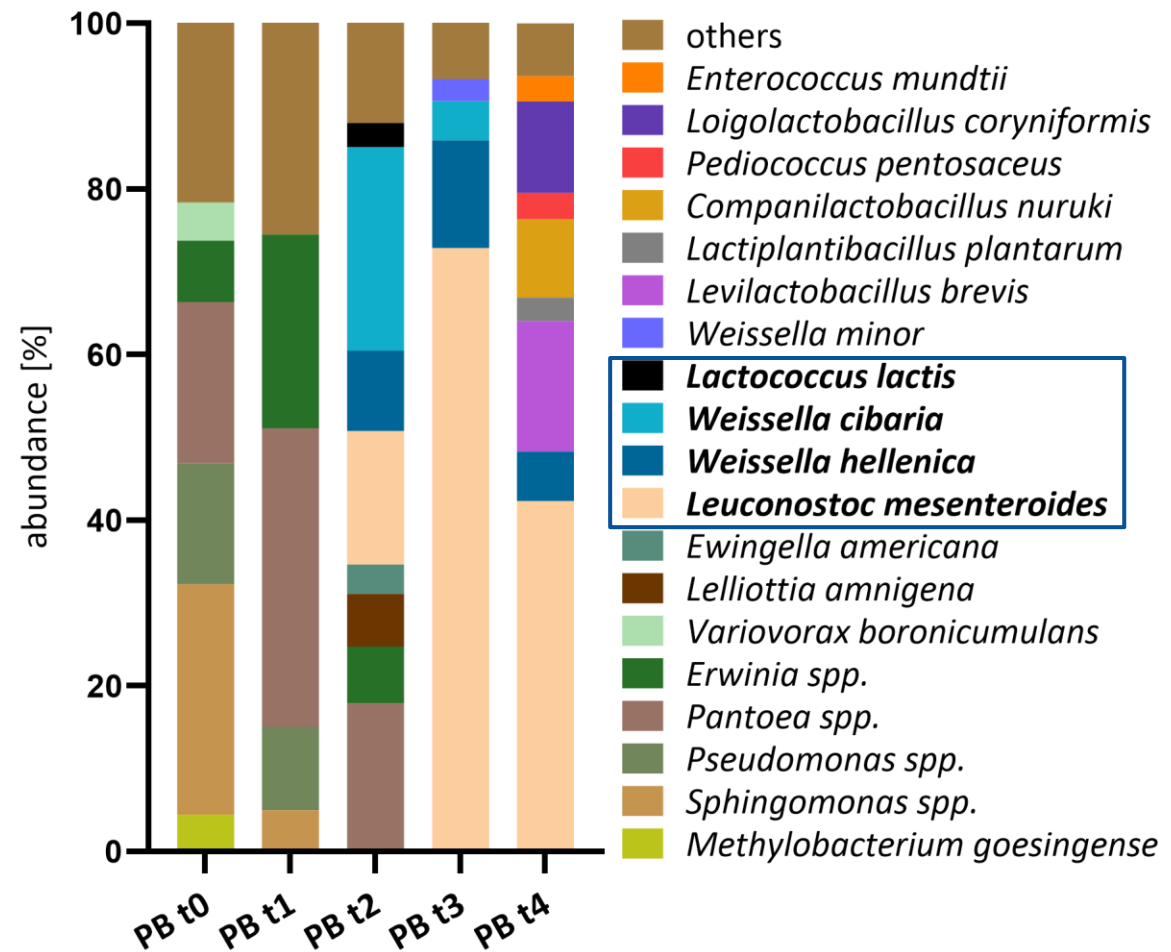
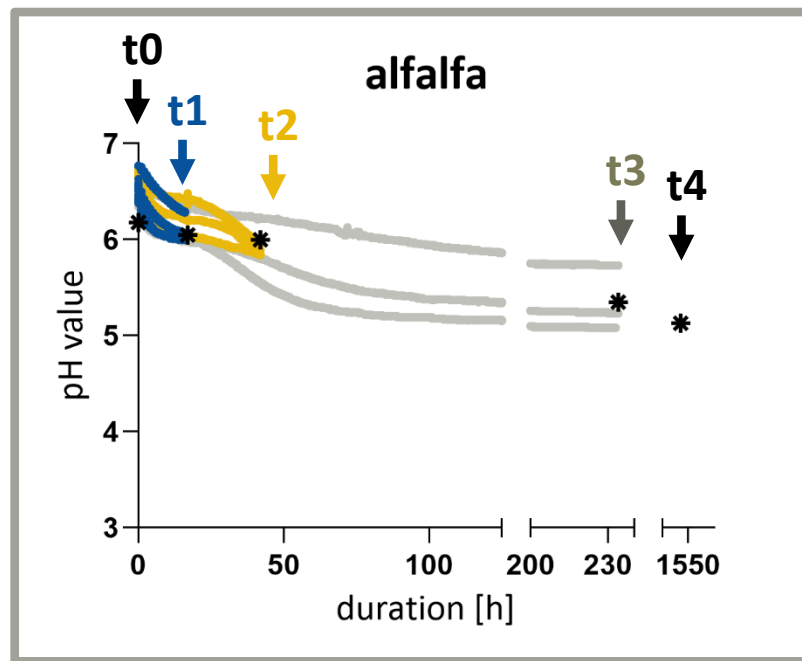
(Photo: Freya Behrens)

MICROBIOME: GRASS



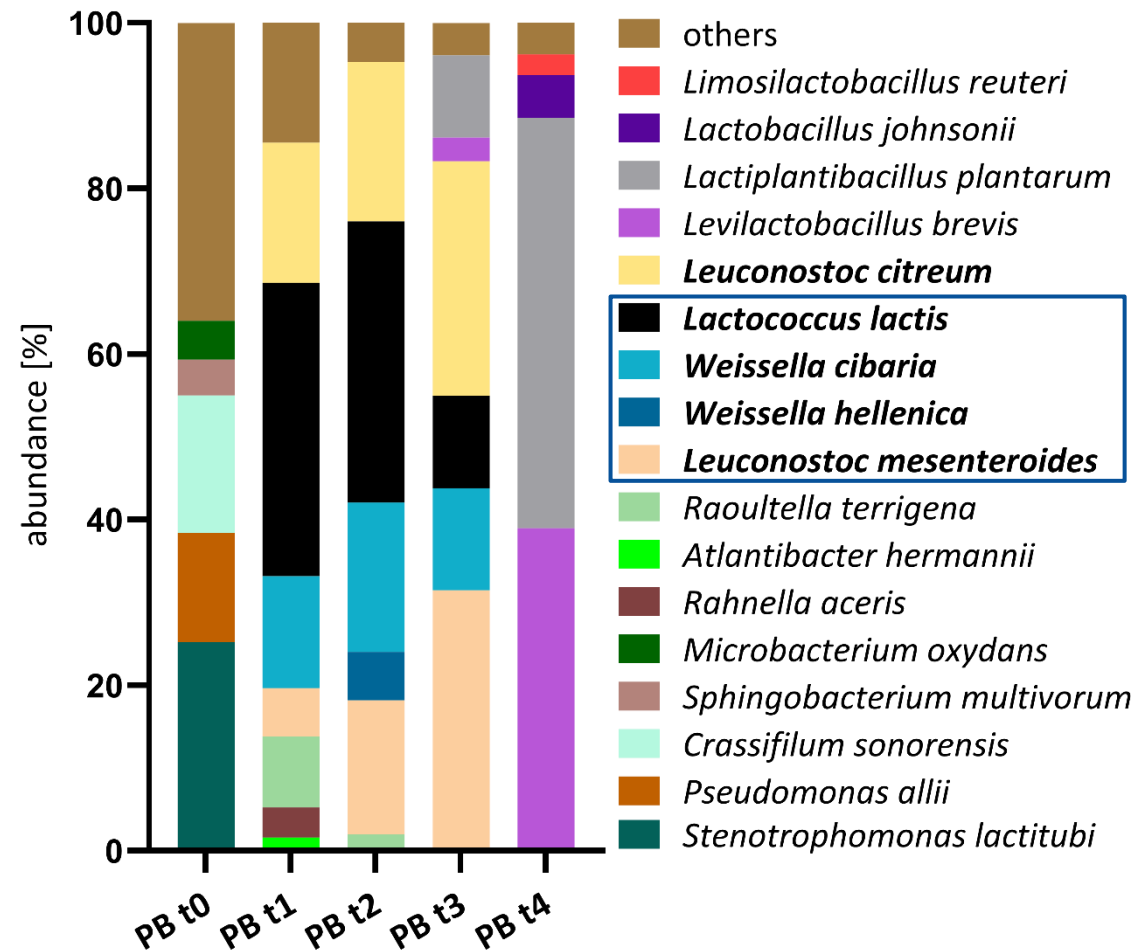
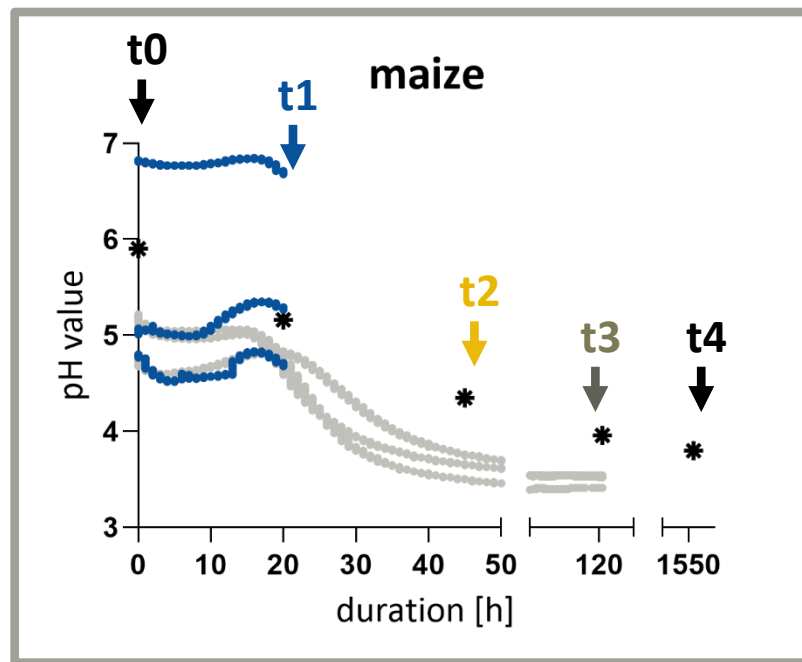
PB = PacBio

MICROBIOME: ALFALFA



PB = PacBio

MICROBIOME: MAIZE



PB = PacBio

CONCLUSION PART 1

- Microbiome of the main fermentation activity was analyzed thanks to **real-time pH monitoring**
- Fermentation was mainly driven by the **heterofermentatives** *Leuconostoc* spp. and *Weissella* spp. and the **homofermentative** *Lactococcus lactis*
- Role of Lactobacilli more important after pH reduction

PART 2: COOPERATIVE FERMENTATION

- isolates obtained from silages of part 1
- Combinations were tested

Heterofermentative LAB

Levilactobacillus brevis LD2

Lentilactobacillus buchneri LD32

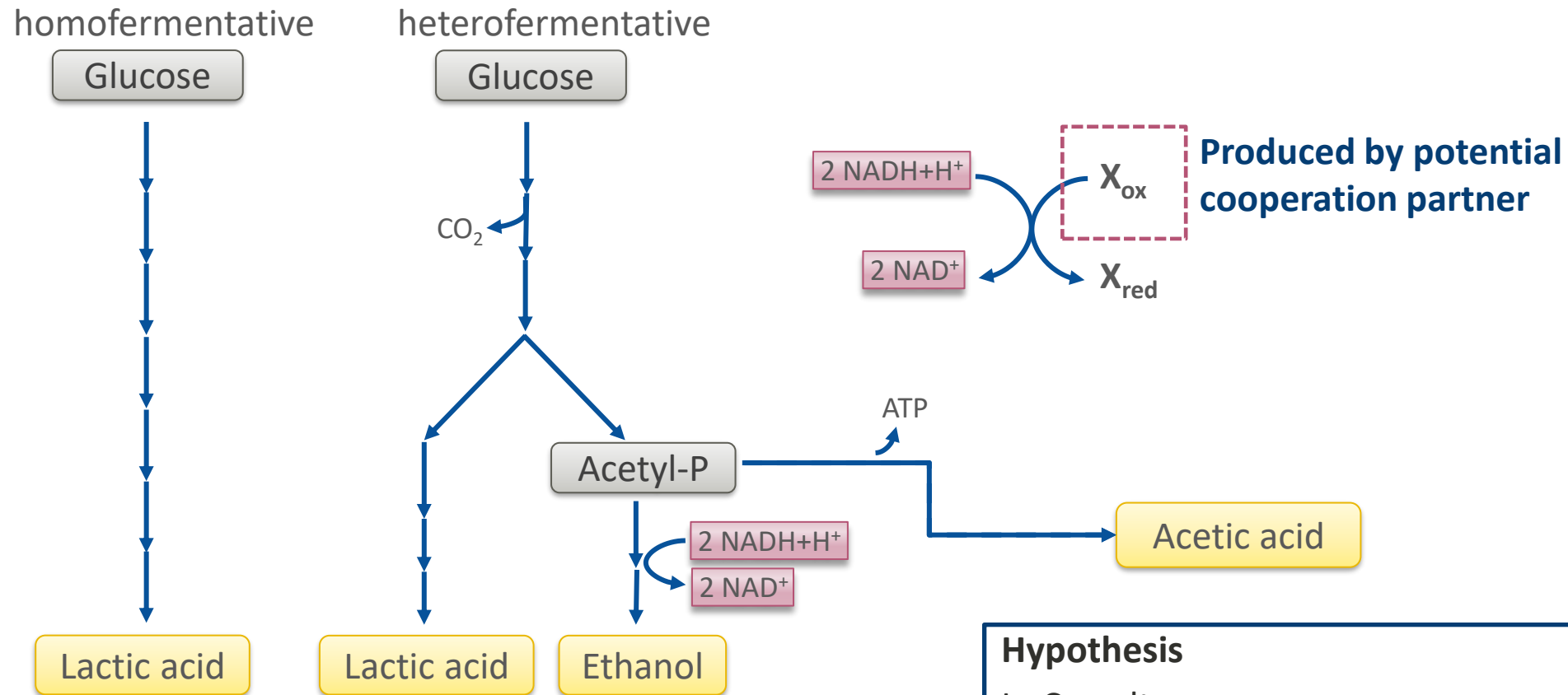
Homofermentative LAB

Pediococcus pentosaceus LD12

Lactococcus lactis LB46

Pure cultures are compared to co cultures

LACTIC ACID FERMENTATION

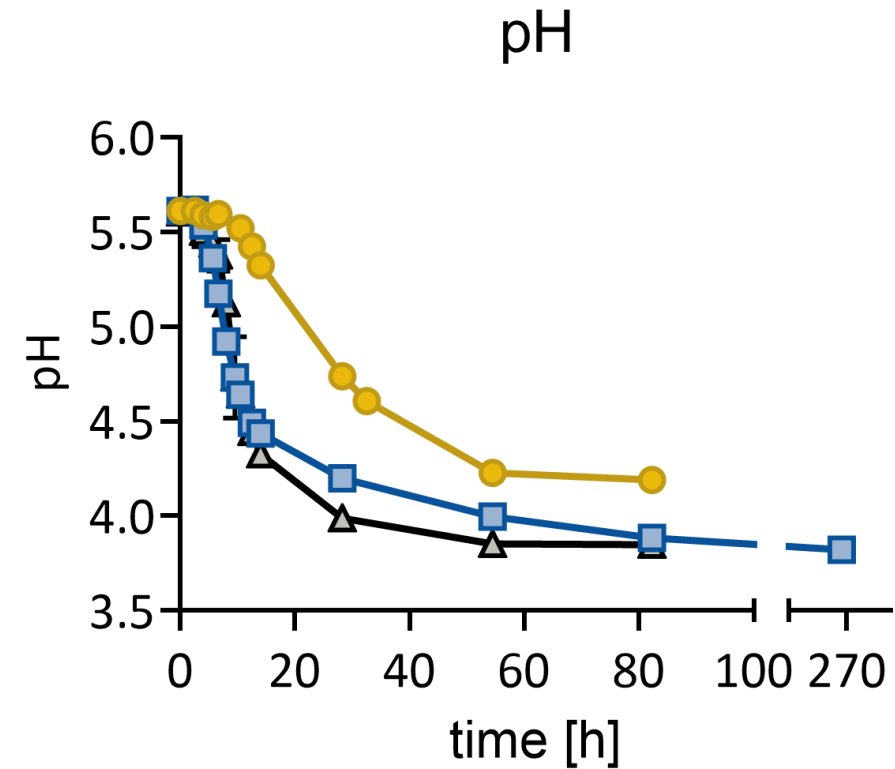
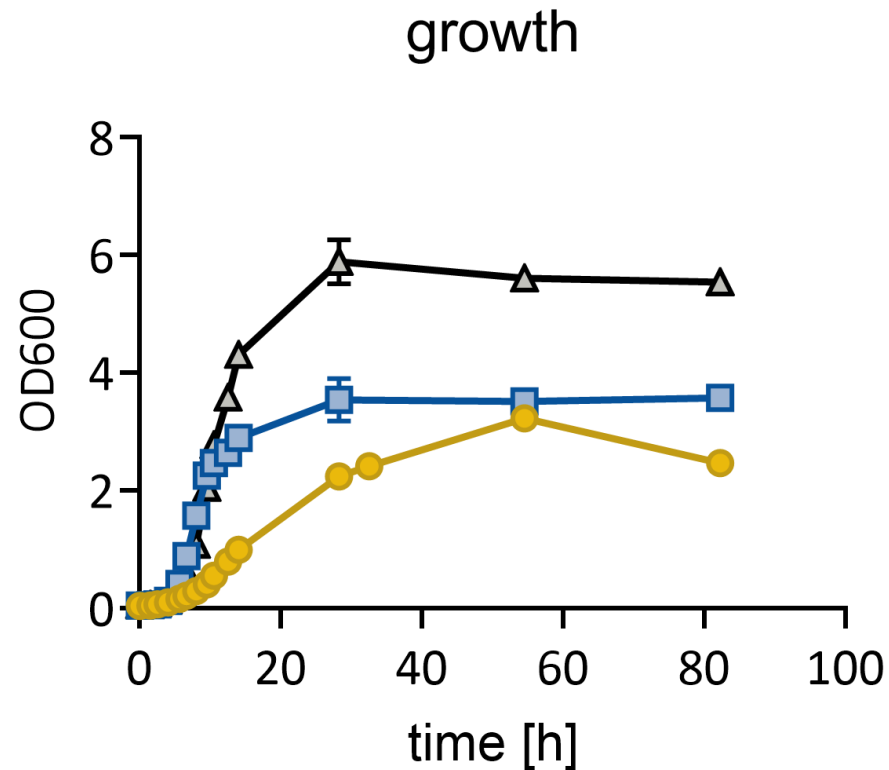


Hypothesis

In Co culture:

- Faster/greater acidification
- More acetic acid, less Ethanol

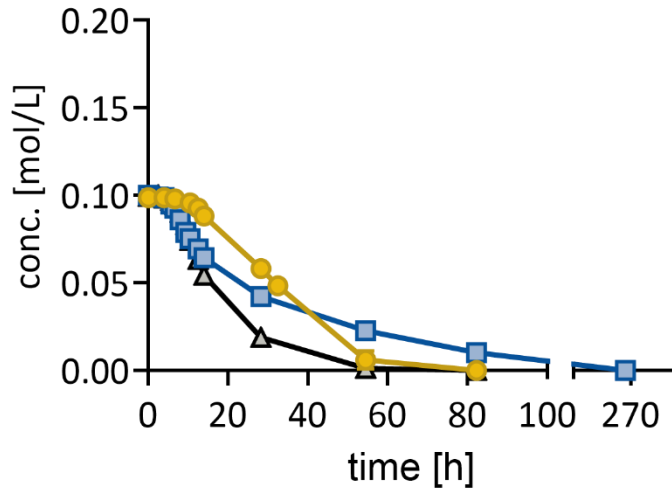
CO CULTURE: GROWTH AND PH



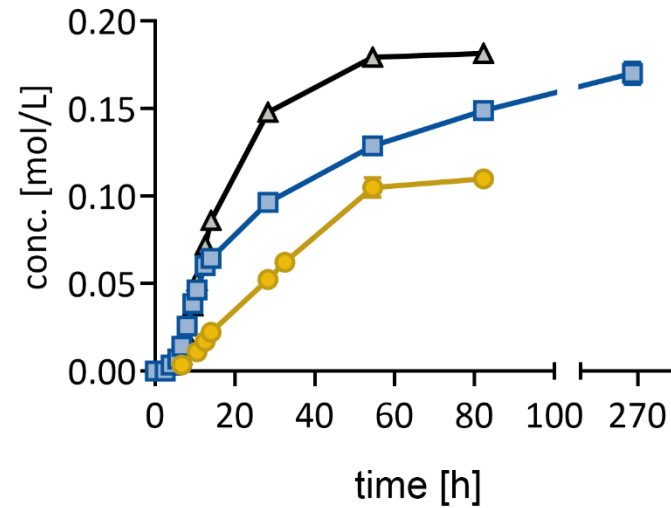
● *Lv. brevis* LD2 (Heterof.) ■ *P. pentosaceus* LD12 (Homof.) ▲ Co culture

CO CULTURE: METABOLITES

Glucose

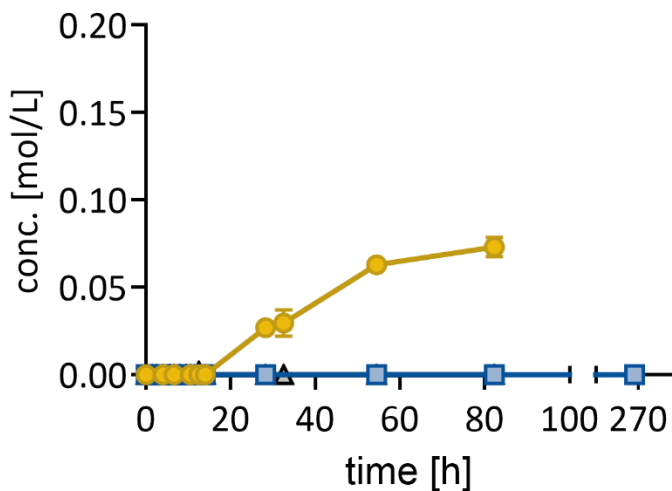


Lactic acid

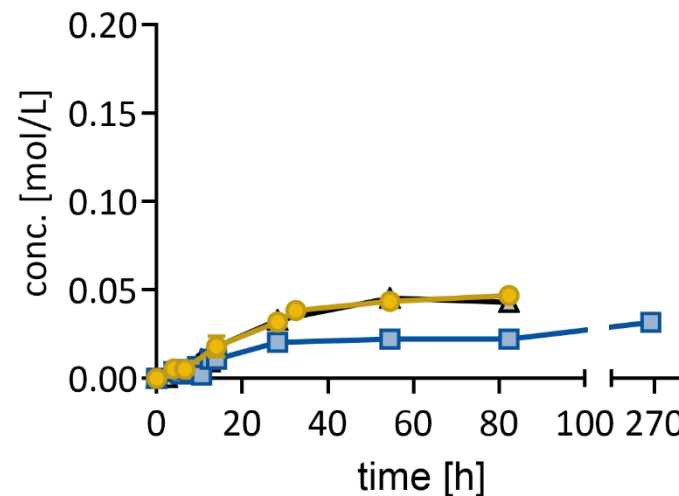


- *Lv. brevis* LD2 (Heterof.)
- *P. pentosaceus* LD12 (Homof.)
- ▲ Co culture

Ethanol

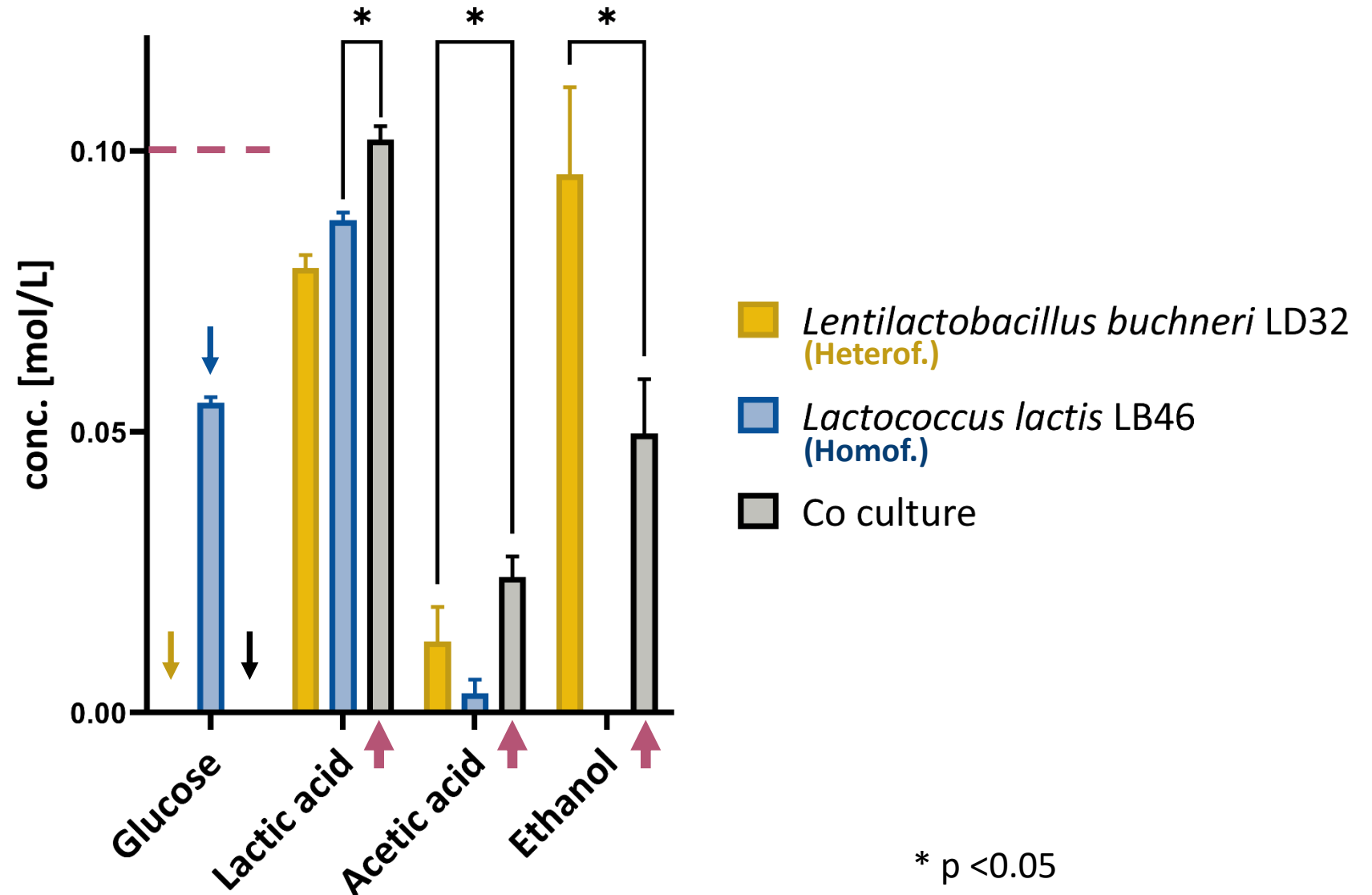


Acetic acid



CO CULTURE: METABOLITES

- Endpoint measurement
- 72 h incubation



CONCLUSION PART 2

- **Cooperation** of homo- and heterofermentative LAB:
 - Higher amounts of organic acids
 - Lower amounts of ethanol
- Details of cooperative mechanisms still need to be elucidated

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