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How LAB can cooperate to improve soy juice fermentation?

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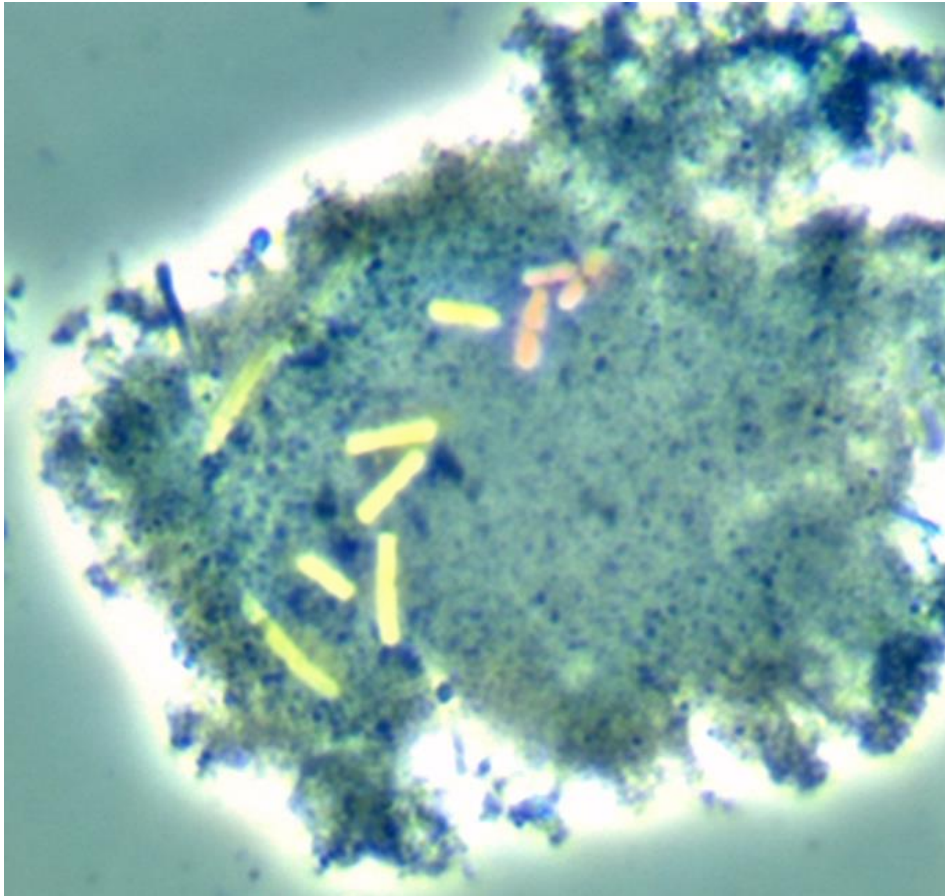
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How LAB can cooperate to improve soy juice fermentation?

PLANT PROTEIN CONFERENCE 2020

OLIVIER HARLÉ



Soy juice is an interesting alternative to animal milk

Plant-based proteins
(Plant + animal) based proteins = 50 % → Health
→ Ecology

(Guéguen et al., 2016; Springmann et al., 2018)



Soy juice from [*Glycine max*]

OFF-FLAVORS

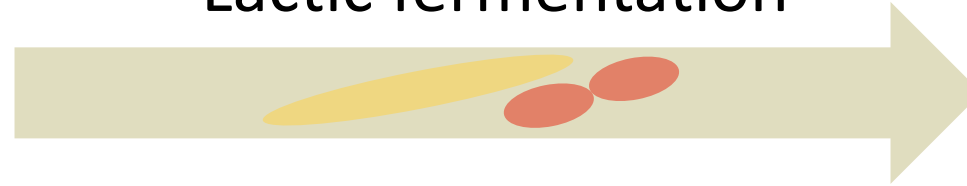
OLIGOSACCHARIDES

(Davin and Berot, 1996; Guillon and Champ, 2002)

The lactic fermentation of soy juice



Lactic fermentation



An organic Soy Juice (SJ) :

- Sugars 8 g/L
- Proteins 36 g/L
- Lipids 19 g/L

A yogurt type
fermented SJ :

- Lactic acid 4 g/L
- Sugars 4 g/L
- Proteins 36 g/L
- Lipids 19 g/L

Lactic fermentation can improve food quality

→ Lactic fermentation can improve organoleptic and nutritional properties of soy juice

OFF-FLAVORS

OLIGOSACCHARIDES

HEDONIC-FLAVORS

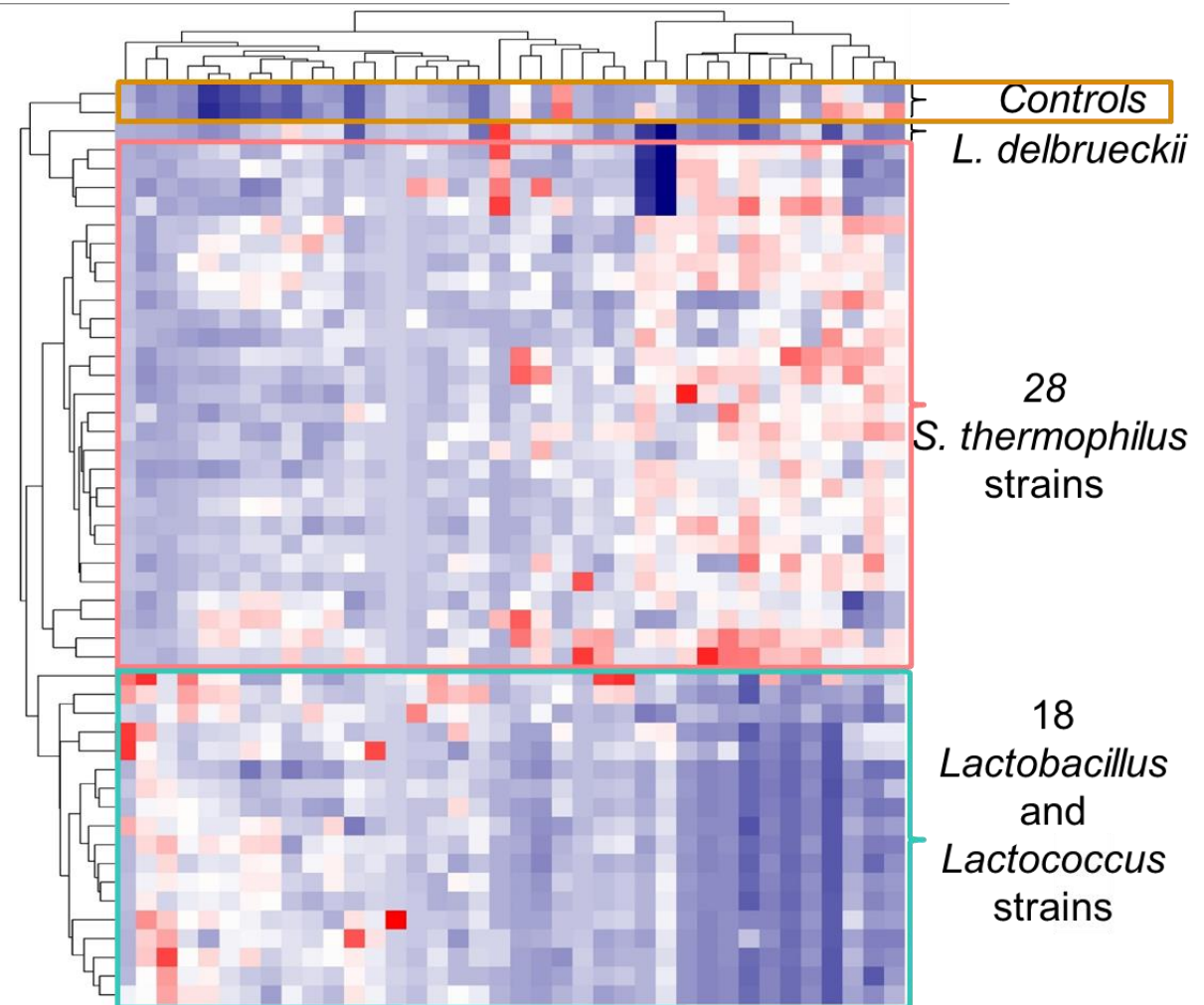
BUT

LAB are diverse

LAB are diverse

In soy juice fermentation, LAB can induce diverse profiles of:

- Sugars
- Organic acids
- Aroma compounds
- Amino Acids
- Vitamins
- Cofactors
- Redox potential modulation (Eh)



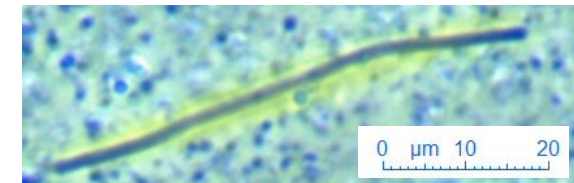
38 aroma compounds identified (Harlé et al, 2020)

LAB good fitness makes good fermentations

Lactiplantibacillus plantarum CIRM-BIA777
(Lp777) releases few AAs but is not
stressed in SJ fermentation



Lactobacillus delbrueckii CIRM-BIA865
(Ld865) releases various AAs and is
stressed in SJ fermentation (cell elongation)



LAB coculture are interesting to ferment soy juice

There can be :

Metabolic complementarities

(Sieuwert et al, 2008)

+

Positive interactions

(Sieuwert et al, 2016)



Improve
organoleptic
properties



Increase
fermentation
rate

Lp777 and *Ld865* increased acidification rate in coculture

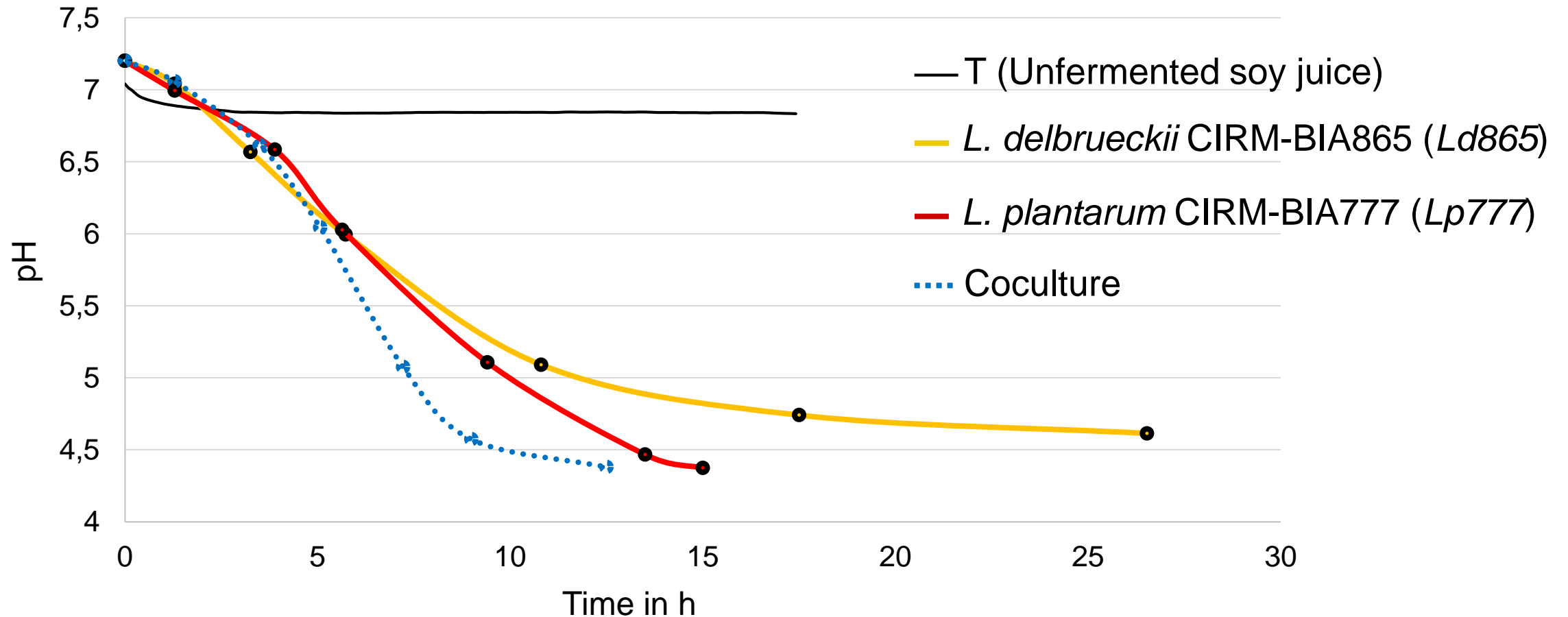
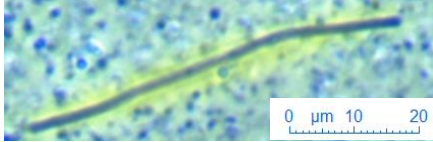


Figure 1. Fermentation kinetics of *Lp777* and *Ld865* in mono- and cocultures in SJ.

Ld865 was less stressed in coculture compared to monoculture

Ld865 in SJ monoculture



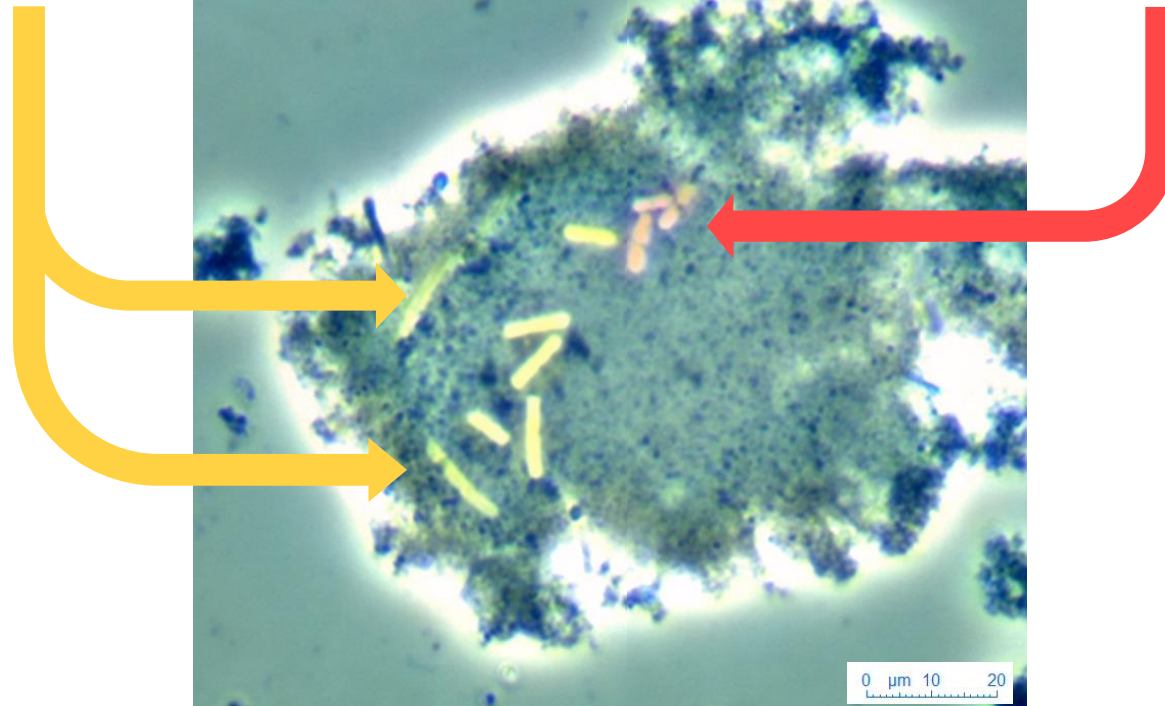
Lactobacillus delbrueckii
CIRM-BIA865

Lp777 in SJ monoculture



Lactiplantibacillus plantarum
CIRM-BIA777

SJ Coculture



Ld865 cell division was stimulated in coculture compared to monoculture

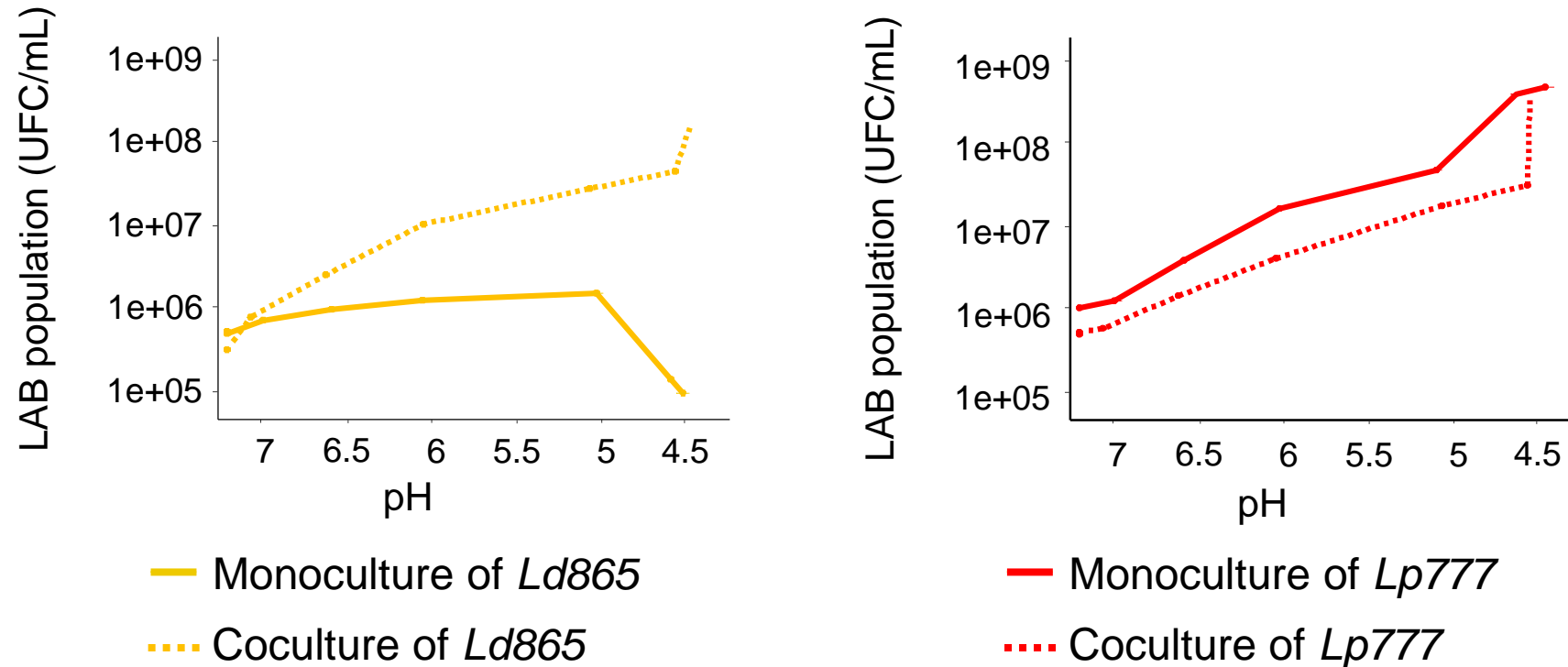
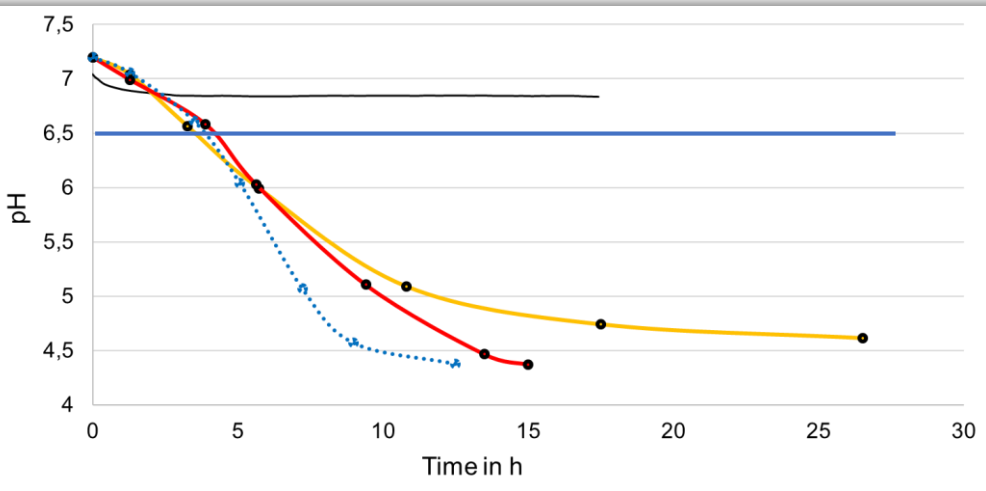
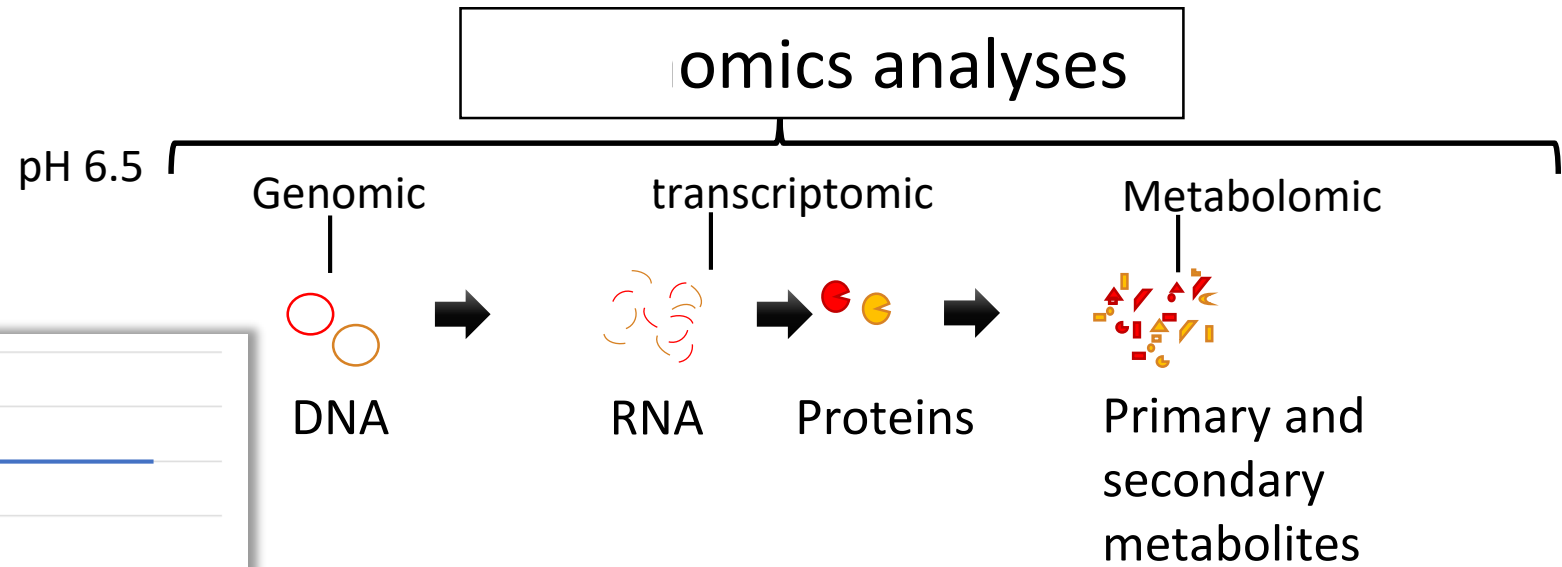


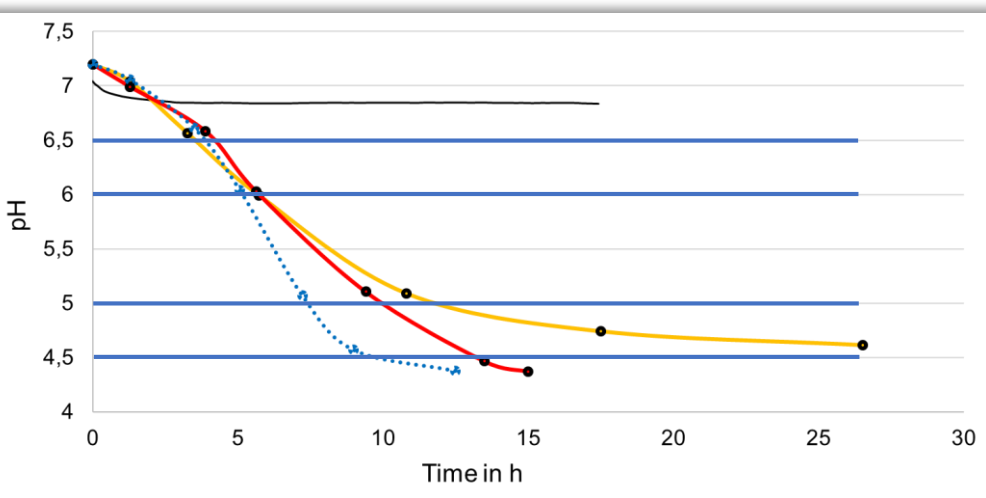
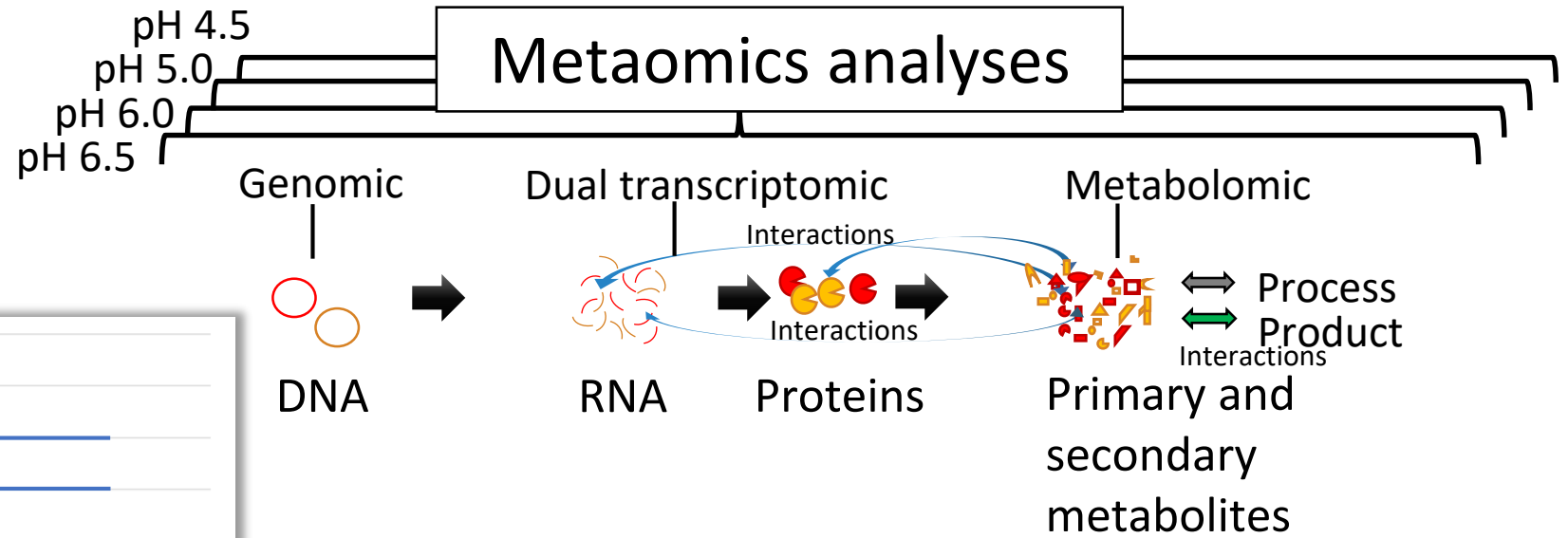
Figure 2. Growth of *Ld865* and *Lp777* performed in monoculture and in coculture in SJ fermentation at 37°C

Molecular bases of *Lp777* and *Ld865* cooperation were investigated



Molecular bases of *Lp777* and *Ld865* cooperation were investigated

(analysis of the kinetic of fermentation)



In coculture, fermentation rate increased compared to monoculture

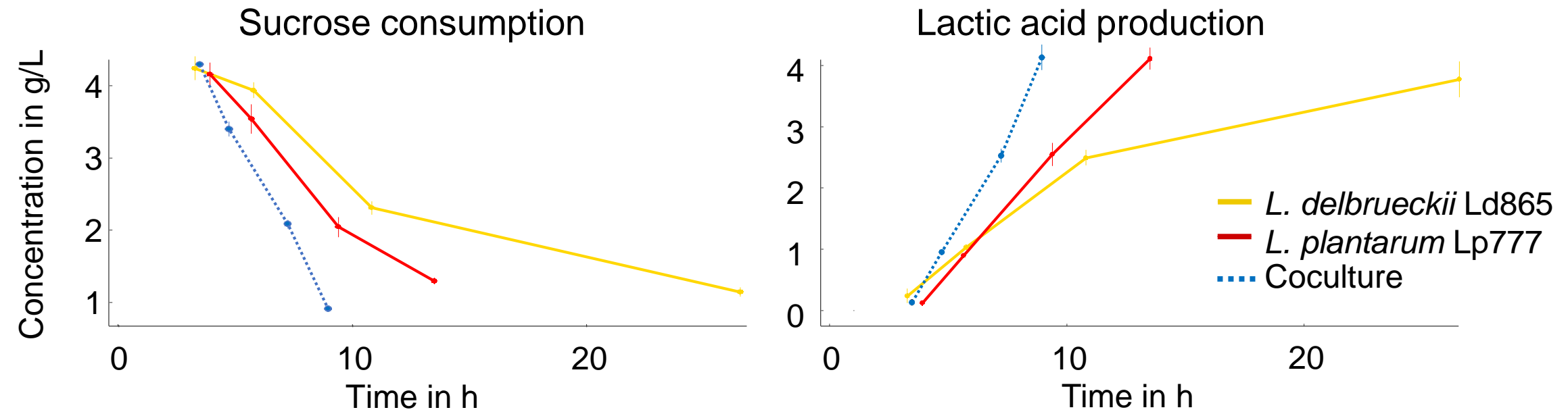
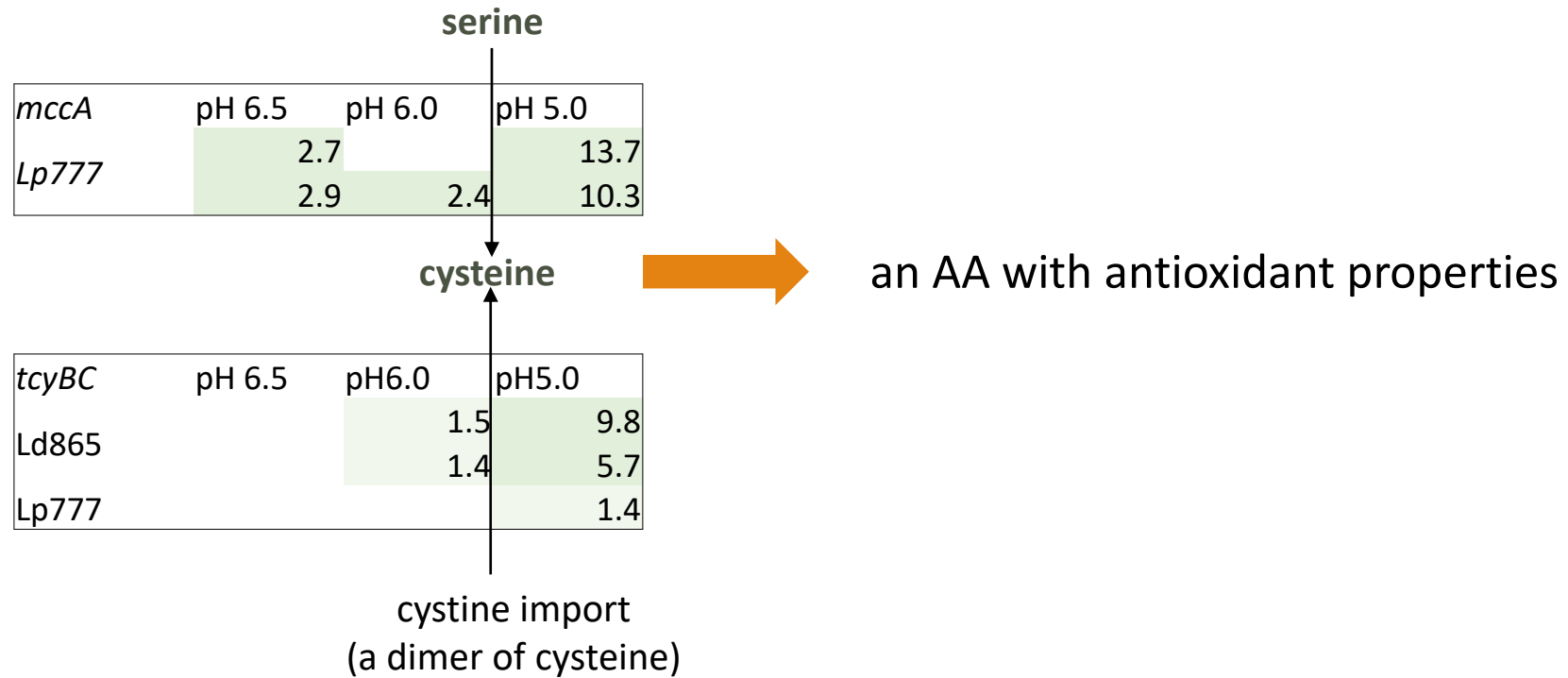


Figure 3. Sucrose consumption and lactic acid production of *Lp777* and *Ld865* in mono- and coculture in soy juice fermentation at 37°C.

In coculture, cysteine synthesis & transport were upregulated



Cystine addition in SJ decreased oxidation-reduction potential

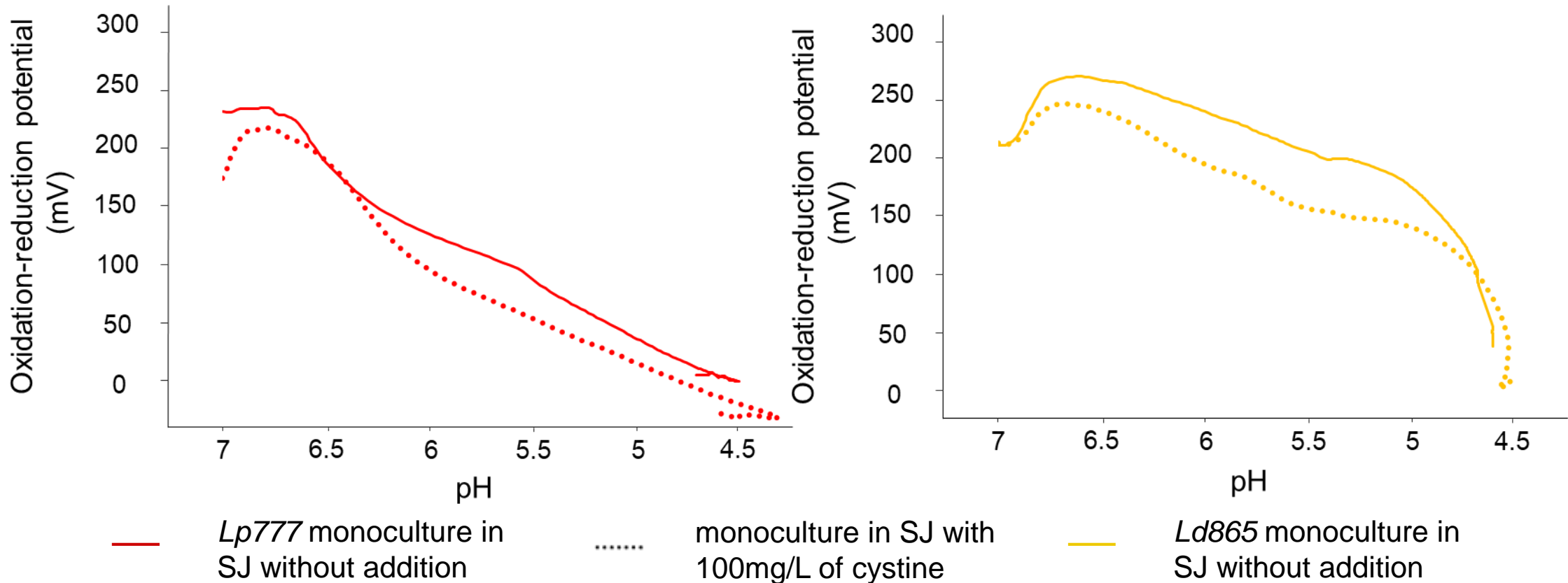


Figure 4. Oxidation reduction potential kinetics of soy juice at 37°C by *Lp777* or *Ld865* monocultures with or without addition of 100 mg/L of cystine.

Cystine addition in SJ increased acidification rate

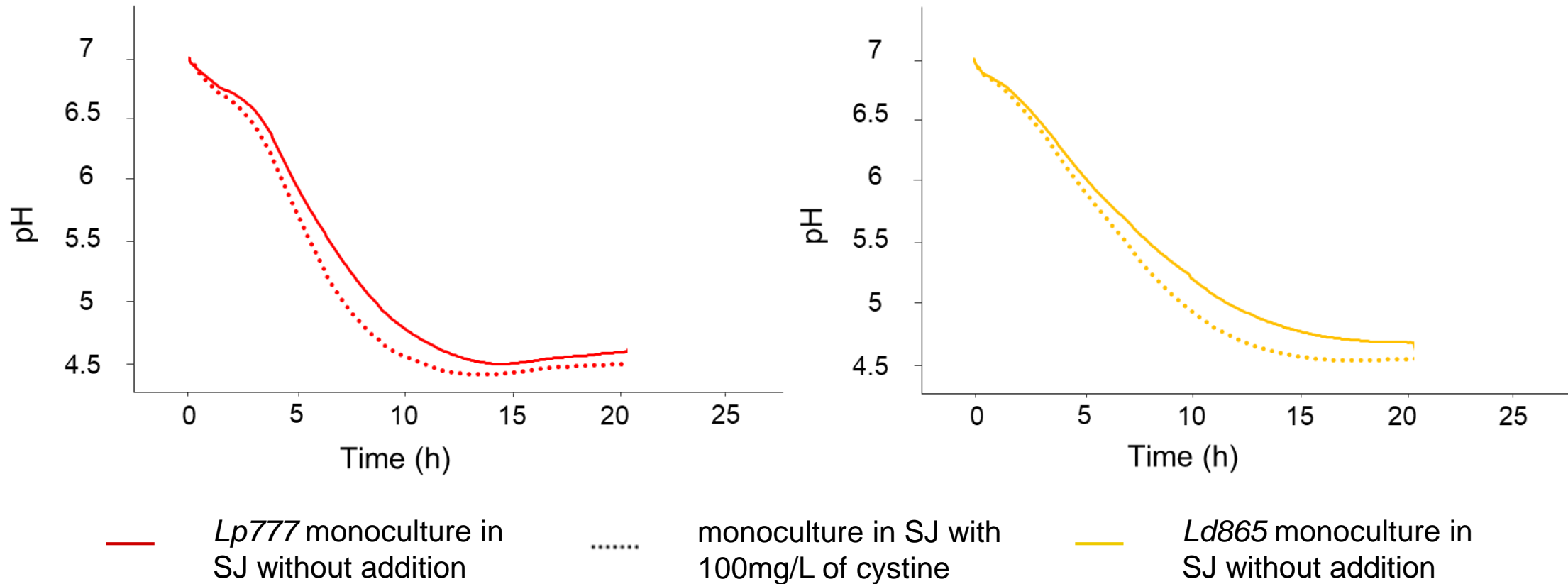
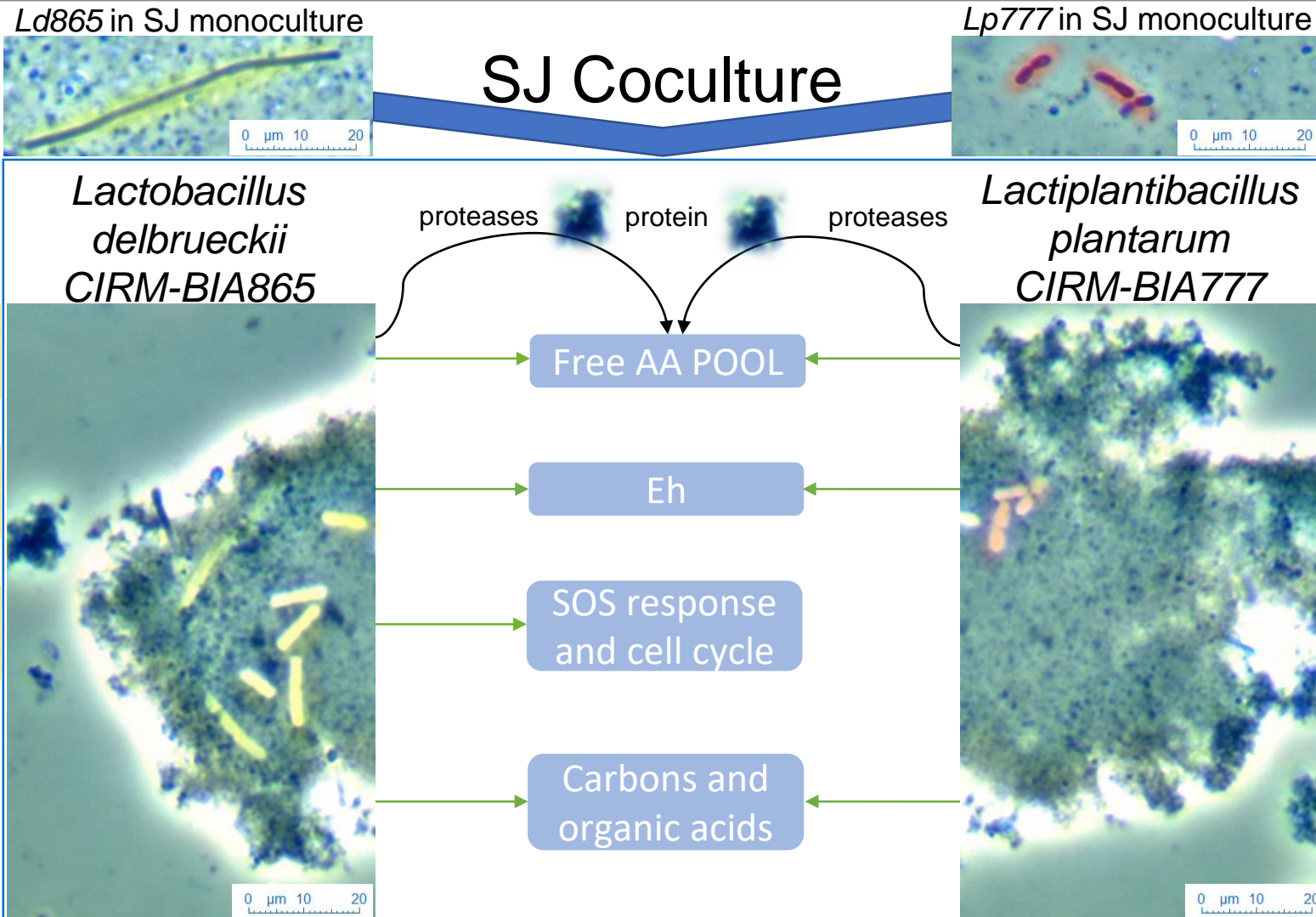
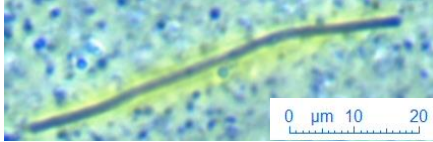


Figure 5. Acidification kinetics of soy juice at 37°C by *Lp777* or *Ld865* monocultures with or without addition of 100 mg/L of cystine.

Conclusion: Molecular bases present various metabolic complementarities



Ld865 in SJ monoculture



Lp777 in SJ monoculture



SJ Coculture

Lactobacillus delbrueckii
CIRM-BIA865

Lactiplantibacillus plantarum
CIRM-BIA777

proteases protein proteases

Free AA POOL

Eh

SOS response and cell cycle

Carbons and organic acids

Amino acids
Cross-feeding

Antioxidant
cooperation

Ld865 growth and cell
division is stimulated

Higher fermentation
rate

0 μm 10 20

0 μm 10 20

Conclusion

Genomics + Dual transcriptomics + Metabolomics



Different points of views



Better comprehension



Better control of the process

Thanks for listening

And many thanks to...



Hélène FALENTIN

Gwenaëlle HENRY



Stéphanie-Marie DEUTSCH

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Anne THIERRY

Marie-Bernadette MAILLARD

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Jérôme NIAY



Triballat-Noyal R&D UF TEAM



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