22 Colloque du Club des Bactéries Lactiques
CBL CAEN
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Comparative study of lactic acid bacteria in soy juice fermentation

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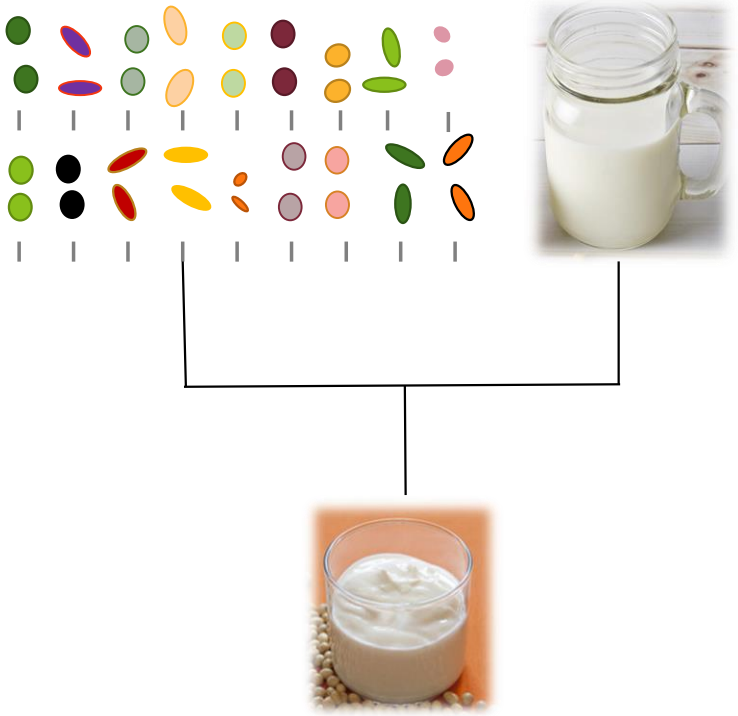

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12th June 2019

Social and economic context

Diet in developed countries :

$$\frac{\text{Plant-based proteins}}{\text{Animal + Plant-based proteins}} = 40\ \%$$

➡ Health

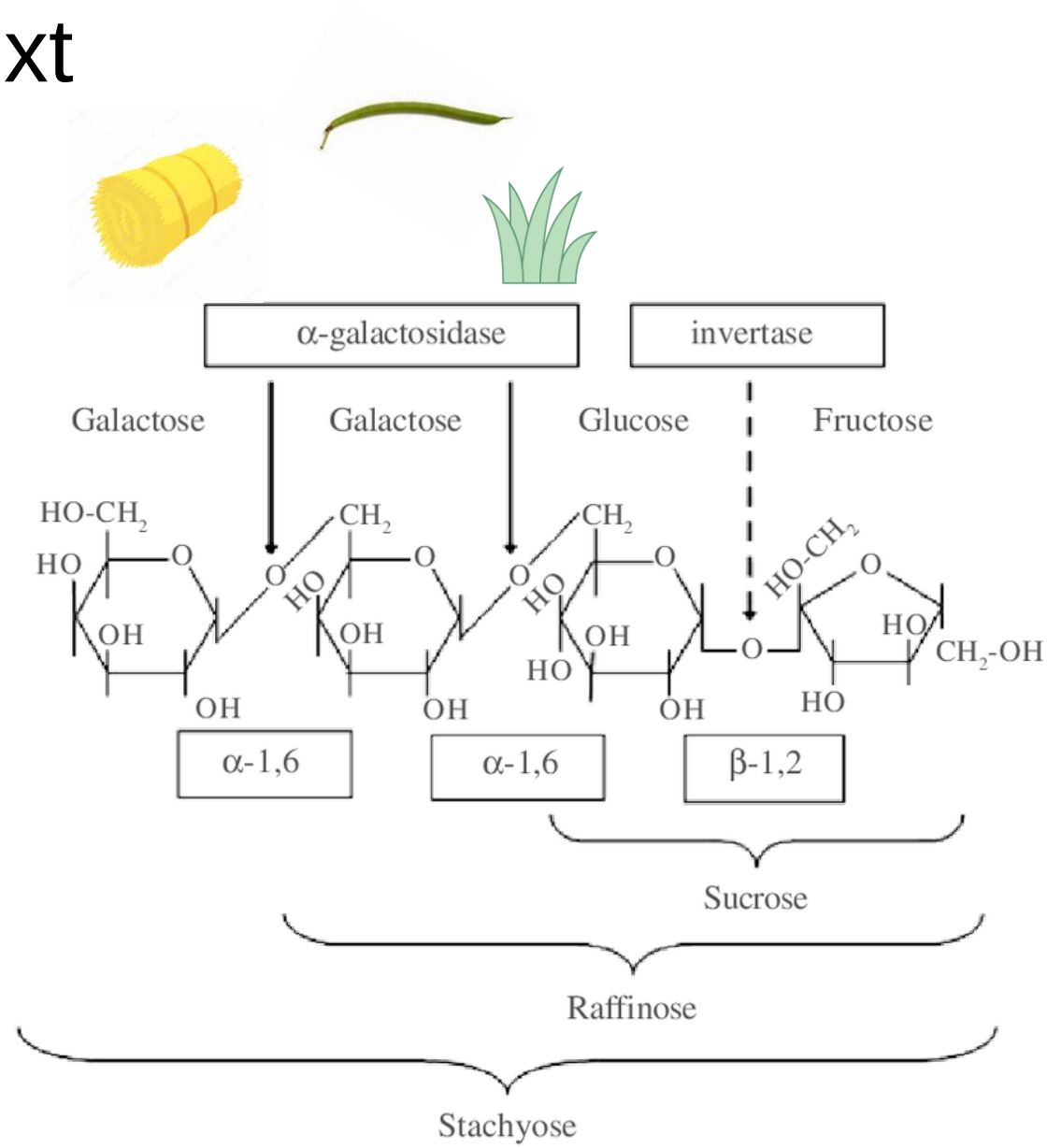
➡ Ecology

Soybean [*Glycine max*] is a good alternative

Social and economic context

But : Soy “off-flavors” are not appreciated

Soy contains high levels
of non-digestible oligosaccharides



Social and economic context

But : Soy “off-flavors” are not appreciated

Soy contains high levels
of non-digestible oligosaccharides

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

OFF-FLAVORS

HEDONIC-FLAVORS

OLIGOSACCHARIDES

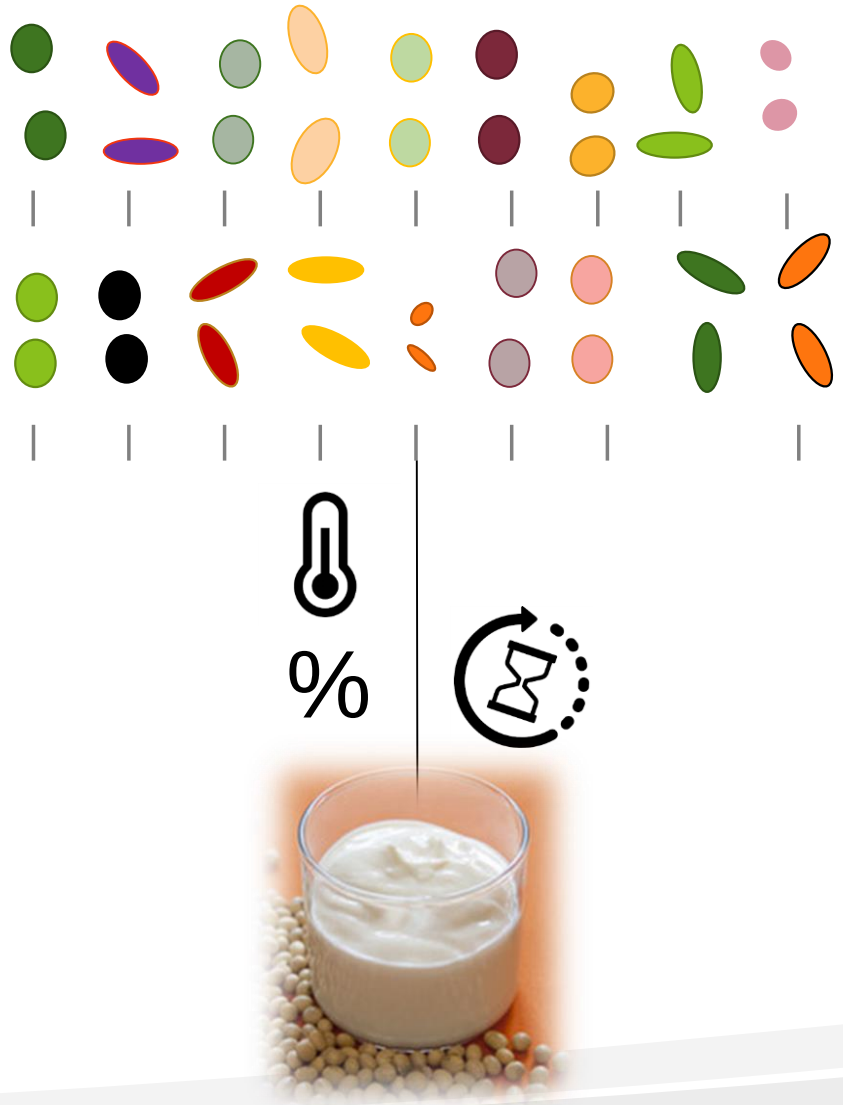
Scientific context

Bibliography :

- ~ 30 publications on soy juice fermentation
- 1 to 32 LAB strains studied by publication

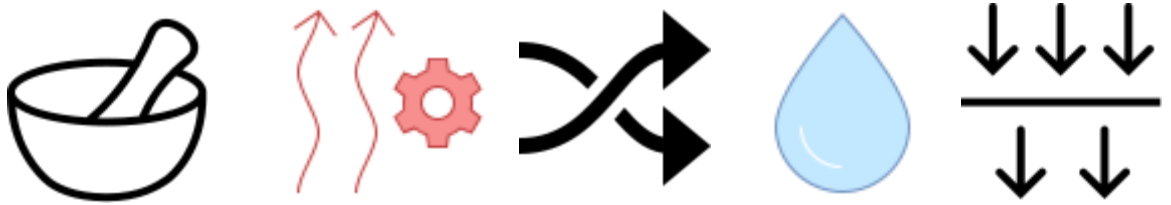
Inoculation levels from 0.1 % v/v ***Wang et al. 2003***
to 5.0 % v/v ***Blagden et al. 2005***

Fermentations from 3 h ***Baú et al. 2015***
to 48 h ***Tsuda et al. 2017***



Scientific context

Soy juice production is a complex process :



Soy juice with total sugars from 1 g/L ***Hati et al. 2014***
to 23 g/L ***Champagne et al. 2009***

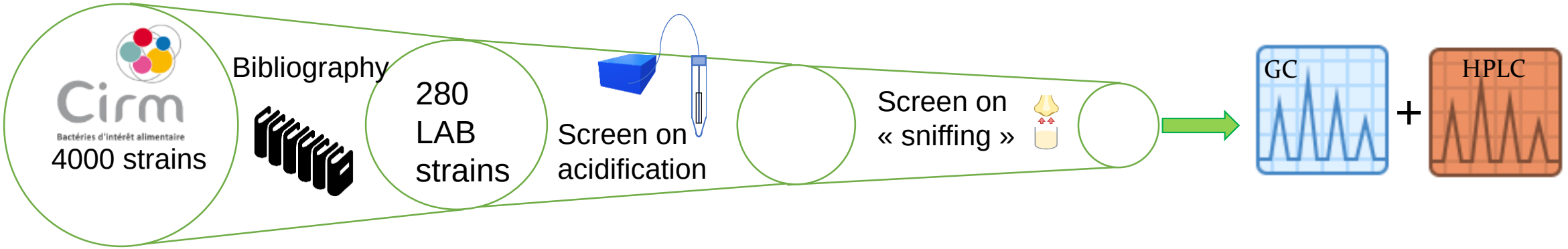
Scientific context

No standards to study soy juice fermentation

→ Knowledge of LAB metabolic profiles to ferment soy juice is limited

What is the diversity of LAB metabolic profiles in soy juice fermentation ?

Screening to select LAB strains to ferment soy juice



I. **LAB ability to use soy oligosaccharides**

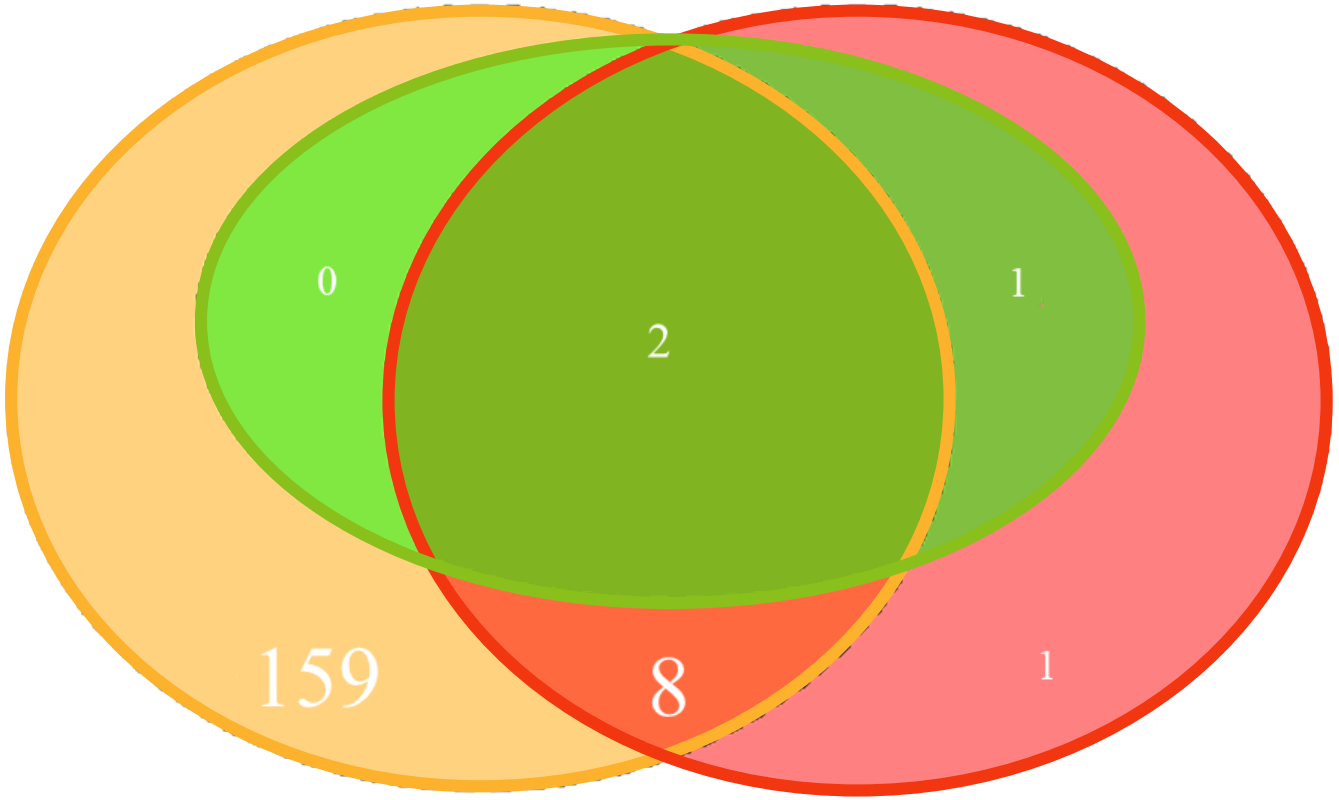
II. Aroma compounds and sensory analyses of fermented soy juices

III. Conclusion

Abilities of 280 LAB strains to acidify synthetic media with sucrose, raffinose or stachyose in 10 h

(5 g/L) (5 g/L) (2 g/L)

Soy juice sugars (g/L)	
Sucrose	5.5
Raffinose	0.9
Stachyose	3.1

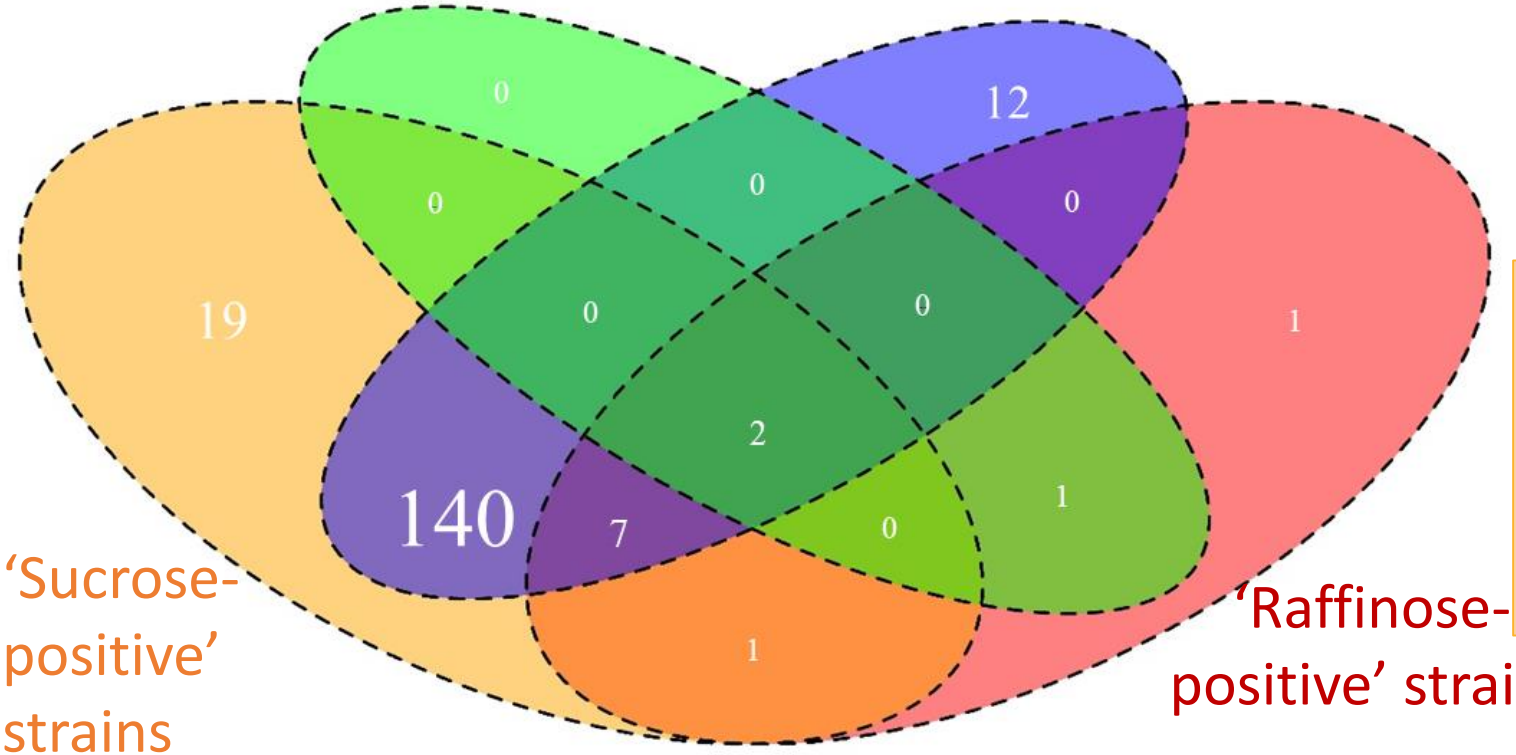


169 LAB are '**sucrose-positive**'
12 LAB are '**raffinose-positive**'
3 LAB are '**stachyose-positive**'

LAB strains abilities to acidify soy juice in 10 h

161/280 LAB strains ferment soy juice below pH 6 in 10 h

Soy juice sugars (g/L)	
Sucrose	5.5
Raffinose	0.9
Stachyose	3.1



‘Sucrose-positive’ strains

‘Stachyose-positive’ strains

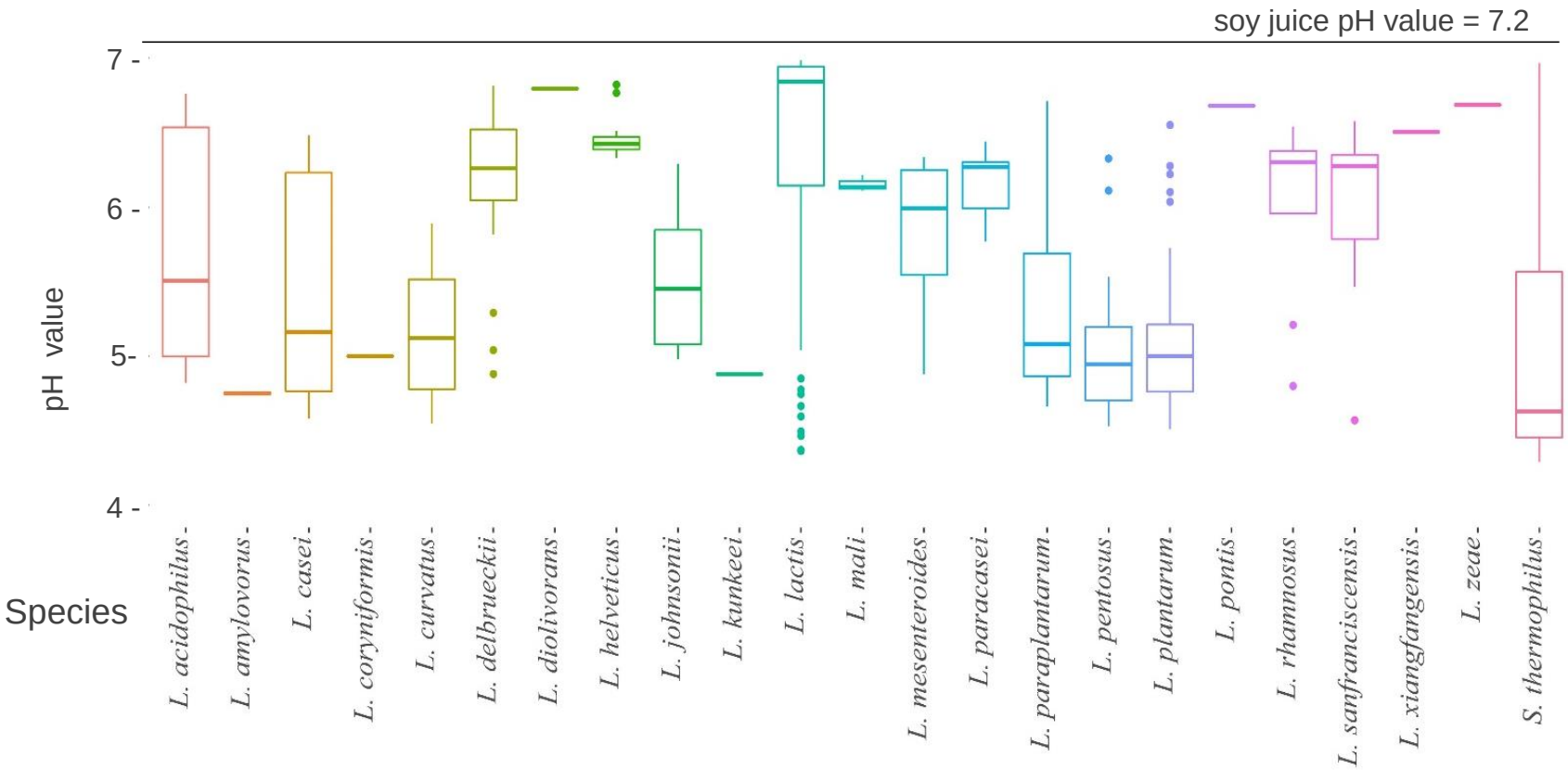
‘Soy juice-positive’ strains

‘Raffinose-positive’ strains

149/169 of ‘sucrose-positive’ strains can ferment soy juice

Strains that can only use raffinose or stachyose can not ferment soy juice

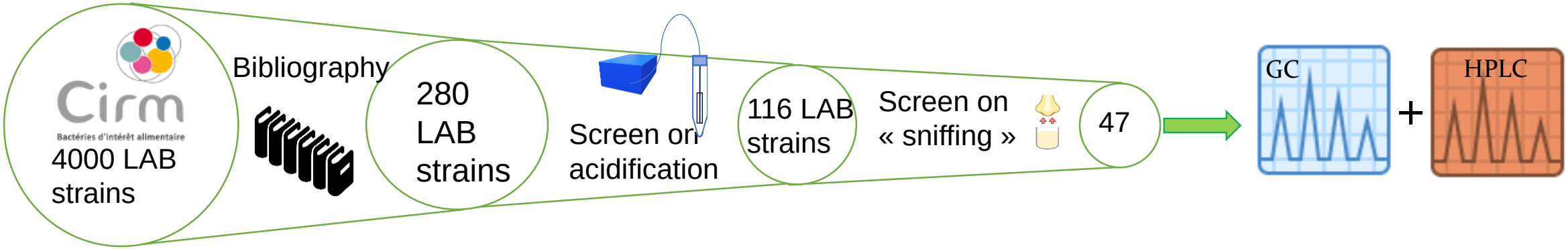
pH values reached by LAB strains by specie in soy juice fermented for 10 h



Fermentation rate is both species- and strain-specific

S. thermophilus is the specie with the greater proportion of acidifying strains (52/59)

Screening to select LAB strains for use in soy juice fermentation

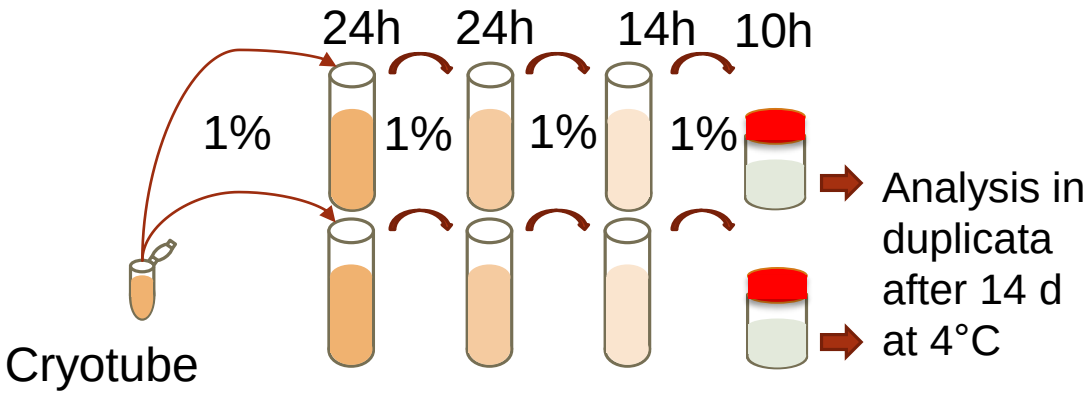


I. LAB ability to use soy oligosaccharides

II. **Aroma compounds and sensory analyses of fermented soy juices**

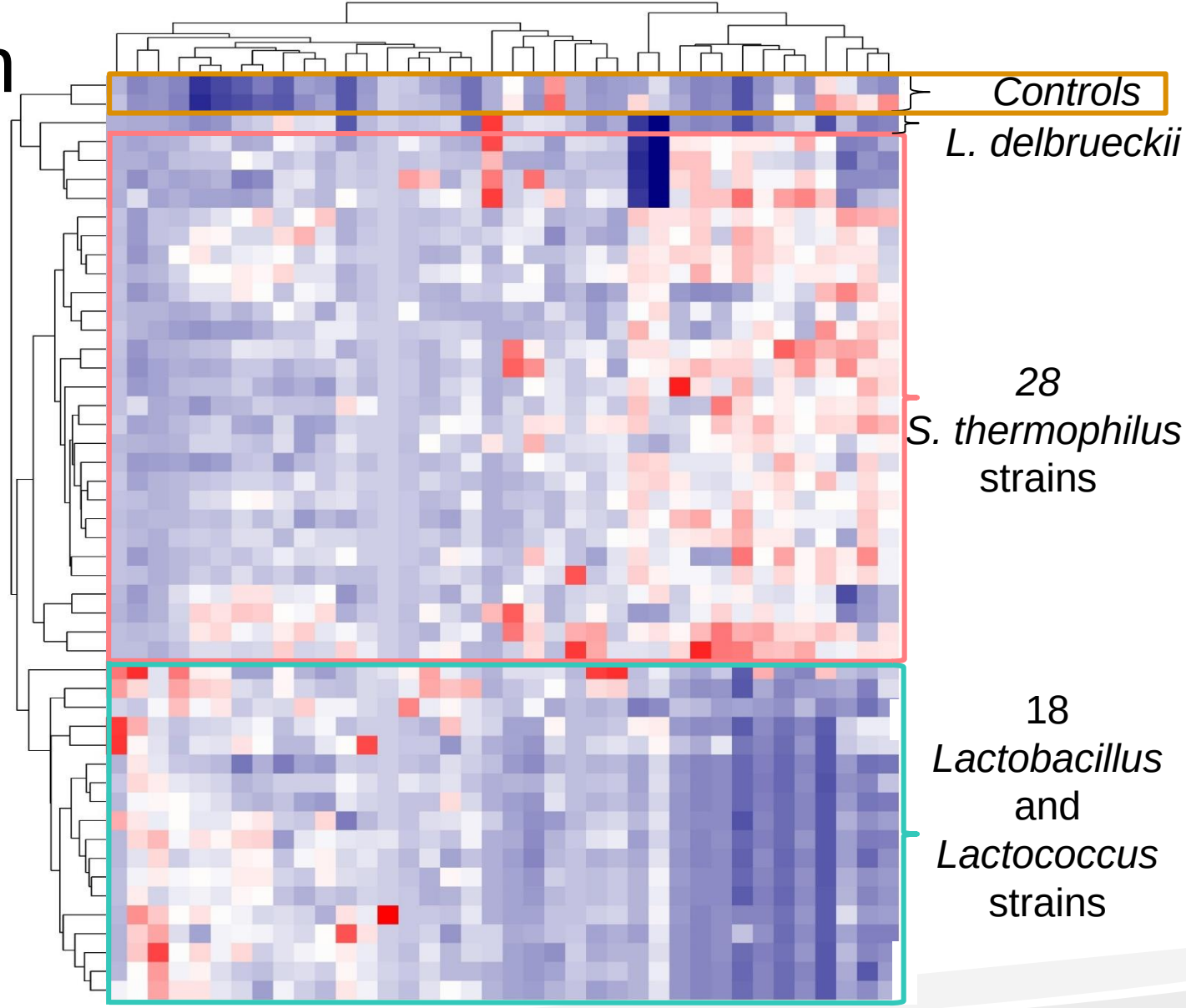
III. Conclusion

Aroma compounds in fermented soy juices



All LAB strains produced at least one volatile compound

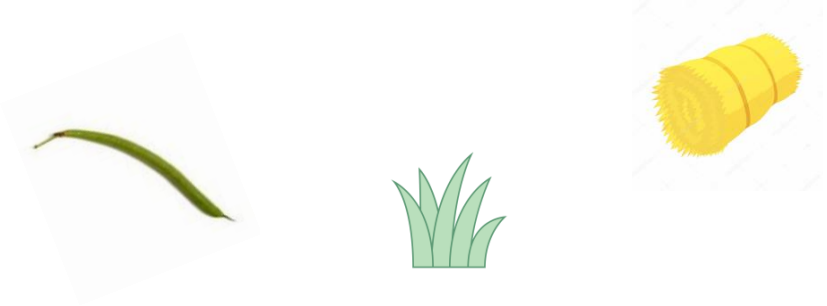
Profiles of aroma compounds are both species- and strain-specific



38 aroma compounds identified

Example of two OFF-FLAVOR compounds in fermented soy juices :

Hexanal is associated with fatty; fruity; green; fresh and sweaty odors



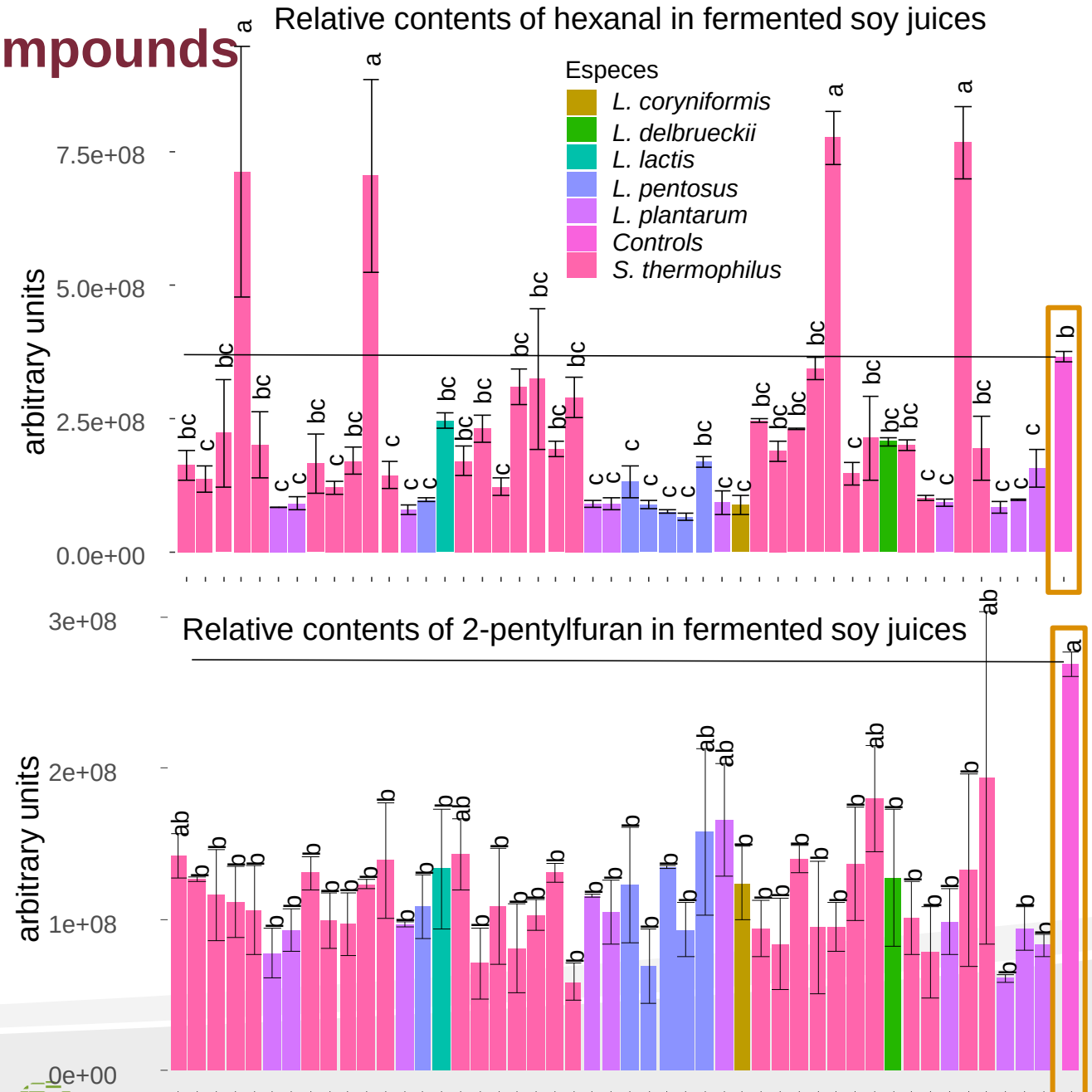
2-pentylfuran is associated with beany; butter; earthy; fruity and green odors

Amounts of two OFF-FLAVOR compounds in fermented soy juices :

16/18 *Lactobacillus* strains **reduced** hexanal content

6/28 *S. thermophilus* strains **reduced** and 4/28 **increased** hexanal content

Soy juice 2-pentylfuran content is decreased by most strains (41/47)



Example of two HEDONIC-FLAVOR compounds in fermented soy juices:

Phenylethan-1-ol is associated with hyacinth; gardenia; fresh and sweet odors

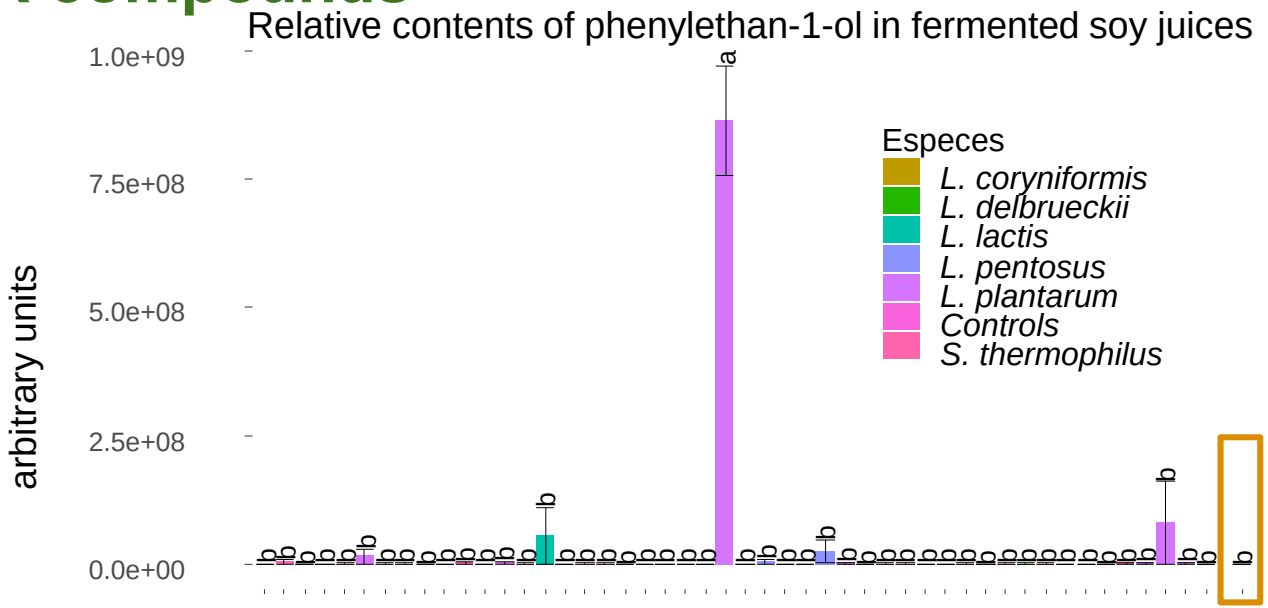
3-hydroxybutan-2-one (acetoin) is associated with butter; cream; fatty; dairy and sweet odors

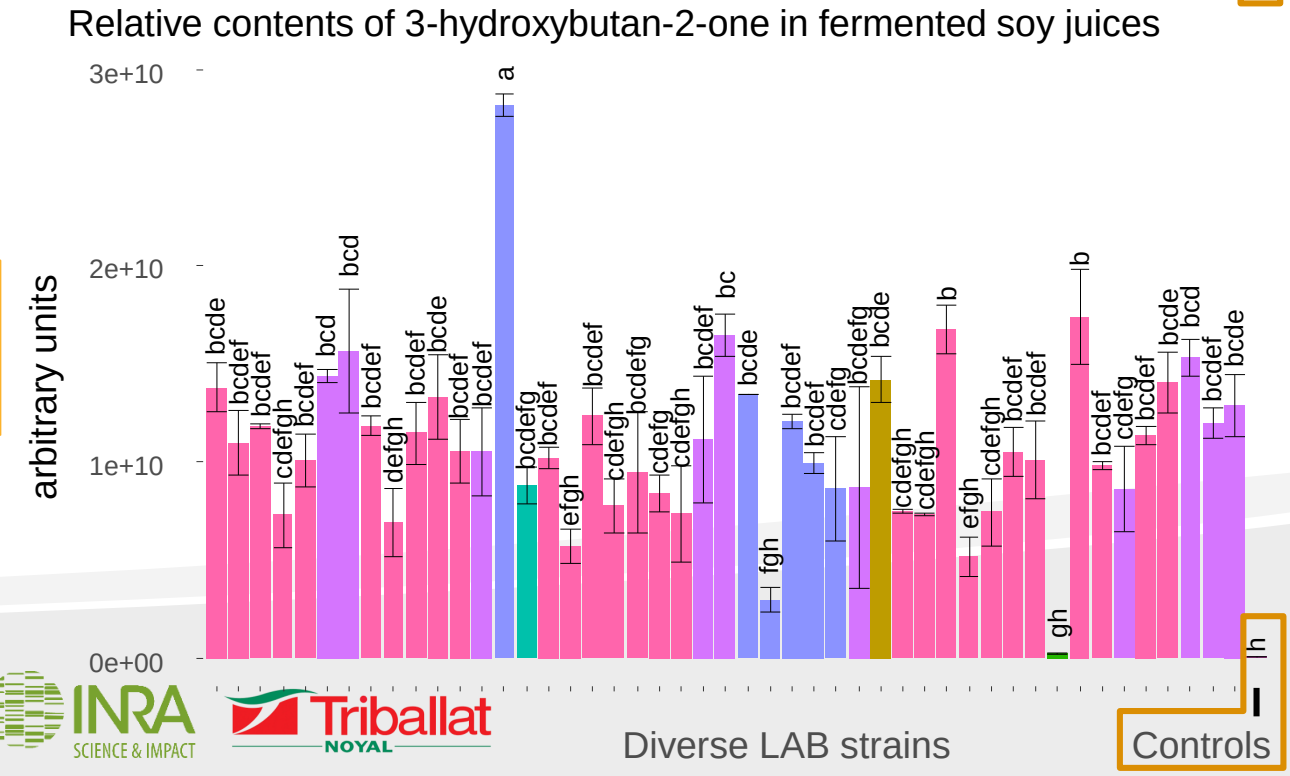
Amounts of two HEDONIC-FLAVOR compounds in fermented soy juices:

One L. plantarum produced phenylethane-1-ol

No *S. thermophilus* strains produced phenylethane-1-ol

3-hydroxybutan-2-one production is both species- and strain-specific

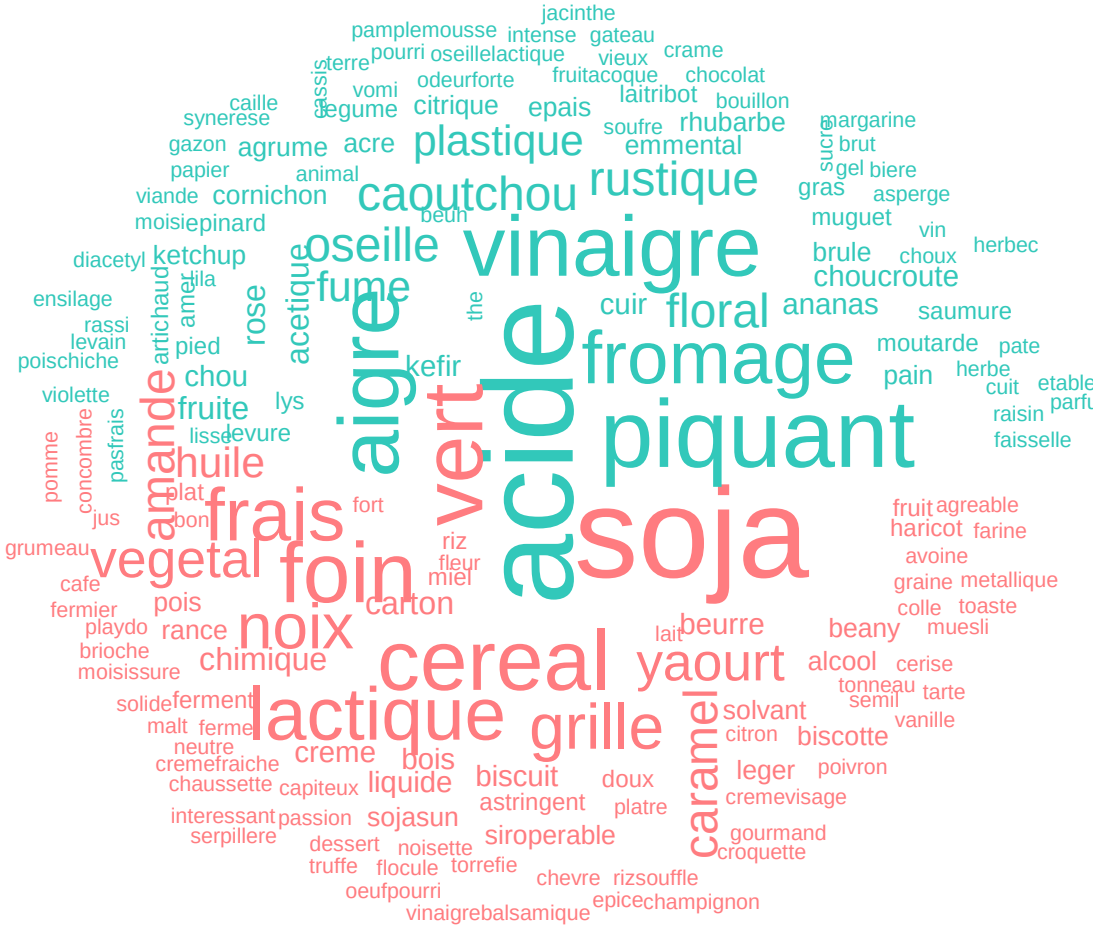




Comparison cloud of the fermented soy juices odors

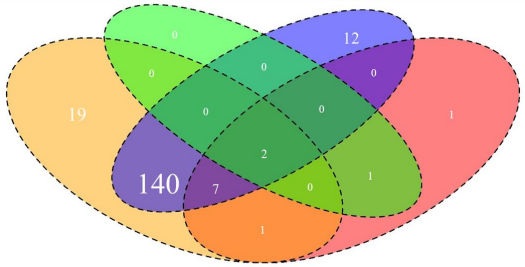
Lactobacillus/ Lactococcus FSJs present ‘strong’ odors

S. thermophilus FSJs present ‘soy’, ‘green’ and ‘lactic’ odors



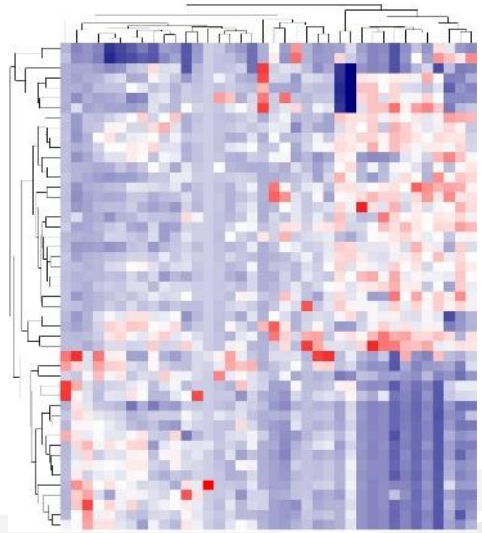
Control (non fermented soy juice) odors

Conclusion



- 58 % of LAB strains can ferment soy juice in 10 h
- All strains that ferment soy juice in 10 h are ‘sucrose-positive’

- All LAB strains produce diverse volatile compounds in soy juice fermentation that are both species- and strain-specific
- Screening LAB strains present interests for the creation of distinct products



- What is the behaviors of LAB strains in mixed-cultures in soy juice fermentation?

Do they compete, cooporate or have other interactions?

Thank you for your attention!

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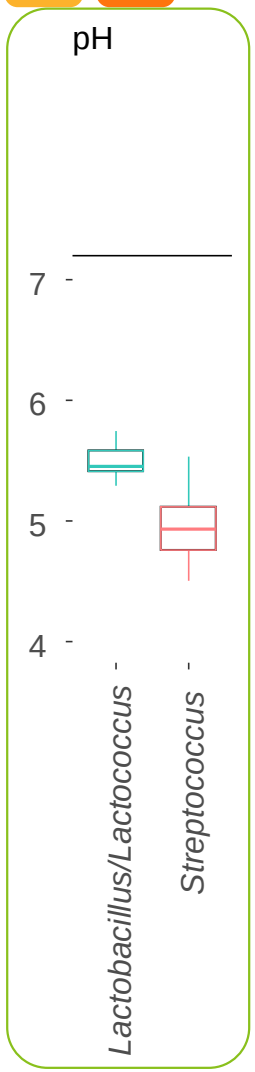
Acidification of fermented soy juices (FSJs)

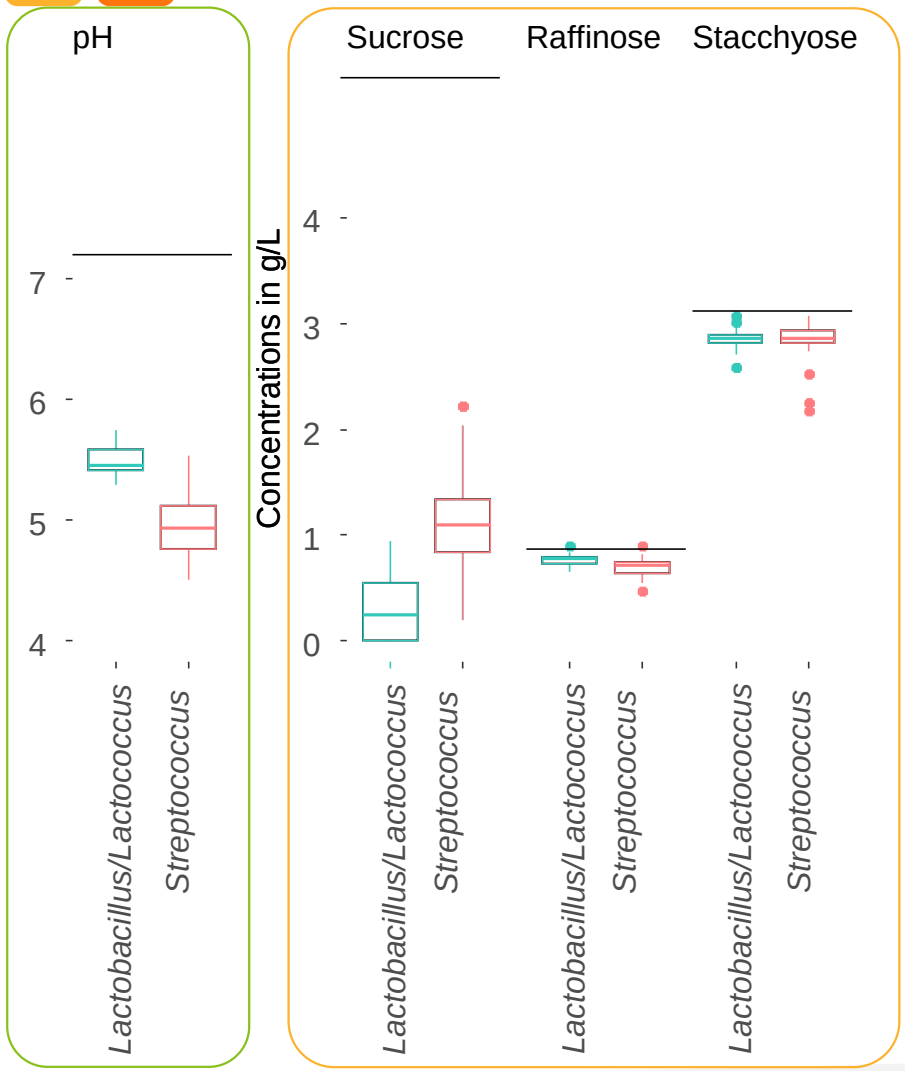


FSJs fermented by ***Streptococcus*** strains

are **more acid** than

FSJs by ***Lactobacillus/ Lactococcus***

Sugars consumed in FSJs

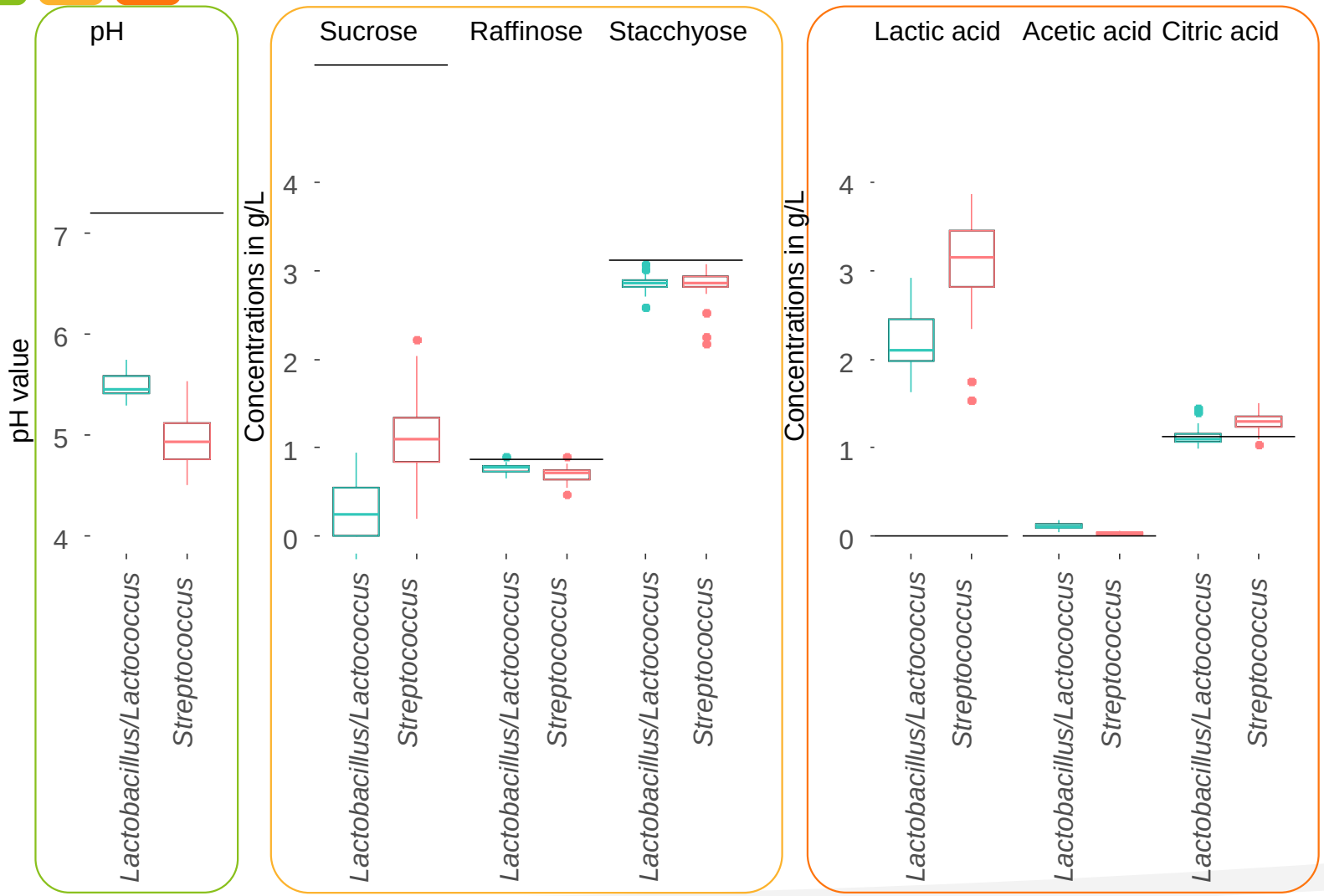


FSJs fermented by ***Streptococcus*** strains

consumed less sucrose than

FSJs by ***Lactobacillus/ Lactococcus*** strains

Organic acids produced in FSJs



FSJs fermented by ***Streptococcus*** strains

produced **more lactic, more citric** and **less acetic acid** than

FSJs by ***Lactobacillus/ Lactococcus*** strains