

# Sour Beer

A New World approach to an Old World style.

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Lallemand Brewing

# History & Styles of Sour Beers

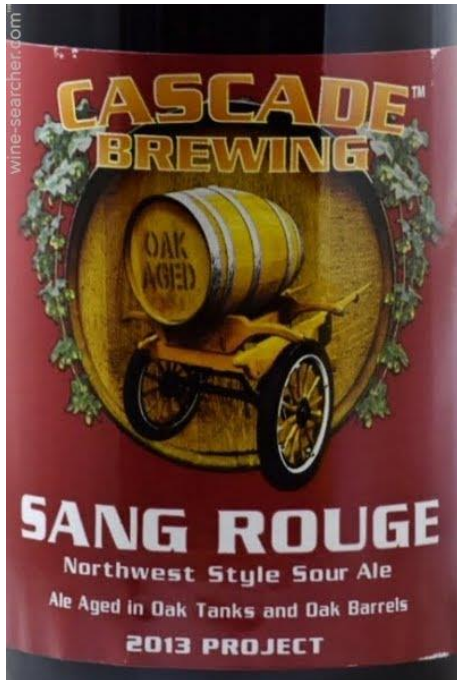
- Sour beer styles have existed for centuries
- What do we mean by Sour beer?
- History and heritage of sour beers have been based in Europe, including:

- 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



# Other factors

- Hop shortage in the 90s
- Bitterness becomes king
- Awareness of global styles



# Growth & Popularity

## Trends in Brewing Diversity of Beer Styles Case Study USA

- What beer styles are craft beer consumers in the USA purchasing and enjoying?



## Trends in Brewing Diversity of Beer Styles Case Study USA

### On the Horizon

Sour styles, such as Berliner Weiss, Gose and American Wild Ale, are rapidly gaining favor with brewers and consumers



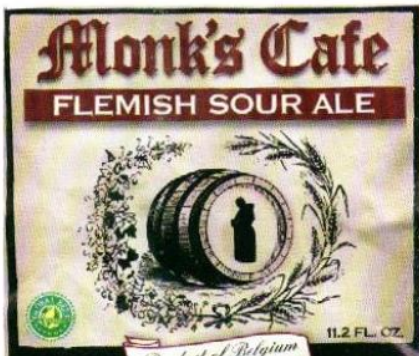
# Growth & Popularity

- Recent explosion in sour beer.....

## People want more sour

Regardless of how you feel about this, consumers are seeking really sour beers

In just a few short years, we seen a huge expansion in the market



Kara Talyor, White Labs. CBC 2015

# Growth & Popularity

- Now growing beyond the US....

10 of the best sour beers in the UK

Sour beers are the new trend in craft beer, and the perfect drink to quench your thirst during the heatwave



## Why Sour Beers' Growth Can't be Stopped

# Key micro-organisms in sour beer

- **Brettanomyces**

- Primarily *Brettanomyces bruxellensis*
- Many sub strains of *B. bruxellensis*
- Many characteristics including: Tropical/fruity, Floral, Earthy, Leather, Apple/Stone Fruit. Strain dependent.
- Some sulphur production early, lends some “funk” What is funk.
- OFF FLAVORS EXIST! You want to drink a wet horse blanket?

- **Lactic Acid Producing Bacteria**

- *Lactobacillus* spp.
- *Pediococcus* spp.

- **Acetic Acid Bacteria**

- Aerobic

# Lactobacillus spp.

- Primary souring bacteria
- Diverse range of sub species
- Temperature sensitive (c.30-49C)
- Softer and tangier lactic acid
- Lowers pH to c.3.3-3.6



# LACTOBACILLUS SUGAR UTILIZATION

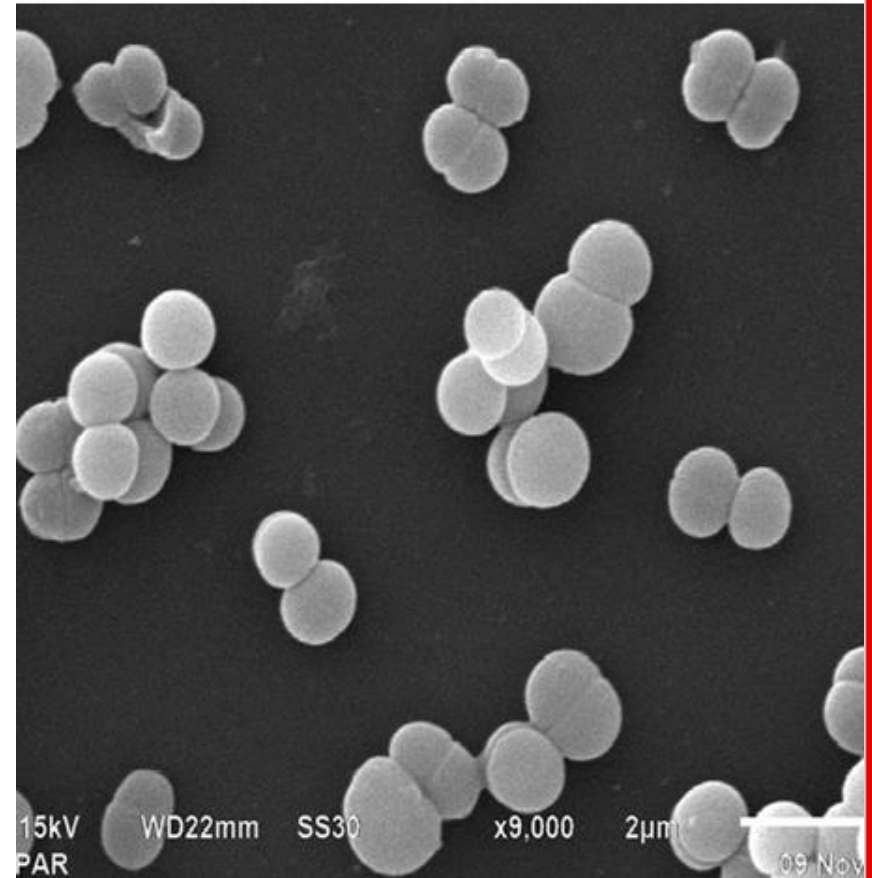
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- Generally prefers glucose, fructose and maltose
- Does not ferment maltotriose
- Is species dependent
- Very little alcohol or CO<sub>2</sub> produced (0.1-0.3% ABV)
- No more than 0.5-1.0°P consumed
- Low pH and metabolic byproducts weaken and then stop growth

Edele Arendt

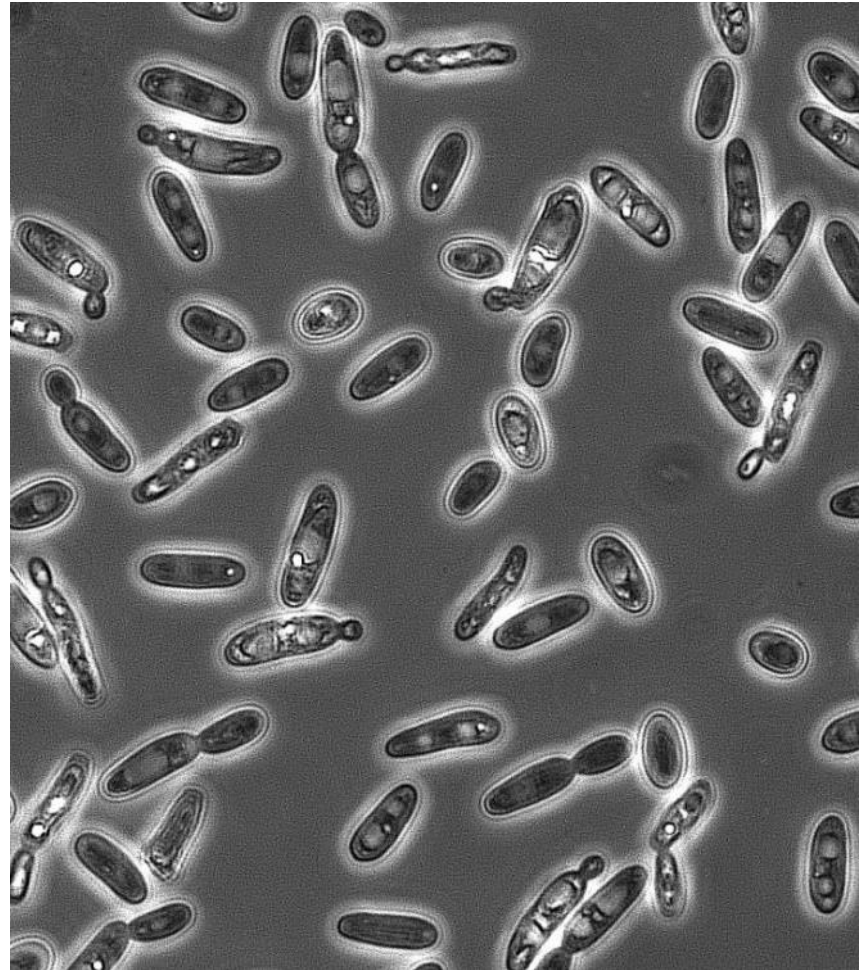
# Pedicoccus spp.

- Slower than Lacto to sour
- Greater hop tolerance
- Cannot reduce Diacetyl/Emulates off flavors
- Sharper and harsher taste
- Can reduce pH <3.0



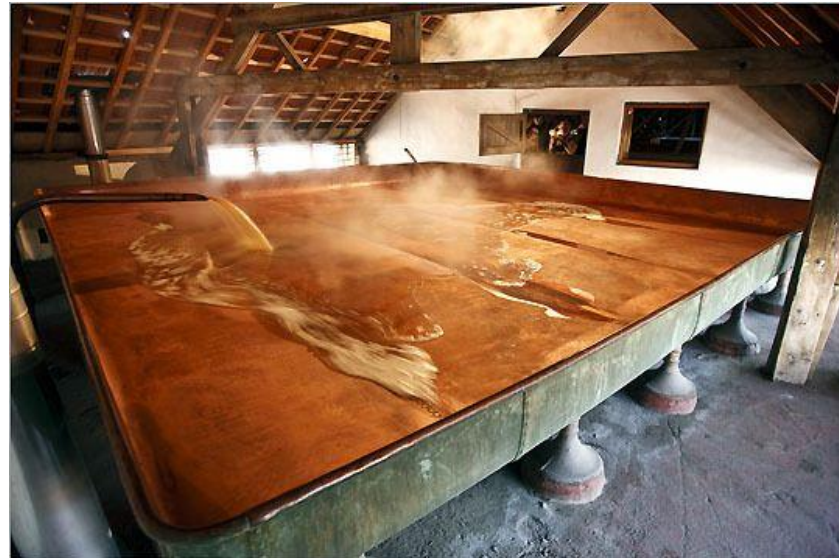
# Wild Yeast: Brettanomyces

- Can utilise broad range of sugars (inc. dextrins)
- Diverse sub species
- Does not contribute a lot of acidity on its own
- Slow acting



# Sources of LAB

- Laboratory (pure or mixed culture)
- Bottle culture
- Nature
- Yoghurt
- Un-mashed grains



# Application and techniques for souring

## ➤ 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



# Kettle sour process

- Mash
- Lauter
- Bring to boil/heat to pasteurize
- Cool to pitching temp 110-118F (43-48C)
- Pitch lactobacillus
- CO2 purge
  - 2 hours at 3 psi
- Acidification
- Boil and kill lactobacillus

**Create a *Building Block***

# Opportunity

- Lallemand already produce LAB
- LAB produced across LAN, LHS and Oenology
- Oenology are world leaders in ML fermentation
- Transferable products and expertise into brewing
- High performance and “value”



	SELECTION	SPECIE	TYPE OF WINE	ALCOHOL TOLERANCE	PH TOLERANCE	SENSORY IMPACT	DOCUMENTATION	MORE INFO
ALPHA 1-STEP®	Selected by IFV, France	Oenococcus oeni	Red Wine White Wine	15.5 %	> 3.2	Mouthfeel Complexity Fruity		+
BETA CO-INOC™	Italian selection from the CRAFT project	Oenococcus oeni	Red Wine White Wine	15 %	3.2			+
O-MEGA®	Selected by Institut Français de la Vigne et du Vin, France	Oenococcus oeni	Red Wine White Wine	16 %	3.1	Freshness Complexity		+
PN4 1-STEP®	Selected by Institute of San Michele - Italy	Oenococcus oeni	Red Wine White Wine	15.5 %	>3.0	Spicy Structure Complexity		+
PN4™	Selected by Institute of San Michele - Italy	Oenococcus oeni	Red Wine White Wine	15.5 %	>3.0	Spicy Structure Complexity		+
V22™	Selected by the Università Cattolica del Sacro Cuore Piacenza Italy	Lactobacillus plantarum	Red Wine	15 %	> 3.6	Fruity - freshness	Technical Datasheet	+
VP41 1-STEP™	Italian selection from the CRAFT project	Oenococcus oeni	Red Wine White Wine	16 %	>3.1	Fruity Mouthfeel Freshness		+
ENOFERM ALPHA®	Selected by IFV, France	Oenococcus oeni	Red Wine	15.5 %	> 3.2	Mouthfeel Complexity Fruity	Technical Datasheet	+
ENOFERM BETA™	Italian selection from the CRAFT project	Oenococcus oeni	Red Wine White Wine	15 %	>3.2	Fruity Mouthfeel		+
LALVIN 31™	Selected from IFV France	Oenococcus oeni	Red Wine White Wine	14 %	> 3.10	Structure Fruity Freshness	Product Declaration Safety Datasheet	+

# Potential

**“Souring is a difficult process to control, and very unpredictable”**

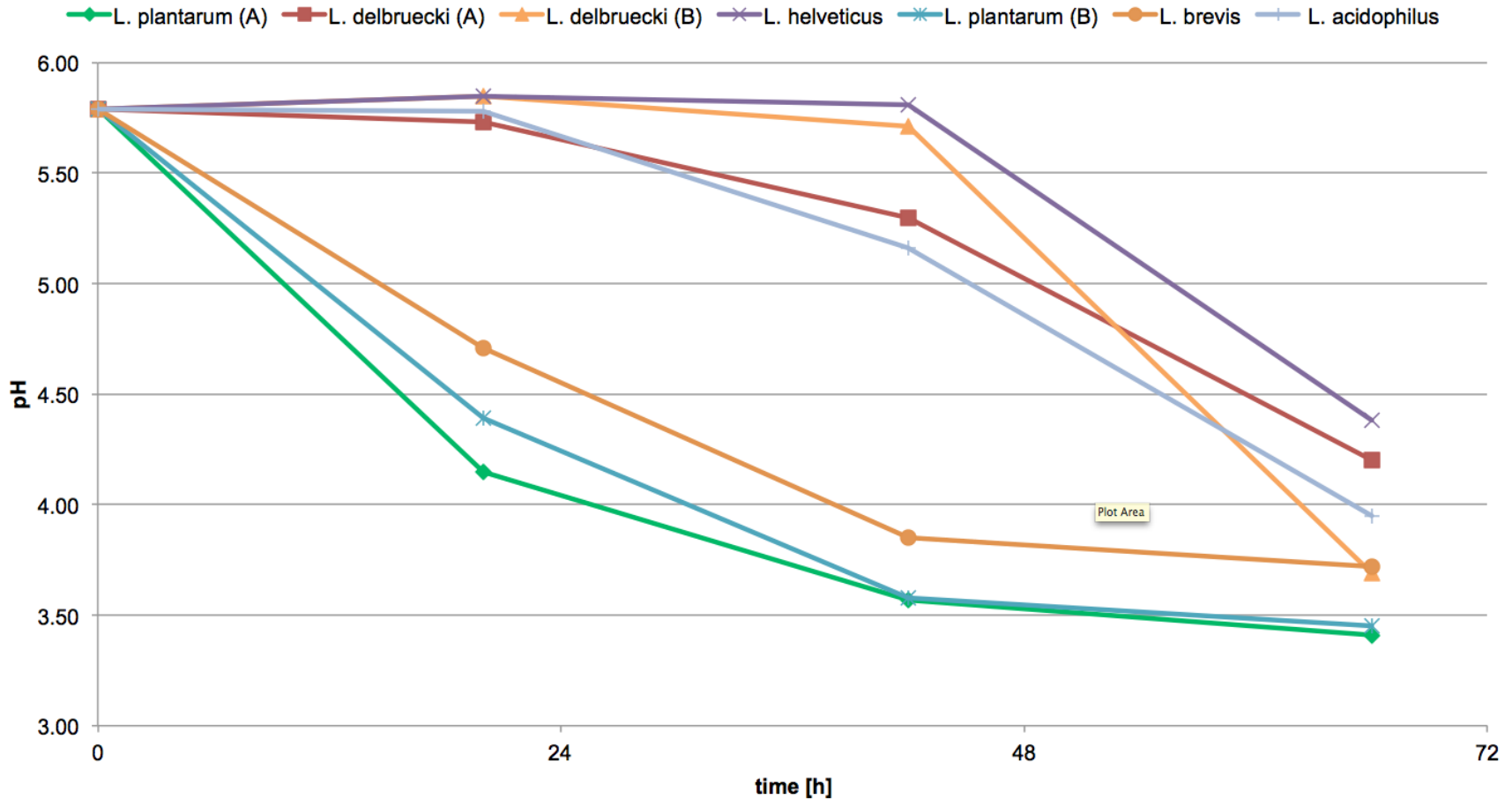
- 1. **Immediacy:** Dry brewing yeast is always ready to use. Simply rehydrate room-temperature dry yeast according to instructions and pitch as required.
- 2. **Stability:** Dry yeast is remarkably stable over months and even years
- 3. **No more cell counting:** No need for a microscope, hemocytometer and staining....simply weigh out the correct amount of dry yeast for your wort volume and gravity and you are ready to go
- 4. **No need for propagation:** You no longer have to build up cell counts through propagation. Just add the suggested amount of dry yeast to your wort for reliable performance
- 5. **No need for aeration:** Skip the extra step of aeration. It is unnecessary with dry yeast.
- 6. **Purity:** The remarkable shelf stability of our dry yeast allows us to conduct 24 tests on every batch (including genetic testing), assuring purity and unmatched performance
- 7. **Value:** When compared cell-for-cell against commercially-produced liquid yeast, Lallemand dry yeast offers excellent value.
- 8. **Security:** Easily restart slow or stuck fermentations with the addition of dry yeast at any time.
- 9. **Flexibility:** Different strains can be mixed by weight, allowing accurate proportions to be measured and giving brewers unmatched creativity in developing new fermentation-related beer characteristics.
- 10. **Consistency:** With simple measurement of pitching rate and reliable yeast performance, you can count on consistent fermentation performance time after time.

# R&D Trials

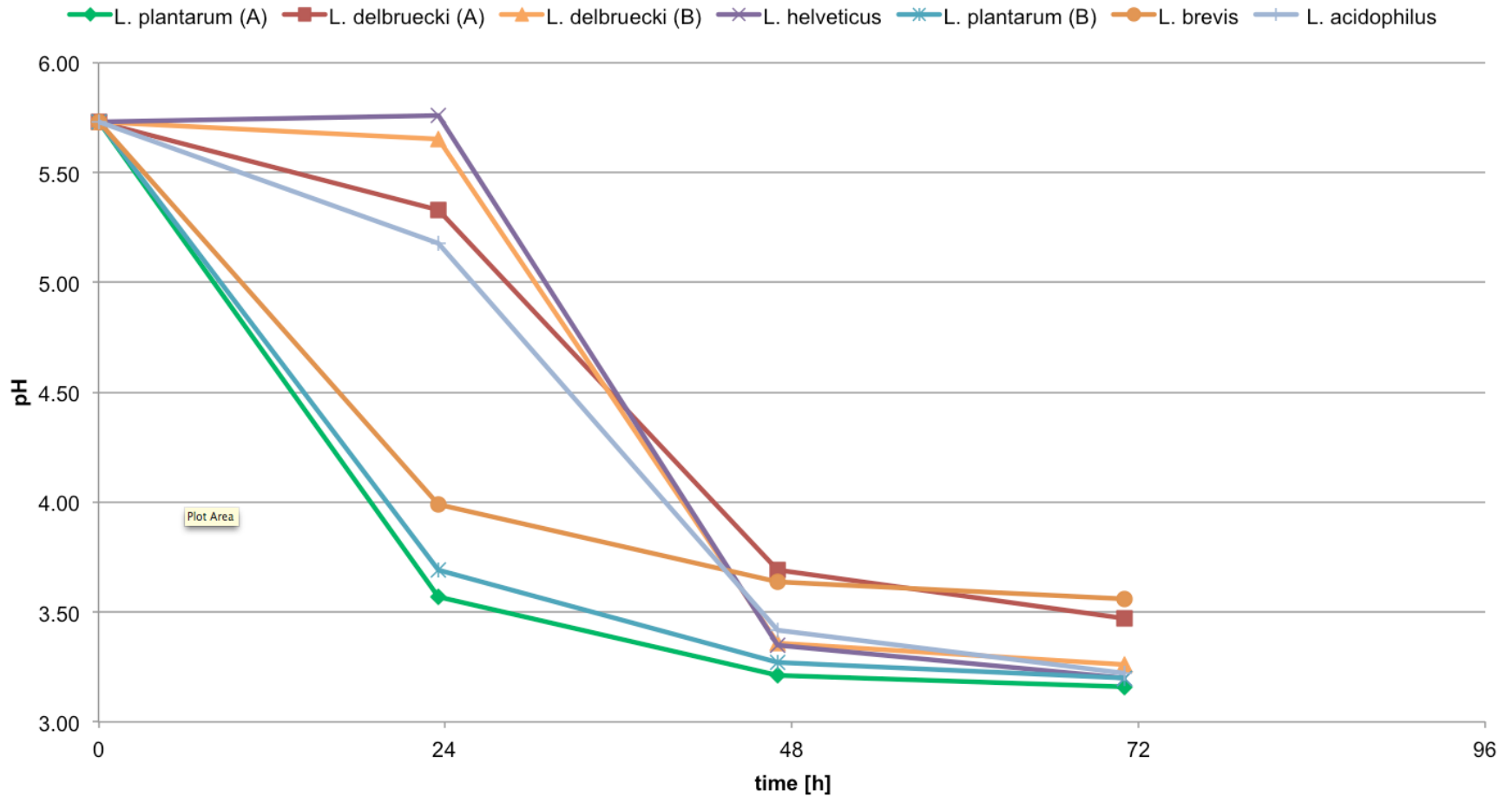
- Achieve pH 3.5 or lower in <48 hours
- Achieve high lactic acid vs low acetic concentration
- Fermentations at 4 different temperatures
- Gravity and pH measurement daily
- Acid and glycerol analysis by HPLC
- Sensory assessment of samples by panel

Strains
<i>L. plantarum</i> (A)
<i>L. delbrueckii</i> (A)
<i>L. delbrueckii</i> (B)
<i>L. helveticus</i>
<i>L. plantarum</i> (B)
<i>L. brevis</i>
<i>L. acidophilus</i>

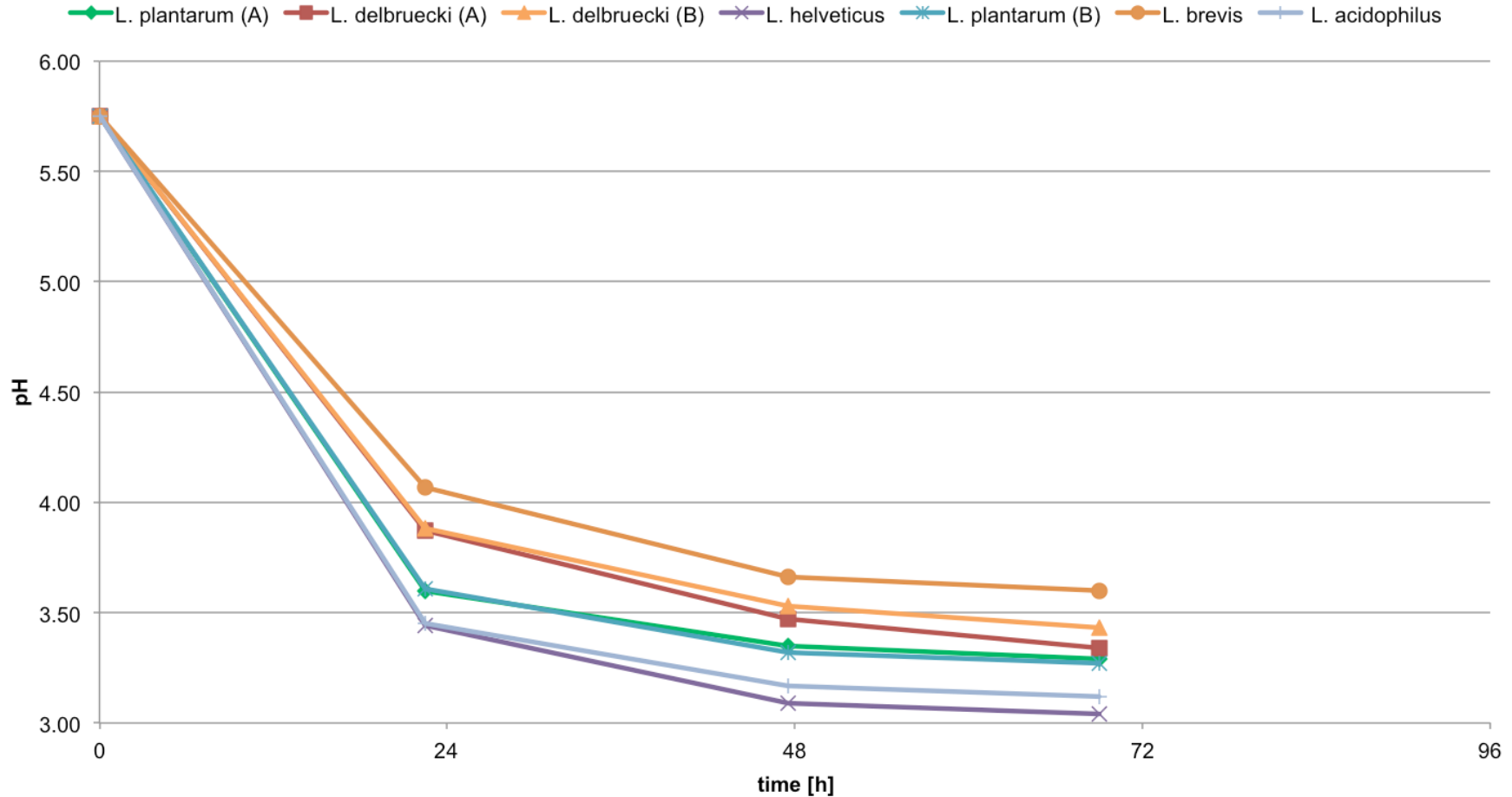
# R&D Trials: Fermentations (20C)



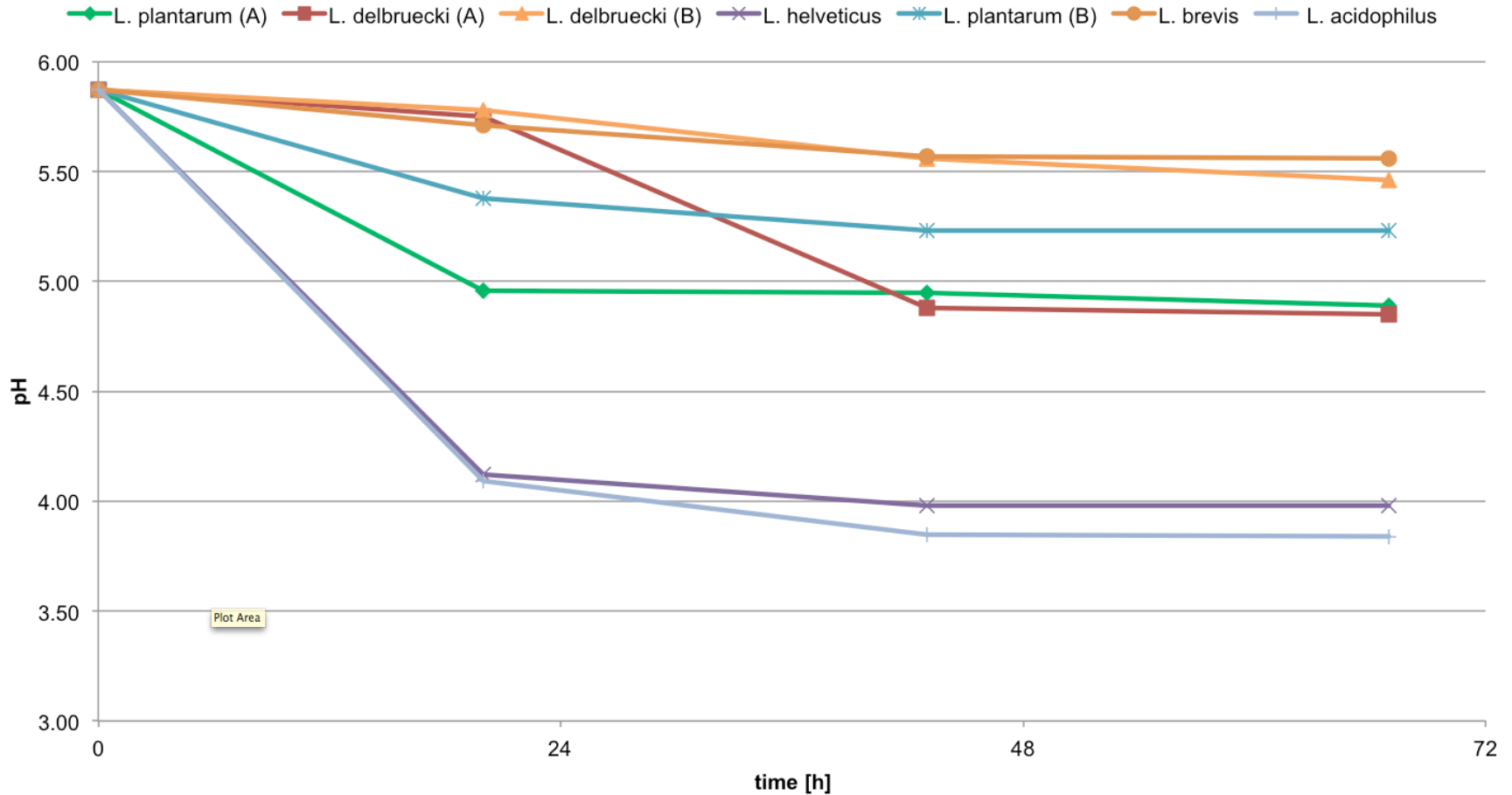
# R&D Trials: Fermentations (30C)



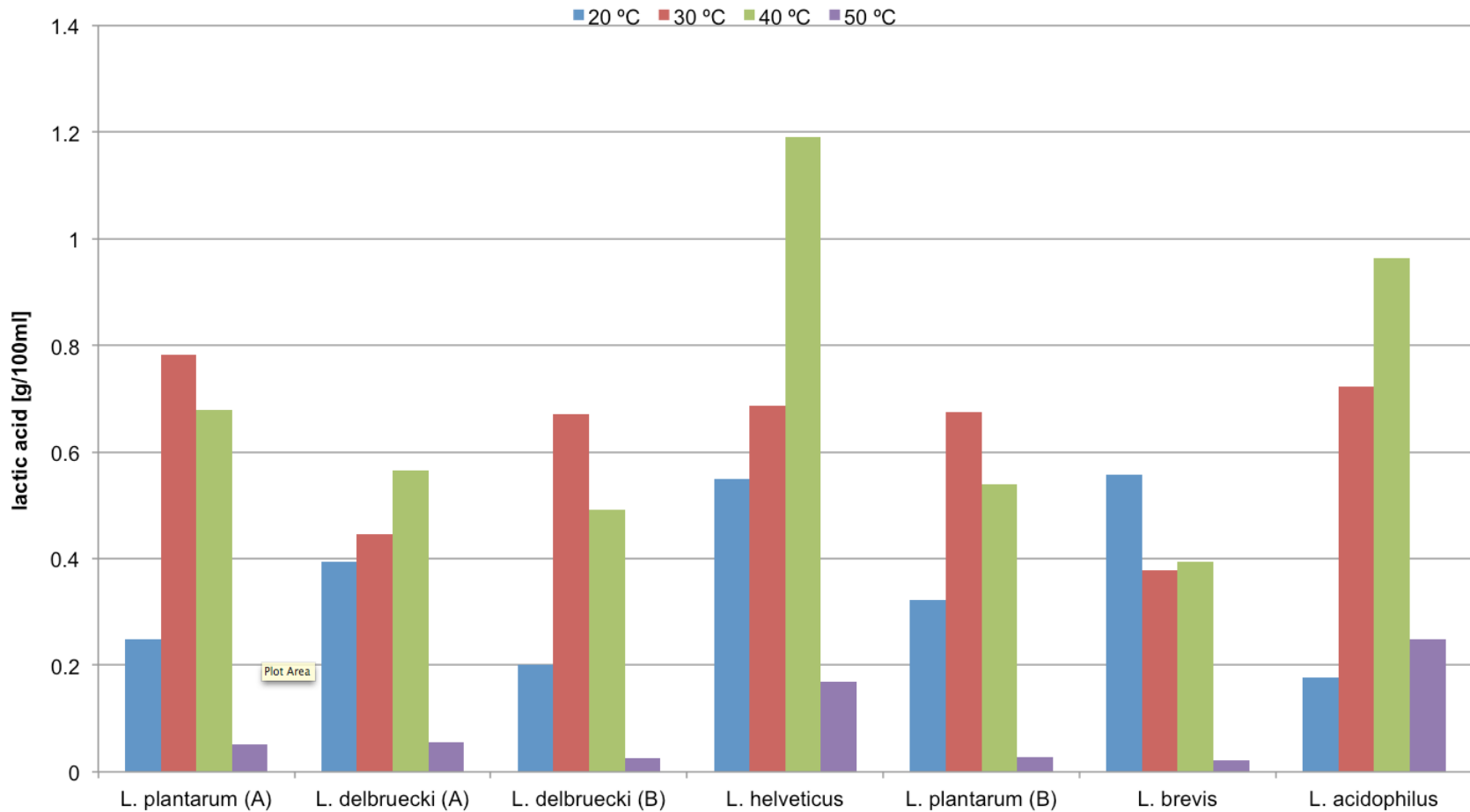
# R&D Trials: Fermentations (40C)



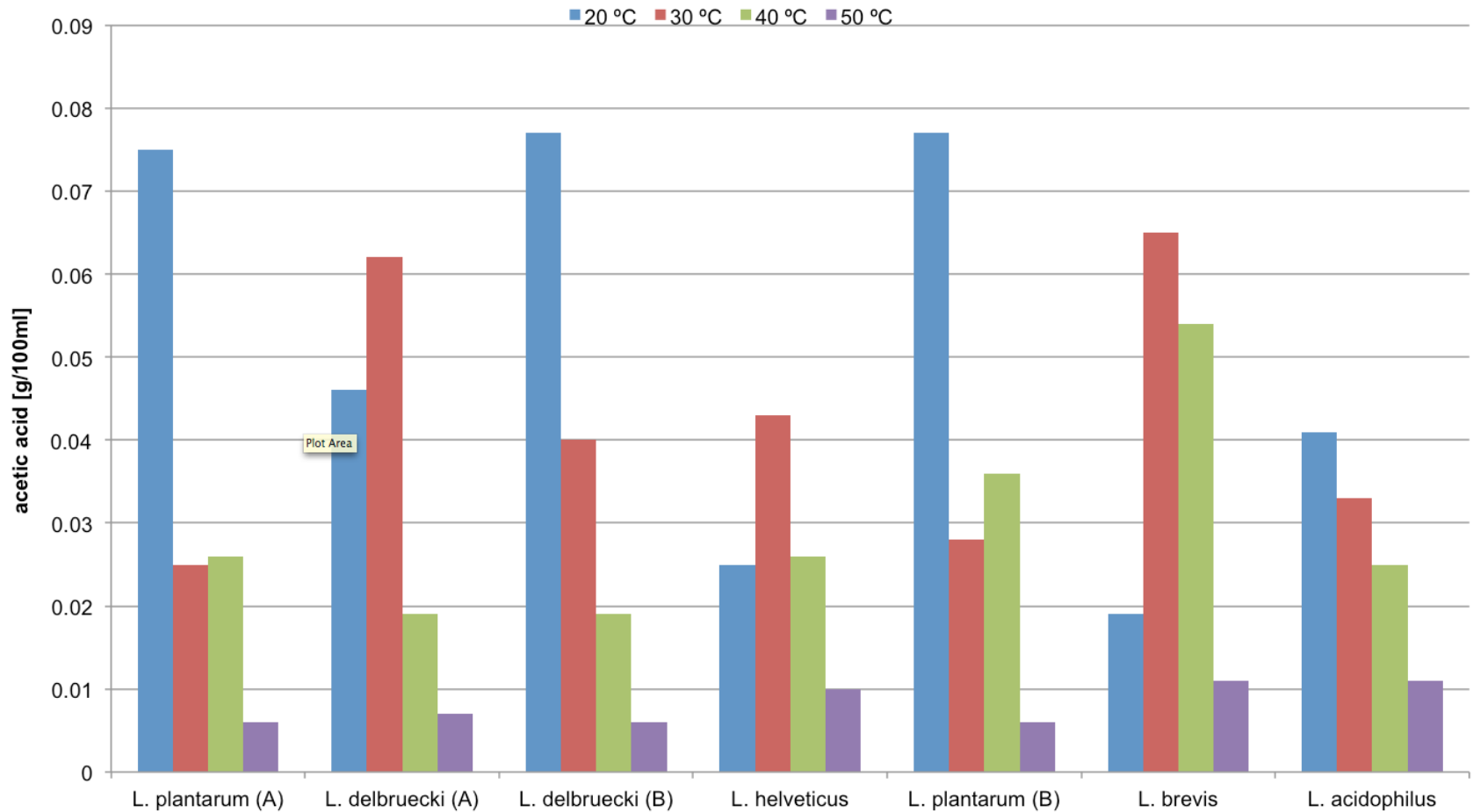
# R&D Trials: Fermentations (50C)



# Lactic acid production



# Acetic acid production



# Sensory characteristics

	20 °C	30 °C	40 °C	50 °C
<i>L. plantarum</i> (A)	Sweet, sour, apple	Fruity smell, sour light tart taste	little sour, wort taste and smell	Wort flavour and smell, not sour
<i>L. delbrueckii</i> (A)	Burnt rubber smell, sweet taste	Sweet, thin, not very sour	Fruity, citrusy sour taste	Wort flavour and smell, not sour
<i>L. delbrueckii</i> (B)	“burnt fruit”, apricot smell, sour taste	Sour light tart taste	Fruity, citrusy sour taste	Wort flavour and smell, not sour
<i>L. helveticus</i>	Fruity smell, sweet taste	Smells like Resins, sour taste	Very sour taste and smell	Light sour taste
<i>L. plantarum</i> (B)	Sweet smell, sour taste	Sweet sour smell, sour taste	Malty, bread smell, sour taste	Wort flavour and smell, not sour
<i>L. brevis</i>	Sweet smell, light burnt taste	Sweet, thin, not very sour	Sweet malt smell, not very sour taste	Wort flavour and smell, not sour
<i>L. acidophilus</i>	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

# UK Trials

- Trials on commercial scale in 13 UK breweries
- 3 Lallemand strains used in various applications:
  - L.Plantarum, L.Delbrueckii
- Working with key breweries



# UK Trial Results

- **ML Prime results very good:**
  - Speed
  - Consistency
  - Good Sensory profile (clean, balanced)
- **Commercial feedback very good**



Gyle number: 45

Strain: ML Prime

Gravity of wort pre-souring: not measured

Pitch rate: 158g in 19.5hl of wort

Method of pitching: Sprinkled dry power onto top of wort

Fermentation temperature: held at a constant 44°C through lactic fermentation

Time taken: 16.5h

Starting PH: 5.57

Finishing PH: 3.64

Gravity of soured and boiled wort: 1.0558

# What is Bottle Conditioned Beer?

- Similar to Cask Conditioned beer (UK)
- “Live” product:
  - Secondary fermentation in bottle
  - Yeast cells in suspension
- Traditional method of carbonation
- Greater flavor stability



# Characteristics of Bottle Conditioned Beer

- Appropriate for all styles
- Typically 4 – 12% ABV
- “Bright” to naturally hazy
- Dissolved CO<sub>2</sub>
  - 3 – 3.5 V/V (6 – 7 g/L)



# Why Bottle Condition?

- Longer shelf-life
- Complexity of flavors
- Crafty aspect
- Fresh flavor



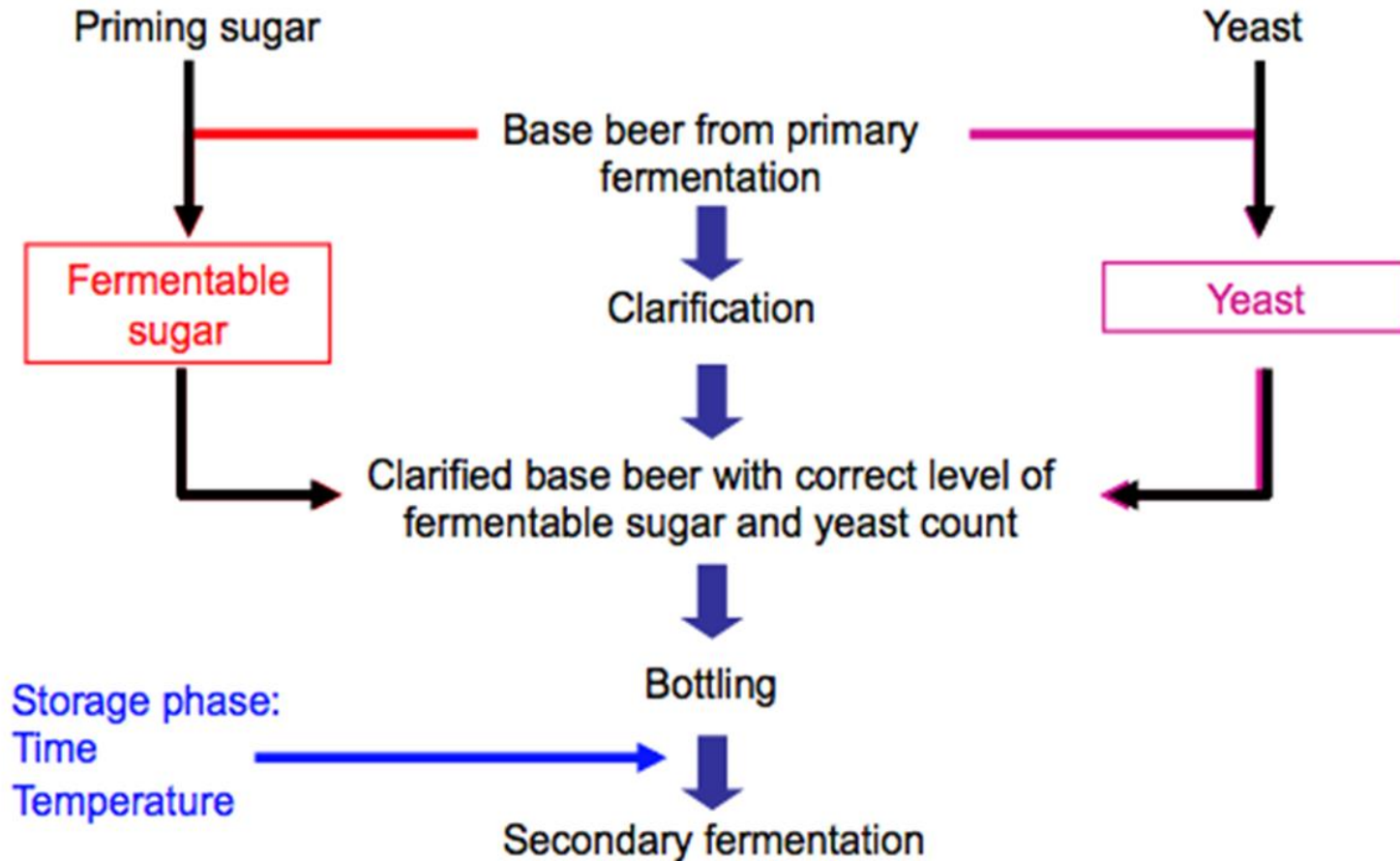
# How to Bottle Condition?

- Additions
  - Fermentable sugars
  - Viable yeast addition
- Bottling
- CO<sub>2</sub> Production
- Parameters to consider:
  - Yeast dosage
  - Priming sugar
  - Temperature
  - Time



# Overview of Process

## Process



# Secondary Fermentation

- Requirements
  - Precise concentrations
- 7 – 21 days at 15 - 25C (59 - 77F)
- Adverse conditions
  - Too cold
  - Too warm



# Shelf life

- Active Yeast as Oxygen scavenger
- Style and Strength dependent
  - 3 -5% ABV
    - 1 year shelf life
  - > 6% ABV
    - Complex flavor matrix
    - Months/years to develop

# Advantages of using CBC-1

- Flexibility – always available
- Easy shipping and storage
- Easy dosage
- Healthy Cells ready to divide
- Selected strains



# Implications

- Not all yeast strains are suitable
- Strain dependent
  - Production and evolution of CO<sub>2</sub>
  - Flavor profile
  - Tolerance to stress factors
- **Choose wisely. It is critical!!!**

# Summary

- Sour beer is experiencing high interest and growth
- Application of specific LAB very much relevant to souring techniques
- Lallemand produce LAB and have strong expertise which brewing can tap into and collaborate with
- Ideally suited for bottle conditioning
- Wide scope both in the short term and long term
- Huge thanks to participating breweries

*.....Any Questions ??*

