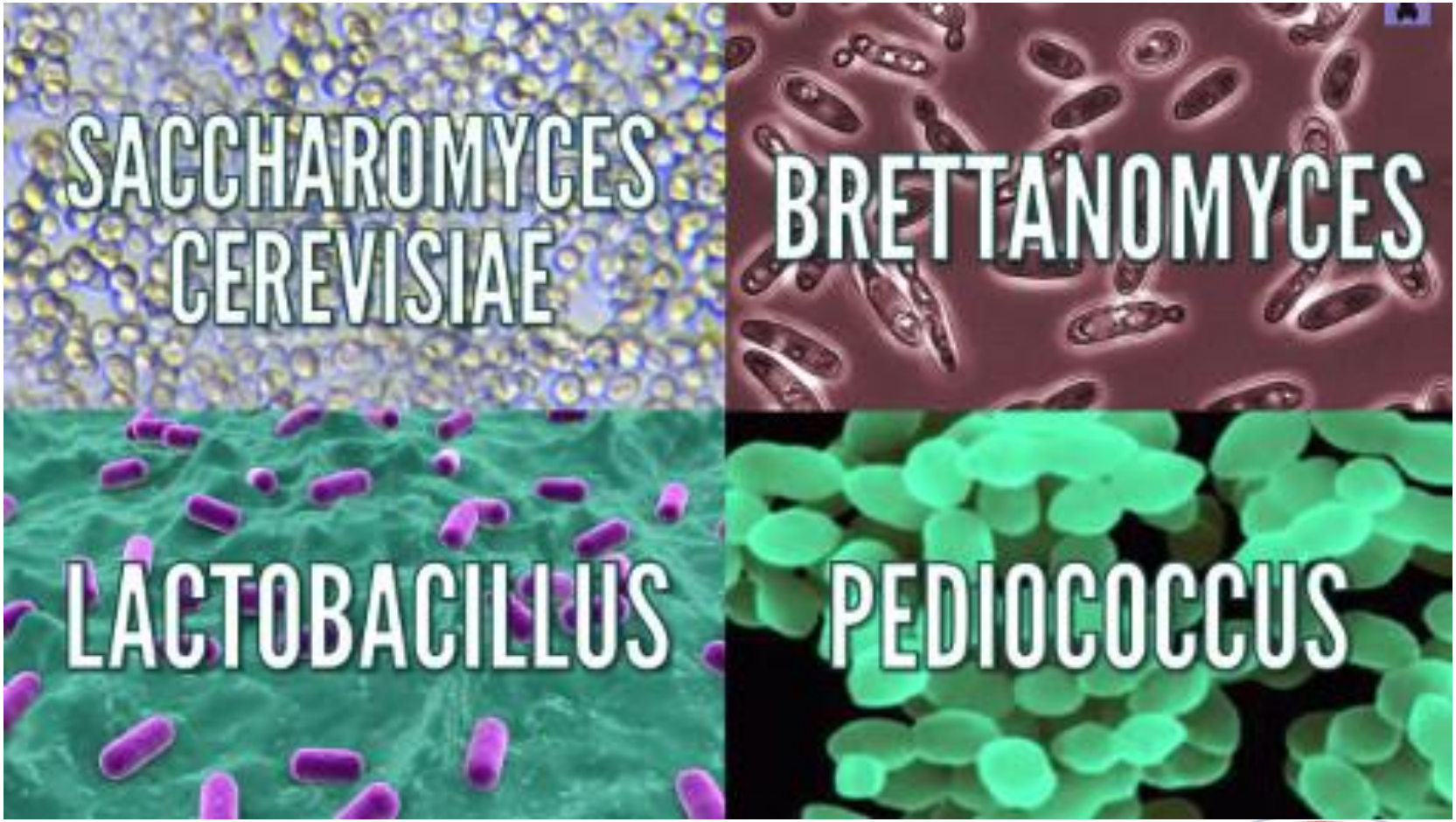
Souring Organisms

Brittney Berg
Lallemand Brewing
bberg@Lallemand.com

Overview

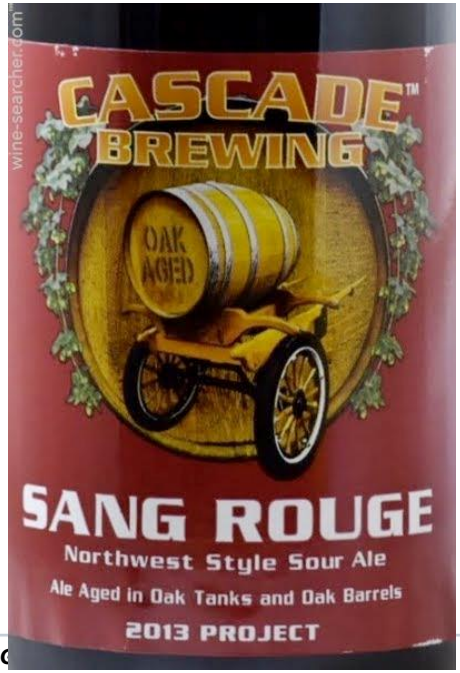

SACCHAROMYCES CEREVISIAE
BRETTANOMYCES
LACTOBACILLUS
PEDIOCOCCUS

History and styles of sour beer

- Sour beer styles have existed for centuries
- What do we mean by Sour beer?
- History and heritage of sour beers have been based in Europe, including:
  - Berliner Weisse
  - Gose
  - Lambic
  - Flanders Red Ale

Modern sours

- Growth in Belgian sour imports in 90's influence US
- Based on historic styles
- Huge diversity in sour styles, flavors and creativity



Souring applications and techniques

- **Mash Souring**
  - Liquor, grain adjustment
  - Bacteria from grain or inoculated
  - 2 – 3 days
- **Kettle Souring**
  - Wort innoculated with LAB
  - 2 -3 days
- **Co-fermentation**
  - Mixed sacc, LAB & Brett
  - Typical fermentation time
- **Barrel/Foeder/spontaneous ageing**
  - Often in wood (or Keolschip)
  - Mixed spectrum of microflora
  - Greater complexity

Key microorganisms

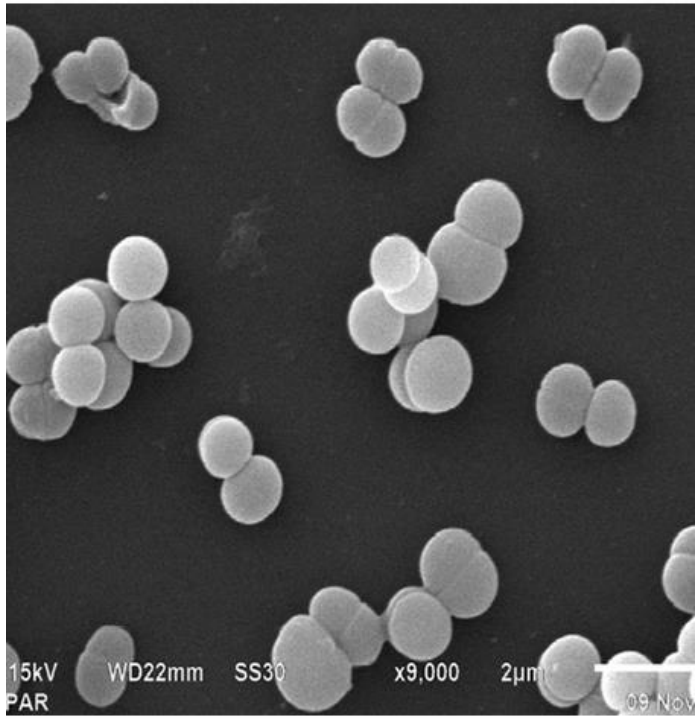
- Bacteria
  - Lactic acid producing bacteria
    - Lactobacillus
    - Pediococcus
- Non-Saccharomyces Wild Yeast
  - Brettanomyces
  - Lachancea
- GMO souring yeast
  - Sourvisiae

Lactic Acid Producing bacteria

Pediococcus & Lactobacillus

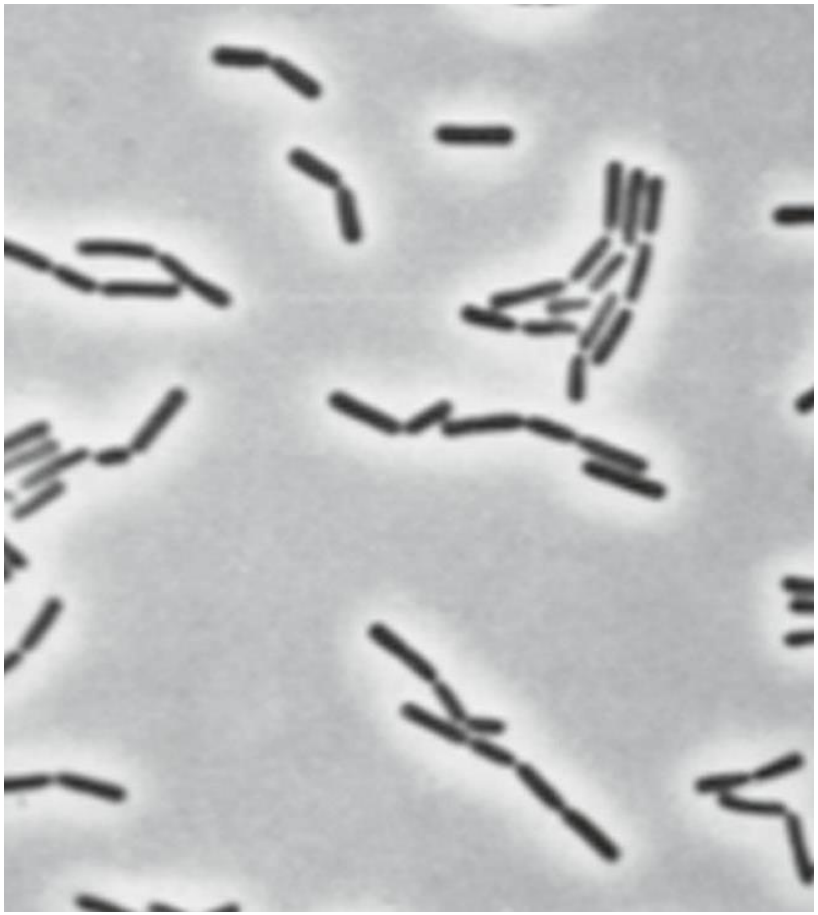
Pediococcus

- Lactic acid producing bacteria, can be <3.0 pH
- Slow acting
- Can grow in CO2 rich environments and in O2 environments
- Found naturally on most fruits
- Hop tolerant
- A “ropey” diacetyl producer
- Help from Brettanomyces!



Lactobacillus

- Primary souring bacteria
- Diverse range of sub species
- Temperature sensitive
- Softer and tangier lactic acid
- Sugar Utilization



Sources of LaB

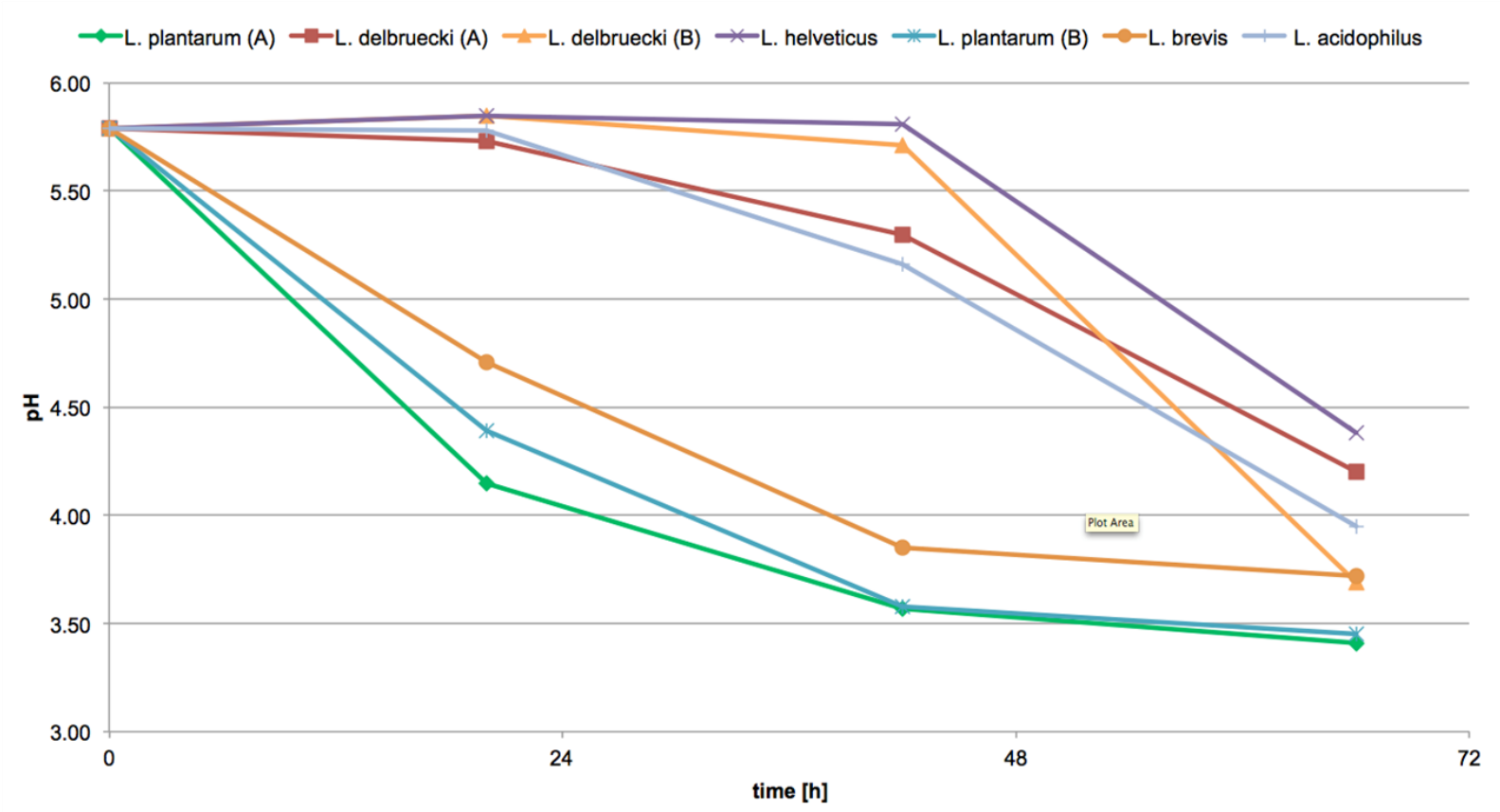
- Laboratory (pure or mixed culture)
- Bottle cultures
- Nature
- Yogurt
- Un-mashed grain

R&D Trials

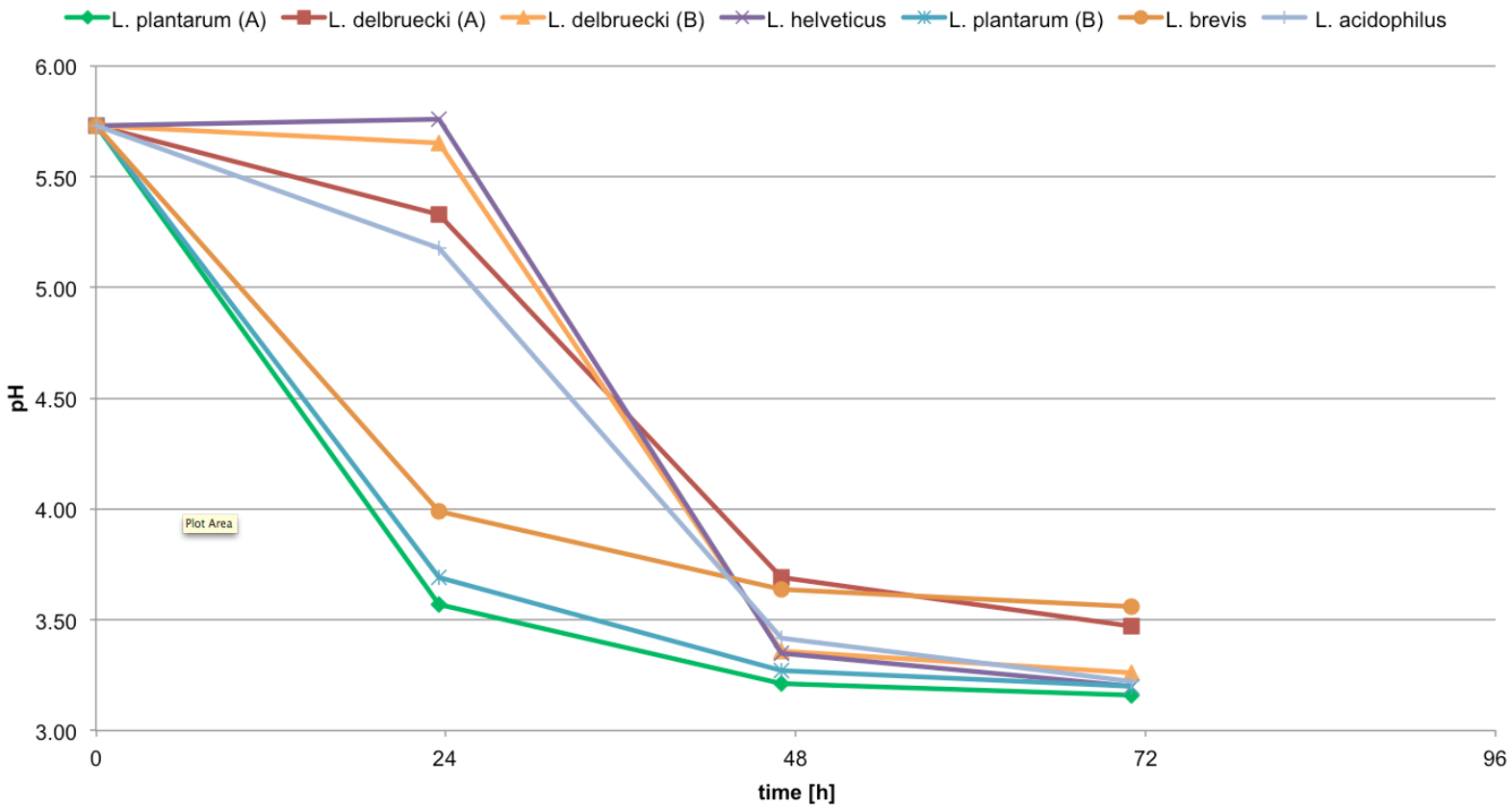
- Achieve pH 3.5 or lower in <48 hours
- Achieve high lactic acid vs low acetic concentration
- Fermentations at 4 different temperatures
- Gravity and pH measurement daily
- Acid and glycerol analysis by HPLC
- Sensory assessment of samples by panel

Strains
L. plantarum (A)
L. delbrueckii (A)
L. delbrueckii (B)
L. helveticus
L. plantarum (B)
L. brevis
L. acidophilus

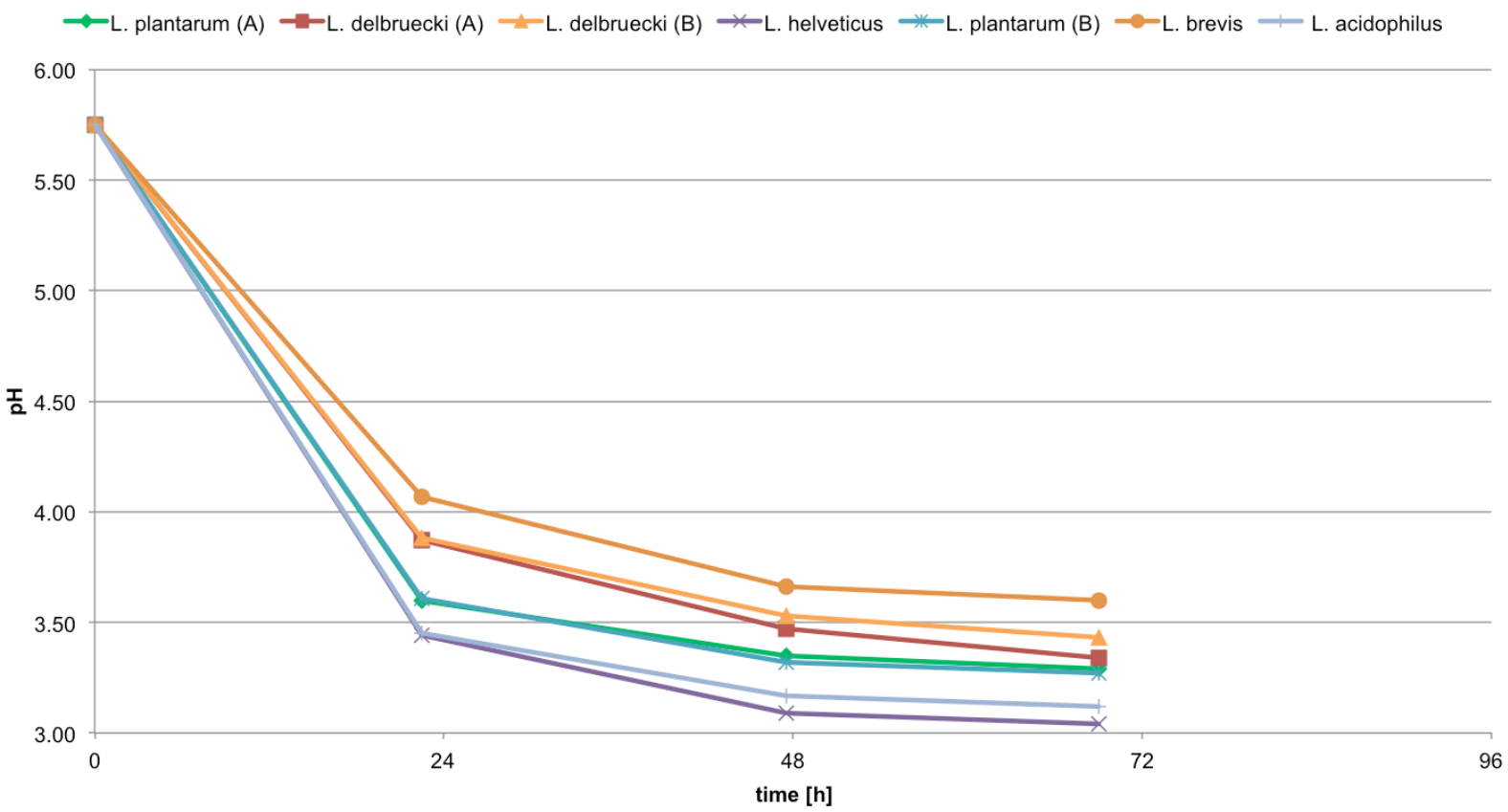
R&d trials: Fermentations (20C) (..F)



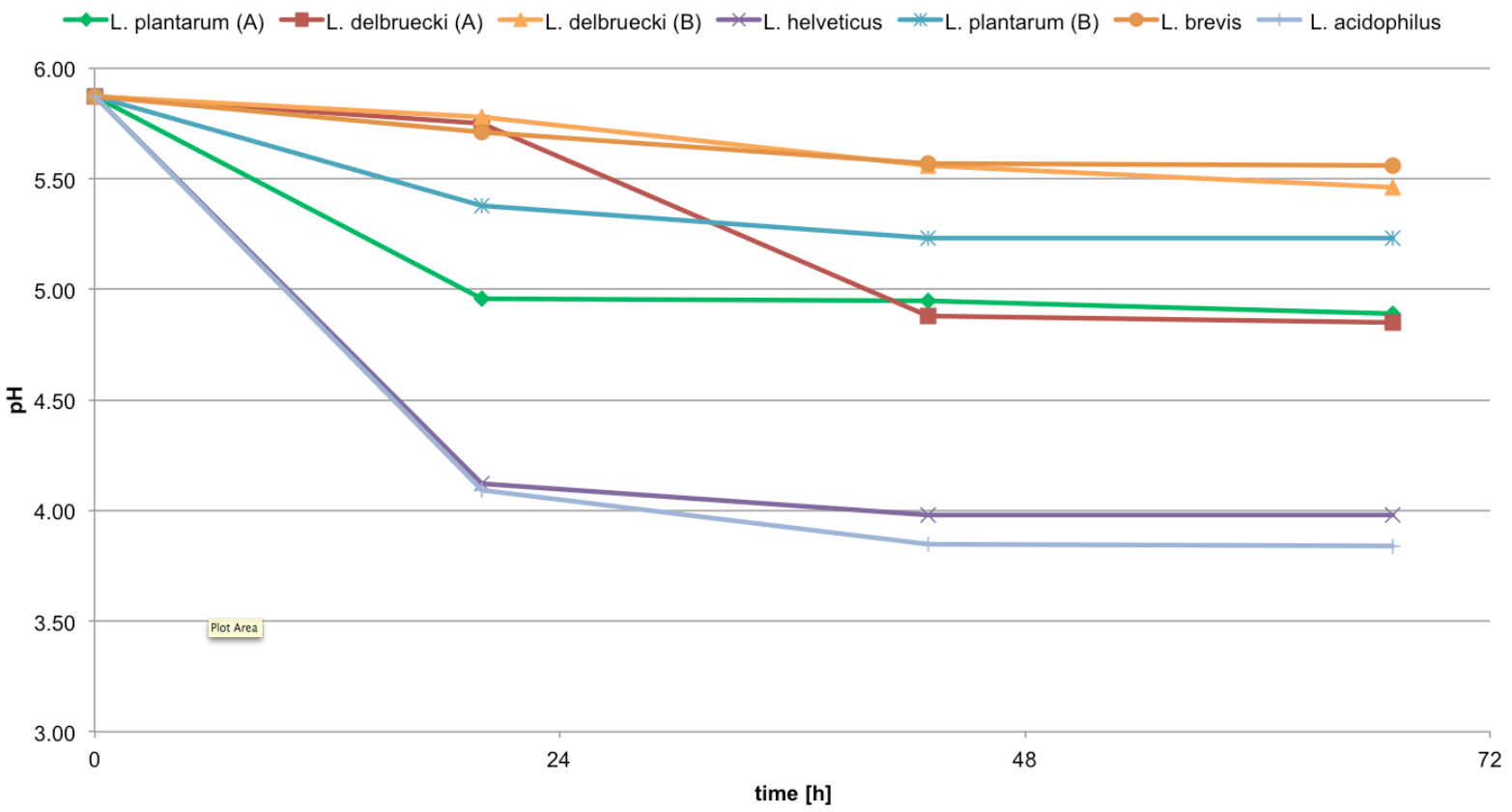
R&D trials: Fermentations (30C)



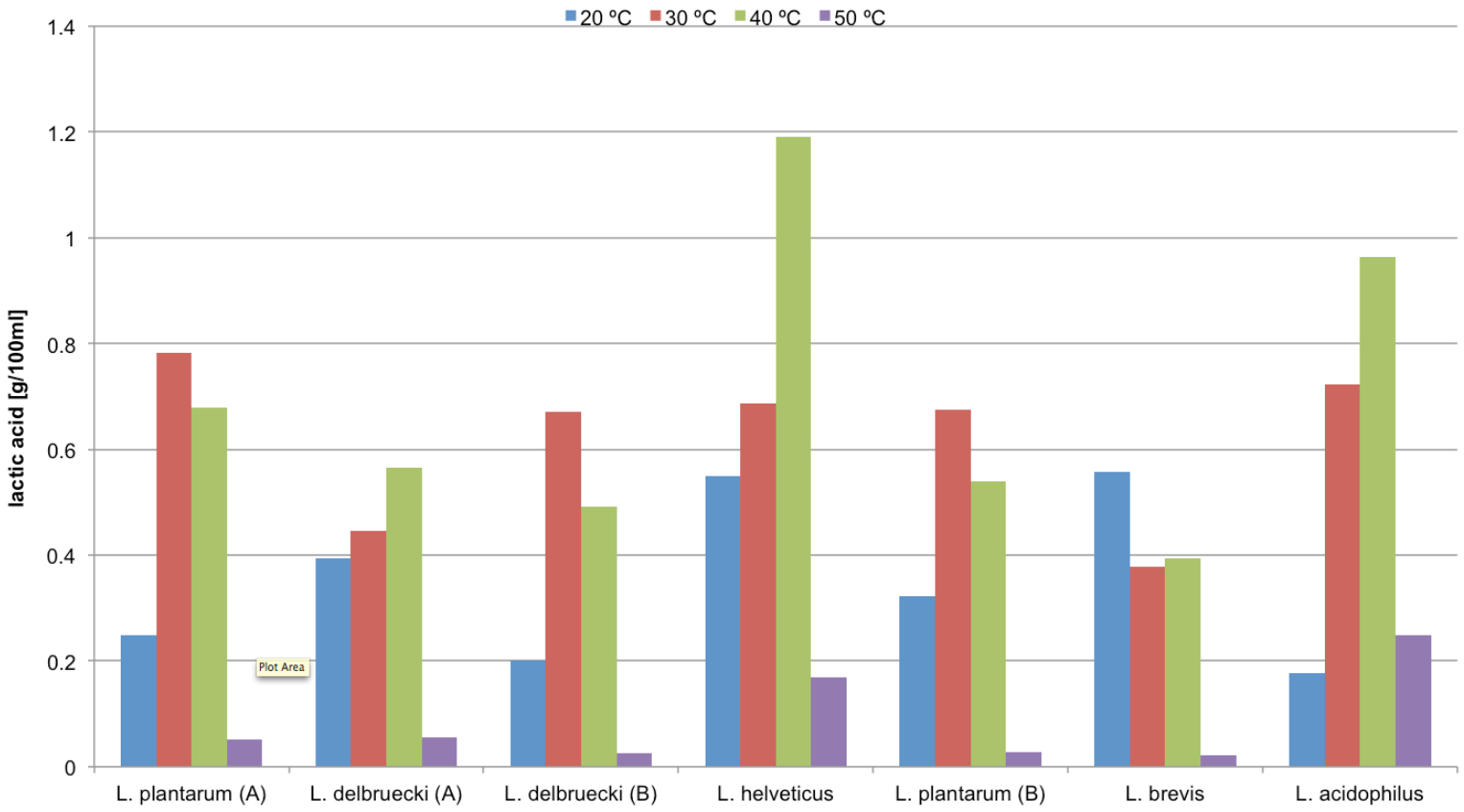
R&D trials: fermentations (40C)



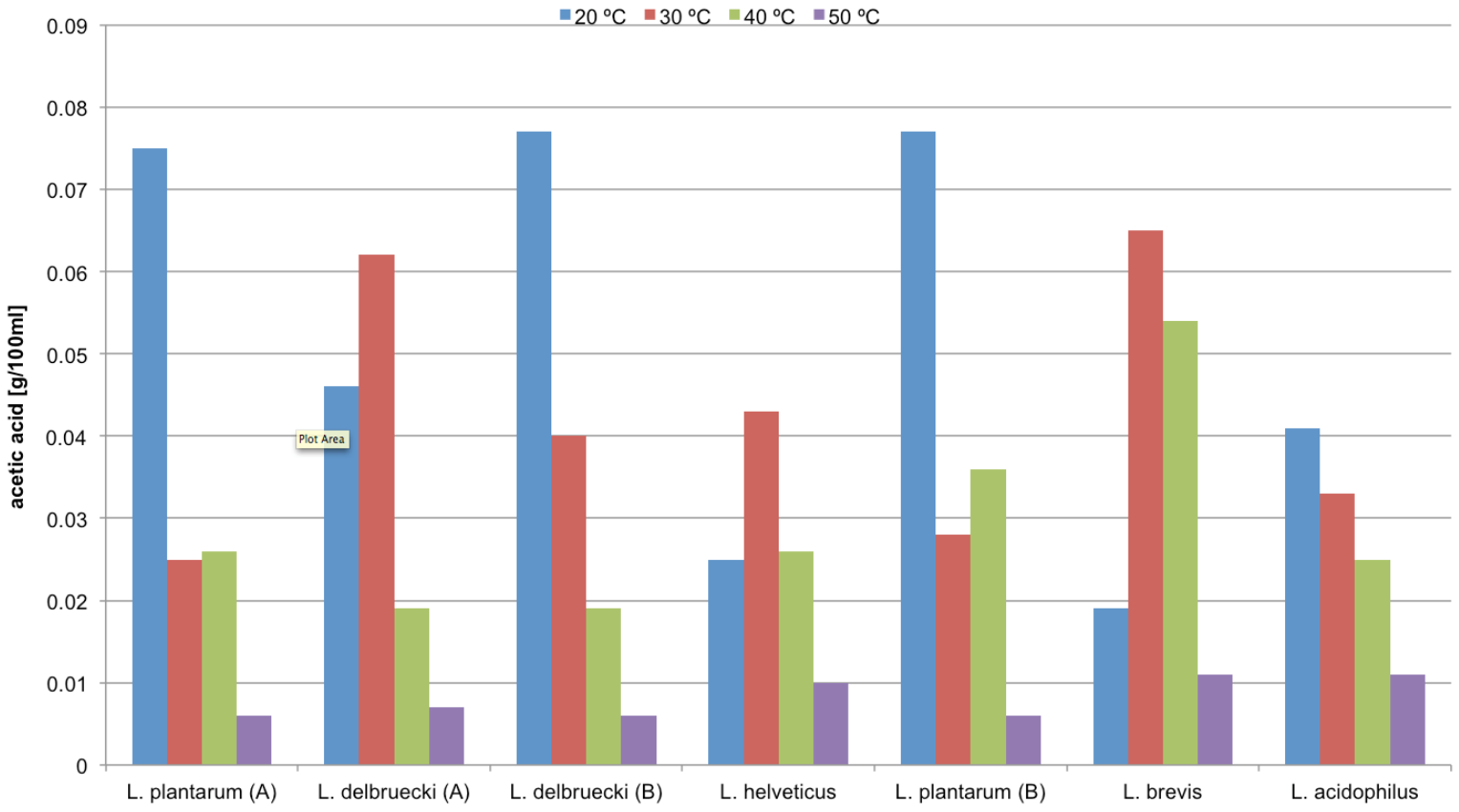
R&D trials: fermentations (50C)



R&D trials: lactic acid production



R&D trials: acetic acid production



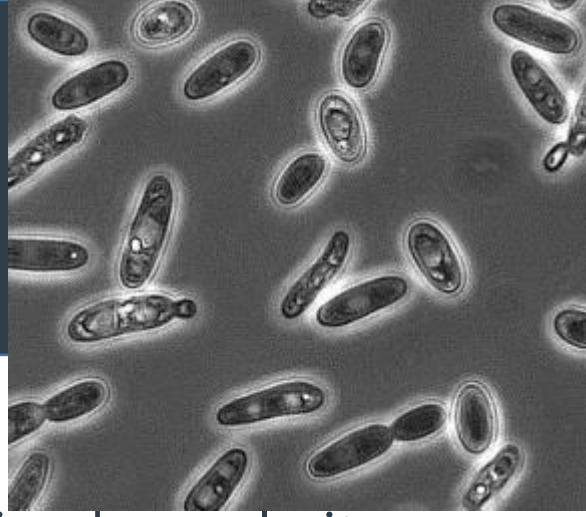
R&D trials: Sensory characteristics

	20 °C	30 °C	40 °C	50 °C
L. plantarum (A)	Sweet, sour, apple	Fruity smell, sour light tart taste	little sour, wort taste and smell	Wort flavour and smell, not sour
L. delbrueckii (A)	Burnt rubber smell, sweet taste	Sweet, thin, not very sour	Fruity, citrusy sour taste	Wort flavour and smell, not sour
L. delbrueckii (B)	"burnt fruit", apricot smell, sour taste	Sour light tart taste	Fruity, citrusy sour taste	Wort flavour and smell, not sour
L. helveticus	Fruity smell, sweet taste	Smells like Resins, sour taste	Very sour taste and smell	Light sour taste
L. plantarum (B)	Sweet smell, sour taste	Sweet sour smell, sour taste	Malty, bread smell, sour taste	Wort flavour and smell, not sour
L. brevis	Sweet smell, light burnt taste	Sweet, thin, not very sour	Sweet malt smell, not very sour taste	Wort flavour and smell, not sour
L. acidophilus	Smells like mango, tastes like green mango	Sour smell, tastes sour, green apple	Very sour taste and smell but better balanced vs. HA-128	Light sour taste

Wild non-saccharomyces strains

Brettanomyces & Lachancea

brettanomyces



- A wild yeast; large genetic diversity
- Was commonly seen as spoilage yeast, gained popularity
- Barnyard, horsey, band-aid & fruity esters
- Tolerant to harsh conditions
- Sugar utilization
- Attenuation
  - Good attenuators due to production of a range of alpha & beta-glucosidases
- Secondary Metabolites
  - Varies based on the composition of the wort, available oxygen, and time.
  - Good at producing acetic acid even low levels of O2

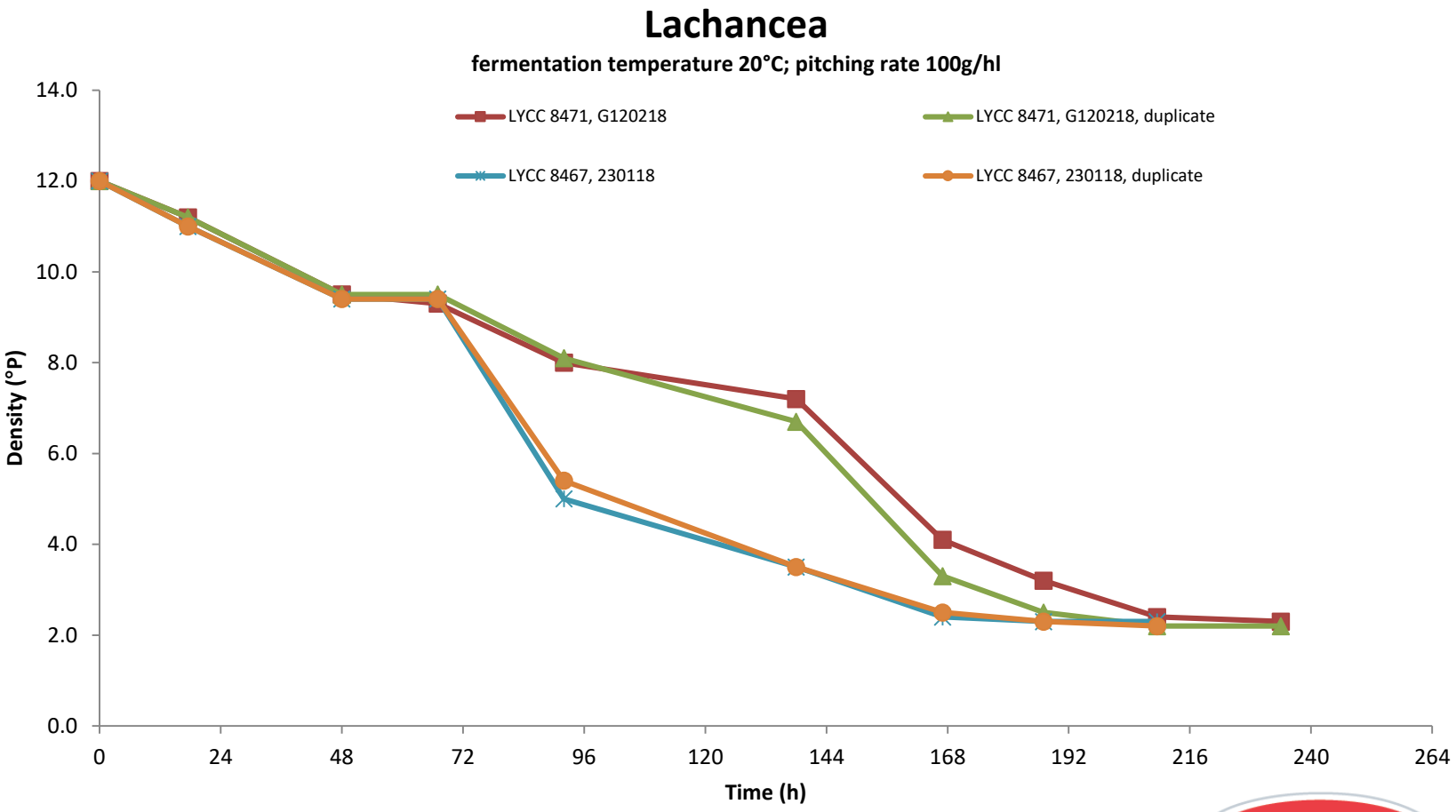
Common Brettanomyces strains

1. *Brettanomyces bruxellensis*
   - Most popular strain – widely used
   - Medium intensity Brett character
   - Commonly found in Belgian pales and Lambics
   - Typically starts as 'horse blanket' / leathery and become more light & earthy as time goes on
2. *Brettanomyces lambicus*
   - Most intense out of the bunch – very horsey, spicey/smokey flavor
   - Found in Lambics
   - Keep O2 low to avoid "nail polish' – ethyl acetate
3. *Brettanomyces claussenii*
   - *Light intensity Brett, can take many months to fully develop noticeable characteristics*
   - *Often associated with fruity aromas – pineapple & mango*

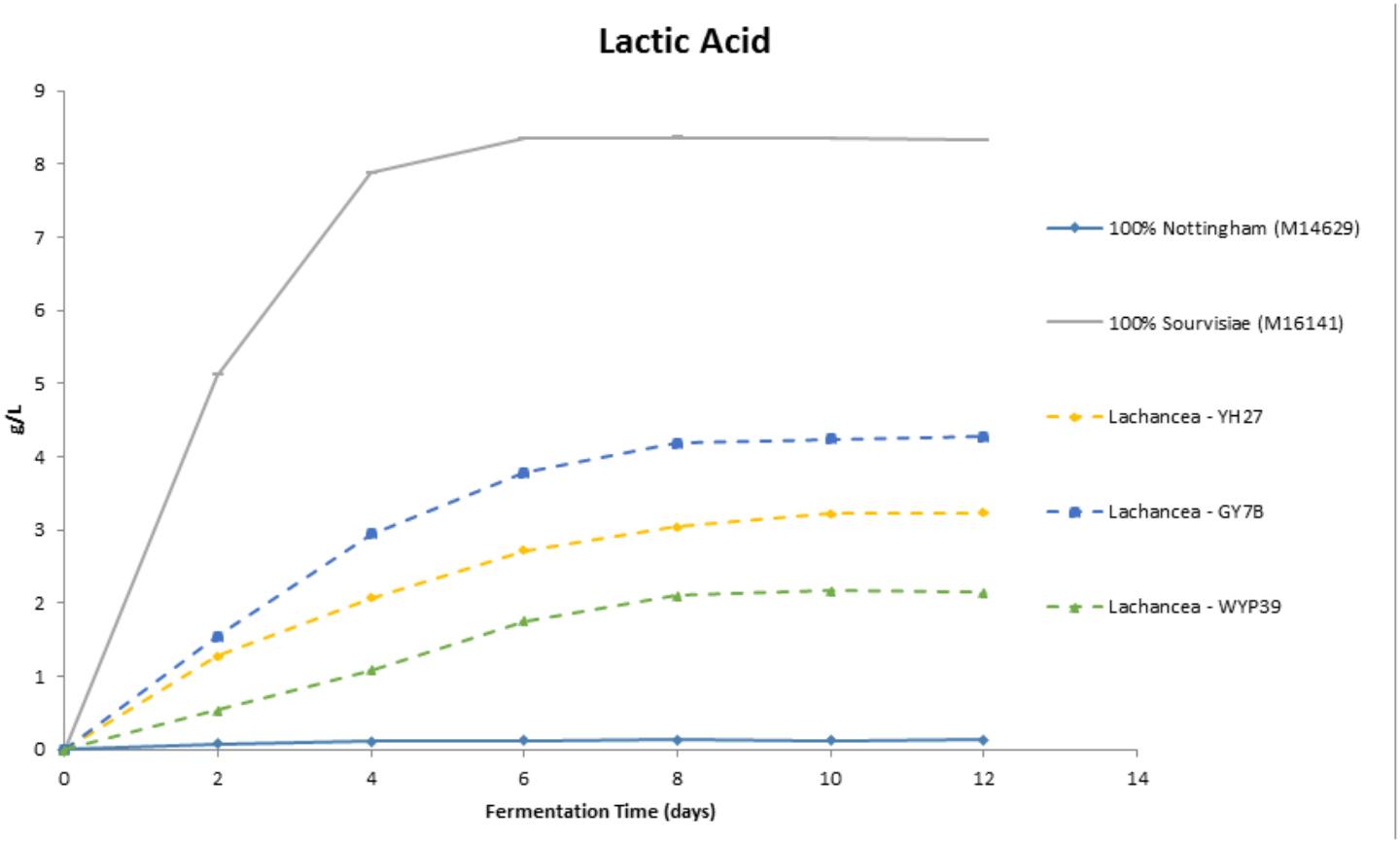
Lachancea

- a lactic acid producing non-sachh yeast
- Like most wild strains, it is a very slow fermenter
- Can be used in primary or secondary ferms
- Not as much know with this strain and not used as often in commercial breweries
- Known strains: *L. fermentati* and *L. thermotolerans*
- New unknown Lachancea strain has been discovered and is believed to be genetically different from that of *L.fermentati* and *L.thermotolerans*
-

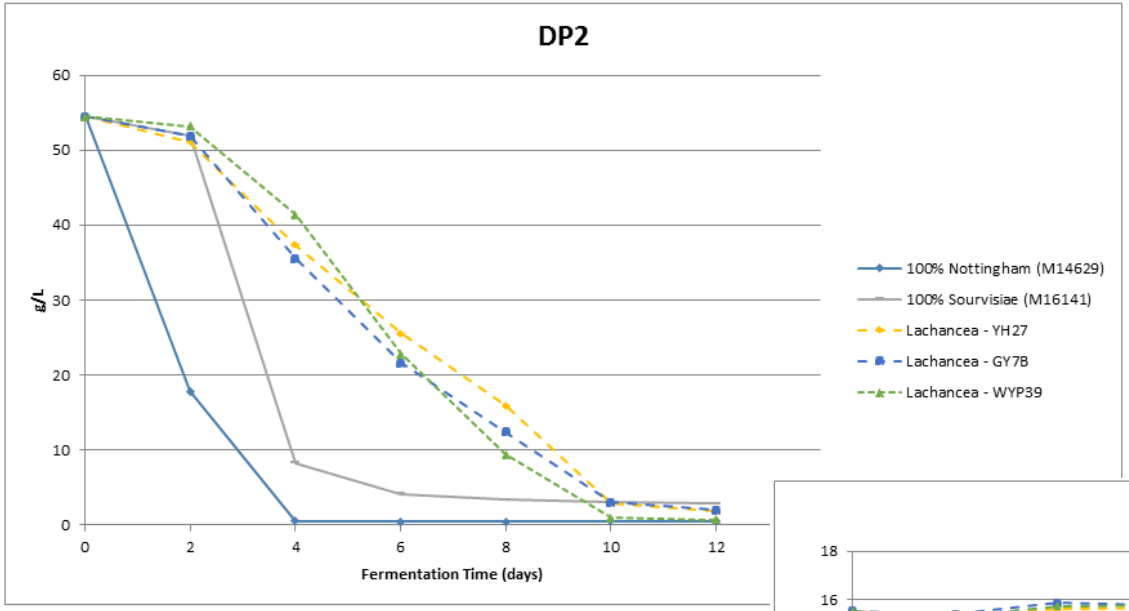
Lachancea fermentation data

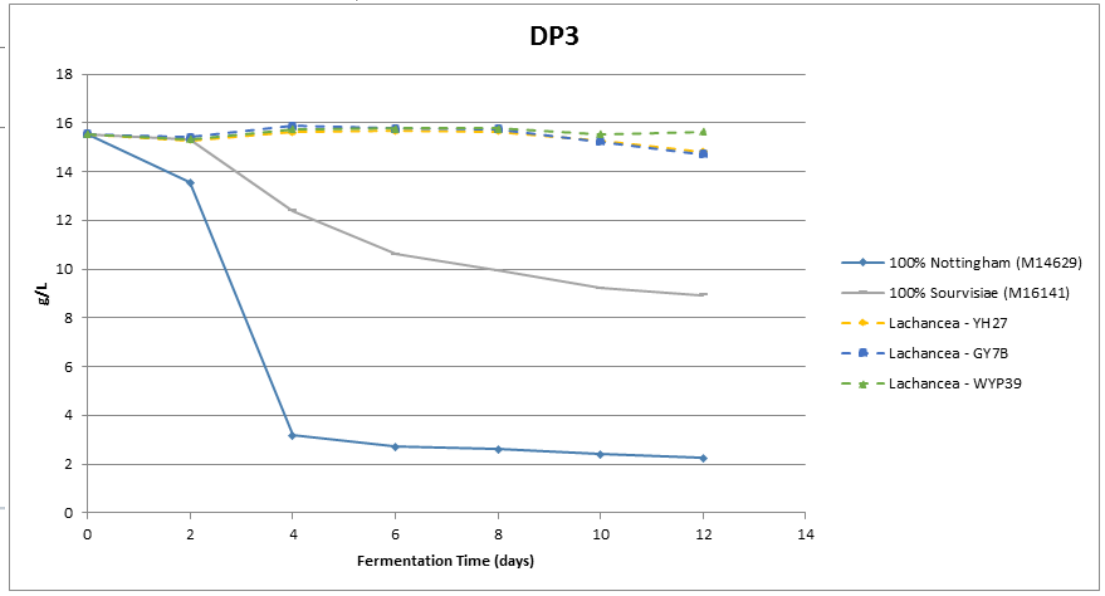


Lachancea lactic acid production



Lachancea sugar metabolism





New Technology

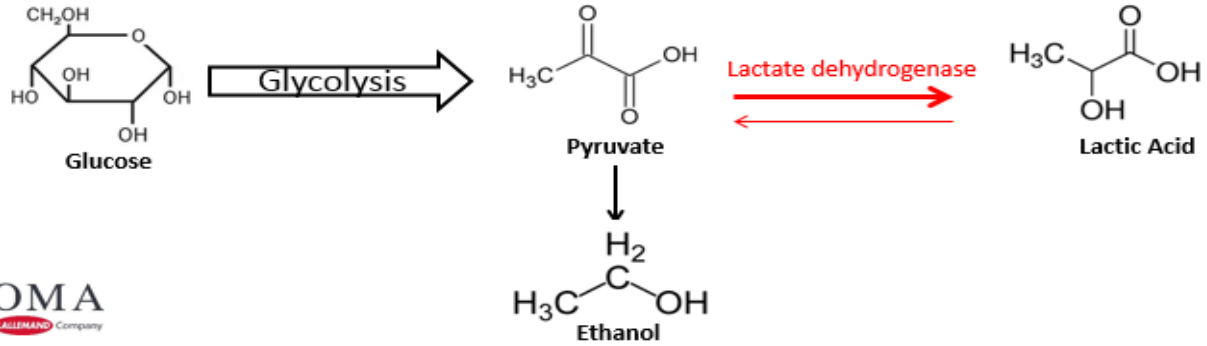
GMO Strain – Sourvisiae™ from Mascoma

New technology: bioengineered strain

Sourvisiae™ is a bioengineered ale yeast (*Saccharomyces cerevisiae*) capable of producing lactic acid during primary fermentation:

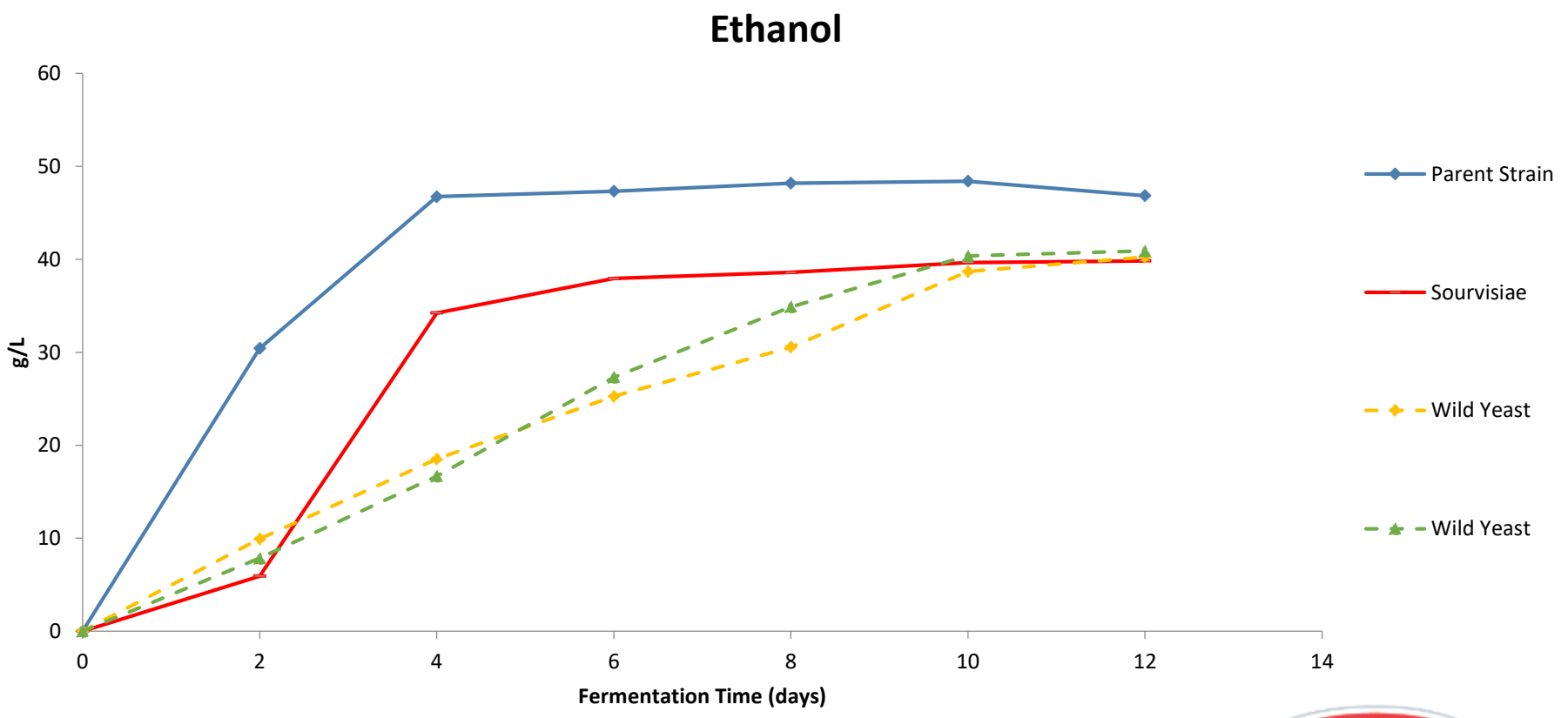
- Reproducible
- Mono-culture
- No other flavor compounds produced
- Generally Regarded as Safe (GRAS)

Pathway for lactic production in Sourvisiae™:



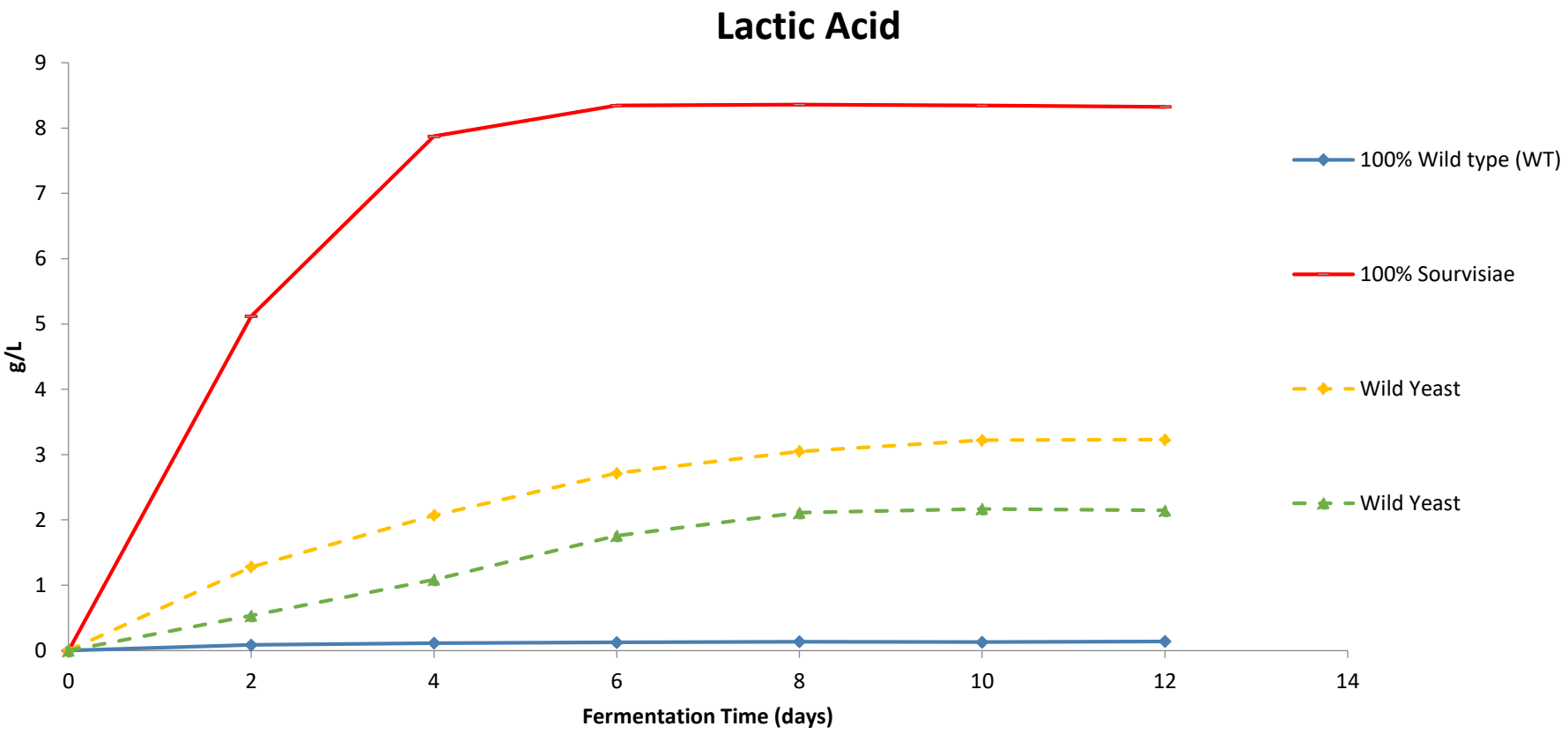
Sourvisiae™

Ethanol production



Sourvisiae™

Lactic acid production



Sourvisiae Pros/Cons

Pros

- Will not hold up your kettle; saves time and money
- So far no THP discovered through sensory

Cons

- GMO may not be for everyone – and that's ok!
- Difficulty predicting initial sourness, relying on blending in the end

Final notes

- Know your final flavor/aroma wants
- SOPs – stay clean!
- Strive for continuous improvement and experimentation
- If you're going to brew sour beer, be prepared to dump it

Questions?

Brittney Berg – Lallemand Brewing
bberg@lallemand.com


Lallemand's
YEAST

CBA Trials

Control vs Sourvisiae

INGREDIENTS AND PROFILE

Malts	90% Great Western Two-Row, 10% Briess Caramel C60
Hops	Bittering - Alchemy Aroma - Cascade
Yeast	Sourvisiae

Wort Analysis:

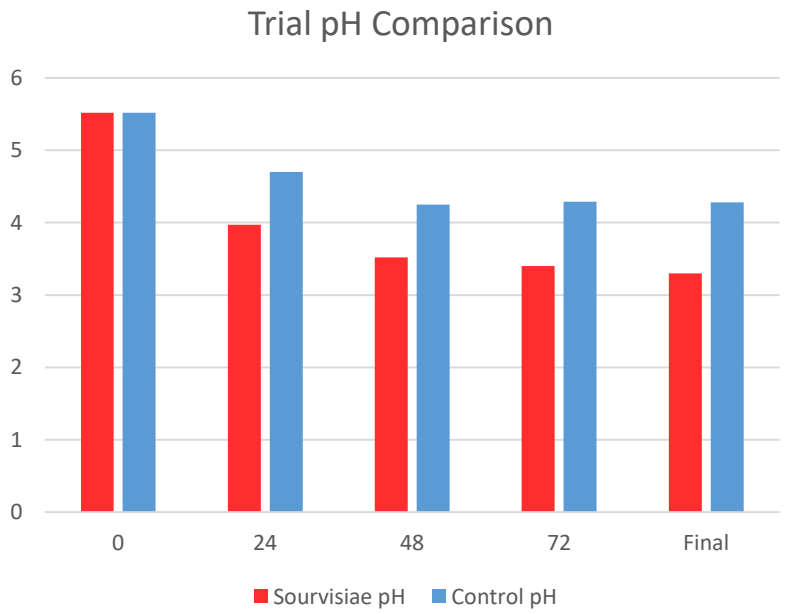
OG: 12.76
pH:5.52
BU:41
SRM: 8.7

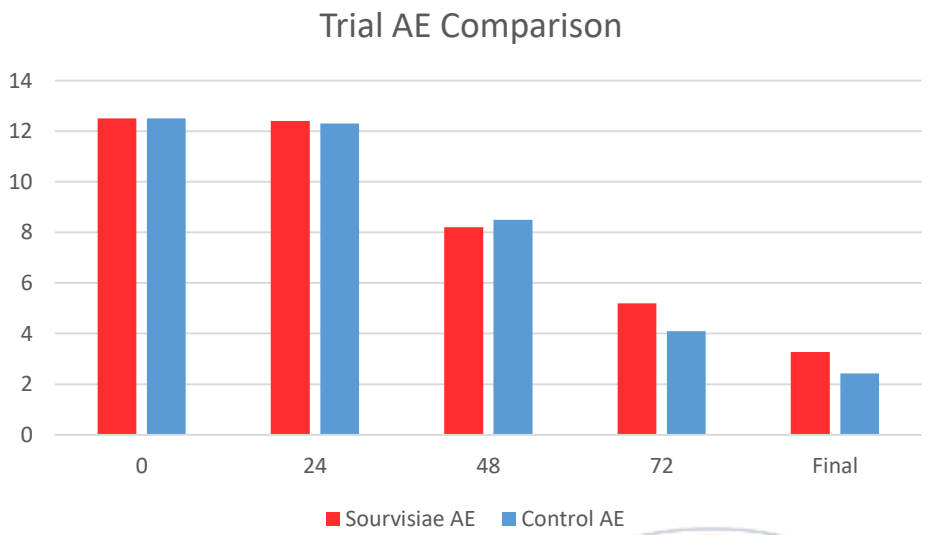
Pitch rate:

100g/bbl into 5 bbls of wort
Pitch Temperature: 65F
Primary Fermentation Setpoint: 66F
Aeration Type: Filtered Plant Air, ~12g/L over 10 minutes of cooling

Trials - Sourvisiae

CBA/Widmer Control vs Sourvisiae





Introduction to Genetic Modification

Direct manipulation of genome with biotechnology:

- Specifically tailored function
- Use of familiar, single template strain
- Yeast are great at accepting other yeasts' DNA
- Finer tuning than classical approaches