YEAST SELECTION AND NUTRITION

Jacques Janse van Rensburg

OVERVIEW

Yeast Selection

Standard Parameters

Finer Details

Examples

Nutrition

Nitrogen (FAN)

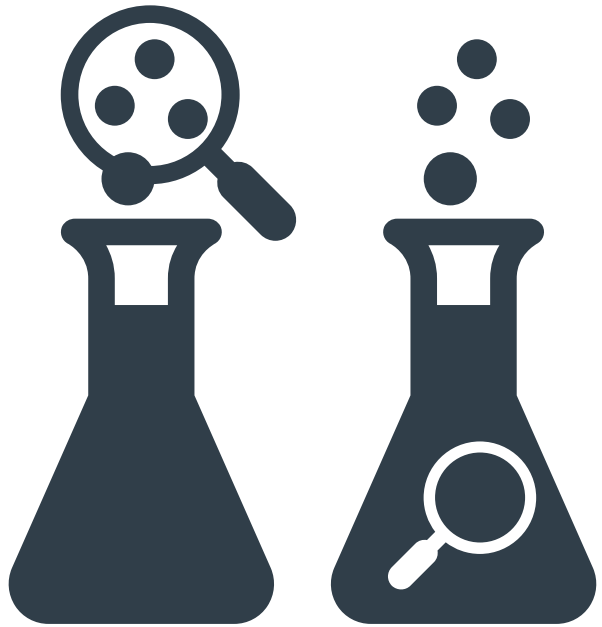
Minerals

YEAST SELECTION – STANDARD PARAMETERS

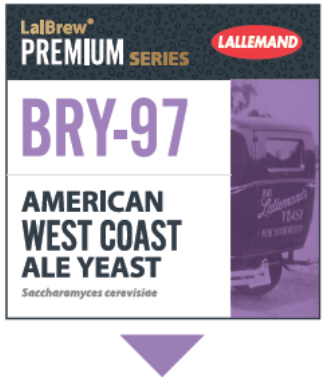
Sugar	Maltose, Maltotriose, Glucose, Dextrin Concentration
Alcohol Tolerance	Beer – 4.5% Double IPA – 7-10% Belgian Quad – 10-13%
Temperature	18-35°C (Ales) 12-16°C (Lager)
pH	4.0-5.5 pH

YEAST SELECTION - FINER DETAILS

- Attenuation
- Flocculation
- Biotransformation
- Phenolic
- Flavour and Aroma



YEAST SELECTION - IPA



QUICK FACTS

ATTENUATION AND STANDARD DEV. IN 12°P STANDARD WORT
81.2 (2.0)

FLOCCULATION
Medium

ALCOHOL TOLERANCE
9% ABV

BIOTRANSFORMATION

β-glucosidase	High
β-lyase	Low

ATTENUATION AND STANDARD DEV. IN 12°P STANDARD WORT
83.2 (0.9)

FLOCCULATION
High

ALCOHOL TOLERANCE
13% ABV

BIOTRANSFORMATION

β-glucosidase	High
β-lyase	Medium

ATTENUATION AND STANDARD DEV. IN 12°P STANDARD WORT
78.3 (3.2)

FLOCCULATION
Moderate

ALCOHOL TOLERANCE
12% ABV

BIOTRANSFORMATION

β-glucosidase	Medium
β-lyase	High

ATTENUATION AND STANDARD DEV. IN 12°P STANDARD WORT
68.6 (1.8)

FLOCCULATION
Low

ALCOHOL TOLERANCE
12% ABV

BIOTRANSFORMATION

β-glucosidase	Medium
β-lyase	Low

ATTENUATION AND STANDARD DEV. IN 12°P STANDARD WORT
83.6 (1.2)

FLOCCULATION
High

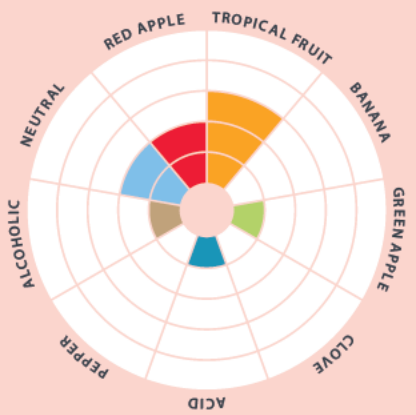
ALCOHOL TOLERANCE
14% ABV

BIOTRANSFORMATION

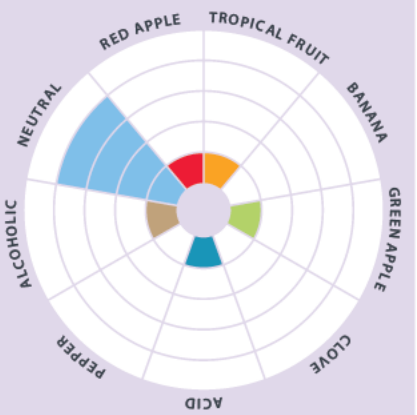
β-glucosidase	Medium
β-lyase	Medium

YEAST SELECTION - IPA

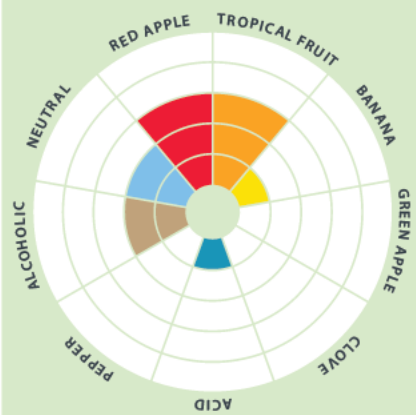
FLAVOR & AROMA



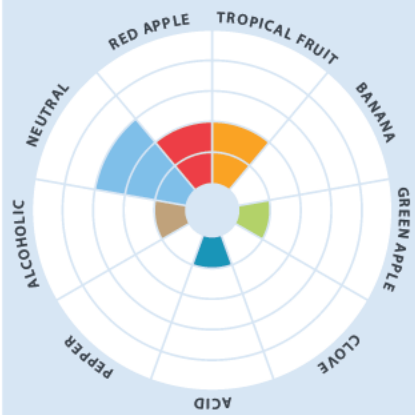
Peach, tropical, dry



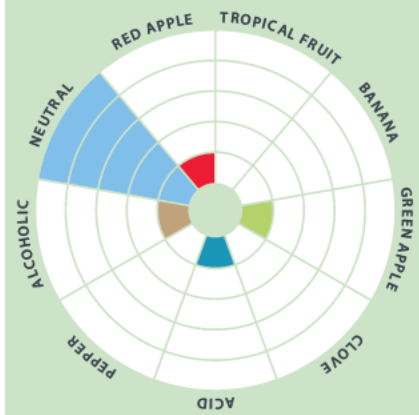
Neutral, clean, dry



Apricot, smooth, medium body

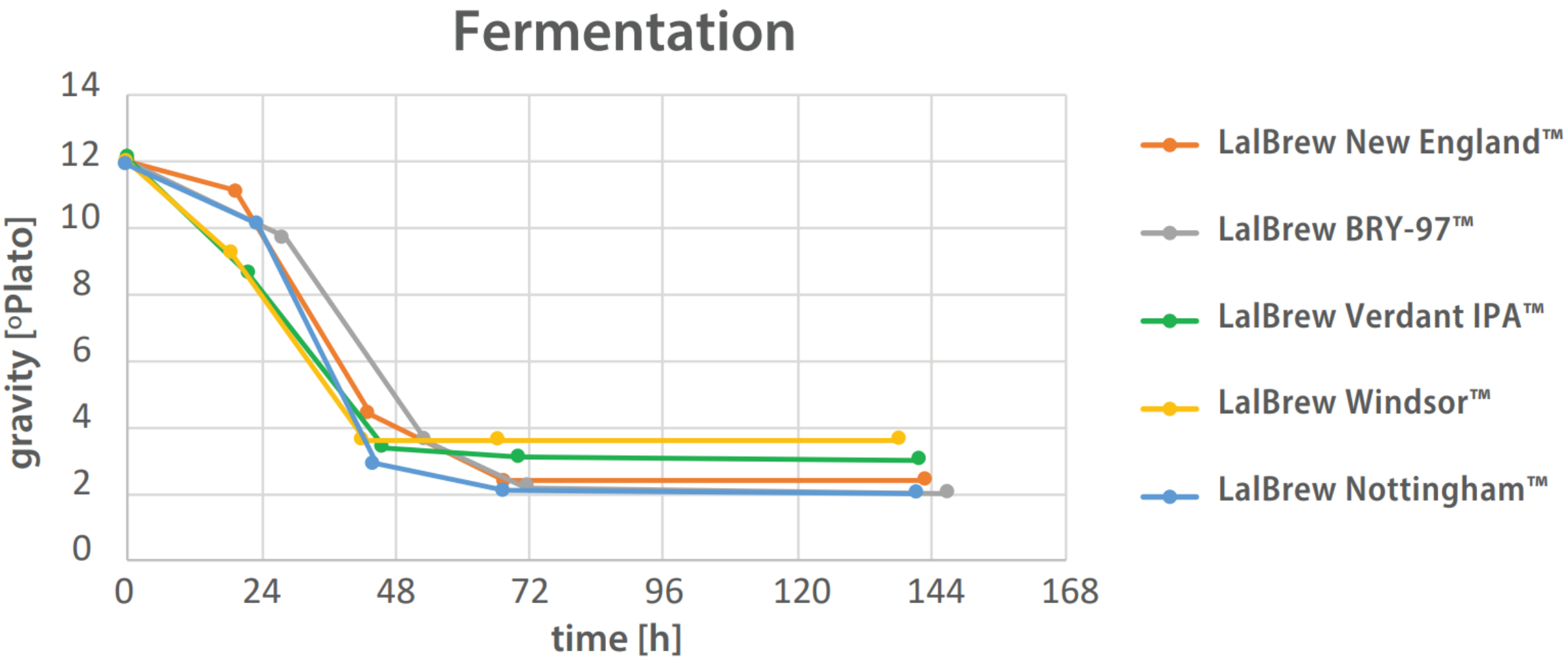


Sweet, fruity, full body

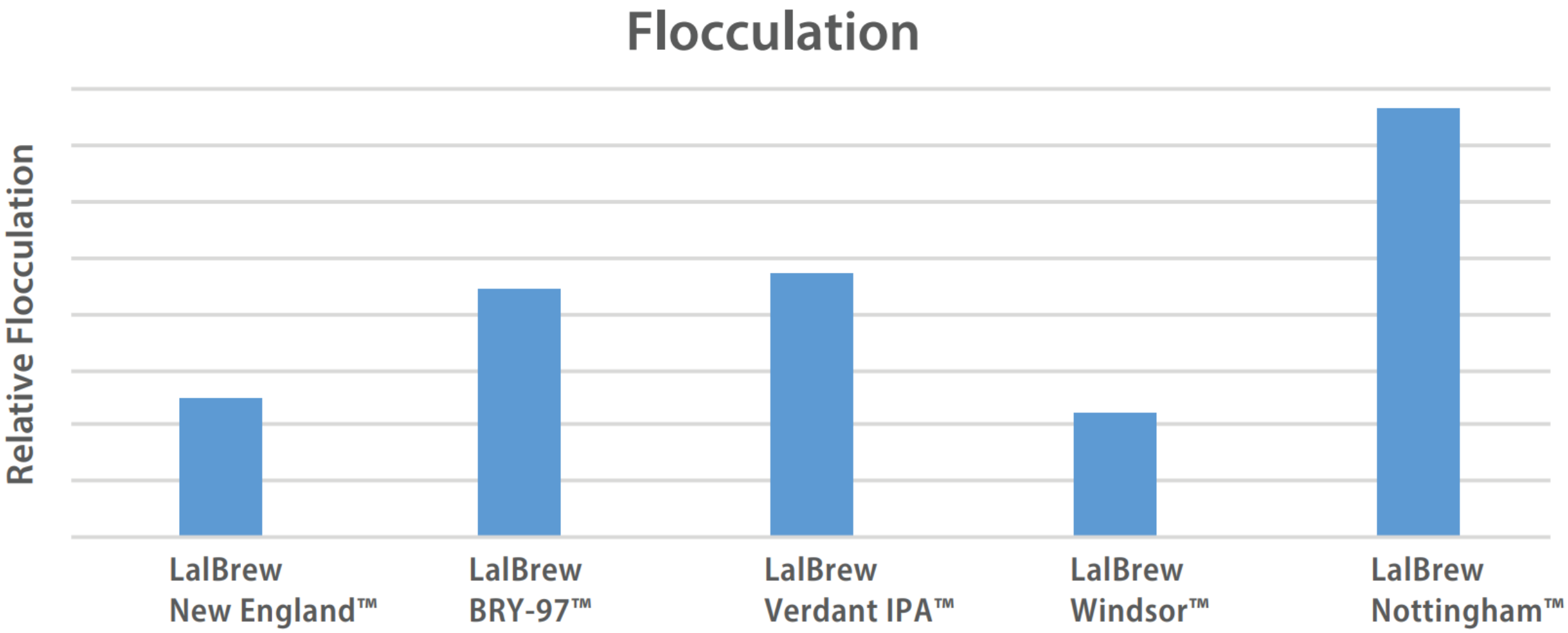


Neutral, clean, dry

IPA


Fermentation
gravity [°Plato]
14
12
10
8
6
4
2
0
0
24
48
72
96
120
144
168
time [h]
LalBrew New England™
LalBrew BRY-97™
LalBrew Verdant IPA™
LalBrew Windsor™
LalBrew Nottingham™

IPA


Flocculation
Relative Flocculation
LalBrew New England™
LalBrew BRY-97™
LalBrew Verdant IPA™
LalBrew Windsor™
LalBrew Nottingham™

IPA

BIOTRANSFORMATION

β-glucosidase

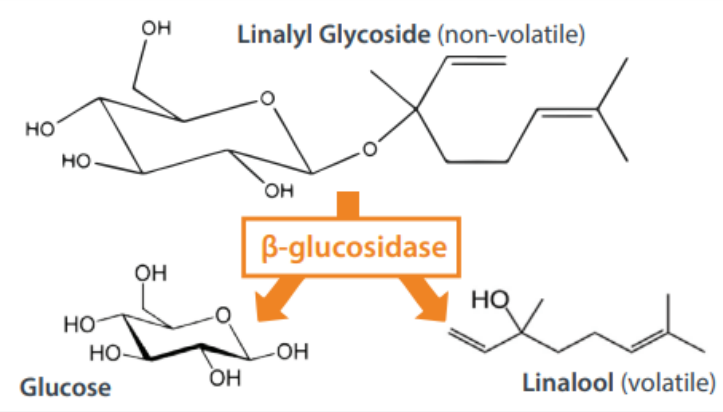


Figure 3: β-glucosidase activity results in the release of an aromatic terpene (and a glucose molecule) from a non-aromatic terpenyl glycoside. Terpenes can have diverse flavor impacts (citrus, floral) and higher levels of terpenes are associated with greater overall hop aroma intensity (OHAI). In this example, aromatic linalool is released from a non-aromatic linalyl-glycoside.

β-lyase

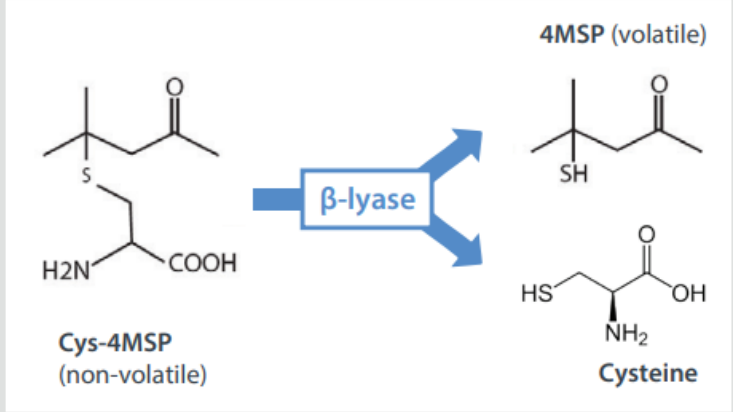


Figure 4: β-lyase activity results in the formation of volatile sulfur compounds called thiols, which are usually associated with tropical aroma and are active at very low flavor thresholds. In this example, aromatic 4MSP is released from a non-aromatic cysteinylated precursor.

Biotransformation activities of IPA yeast strains

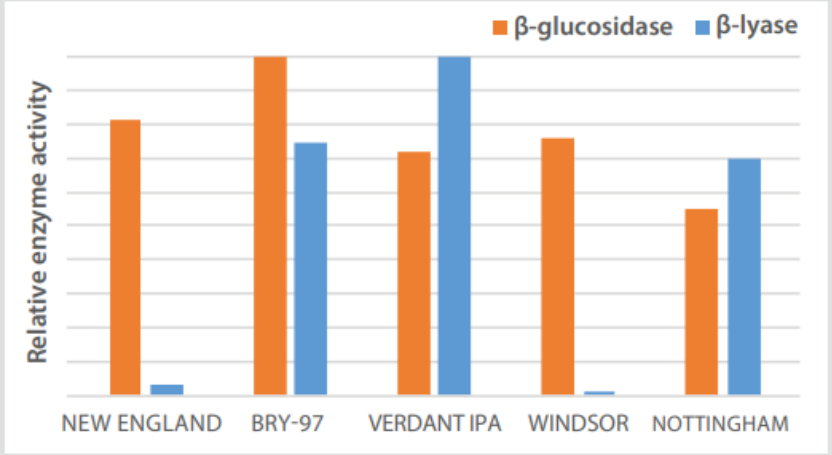


Figure 5: Relative activities of β-glucosidase and β-lyase in different IPA yeast strains. β-glucosidase was measured as secreted enzyme activity using a standard chemical glycoside substrate. β-lyase activity was measured by growth on selective media containing a specific sulfur-based precursor. Relative activities are shown for comparison, but β-glucosidase and β-lyase activities cannot be directly compared with each other.

IPA

BEER STYLE CHART

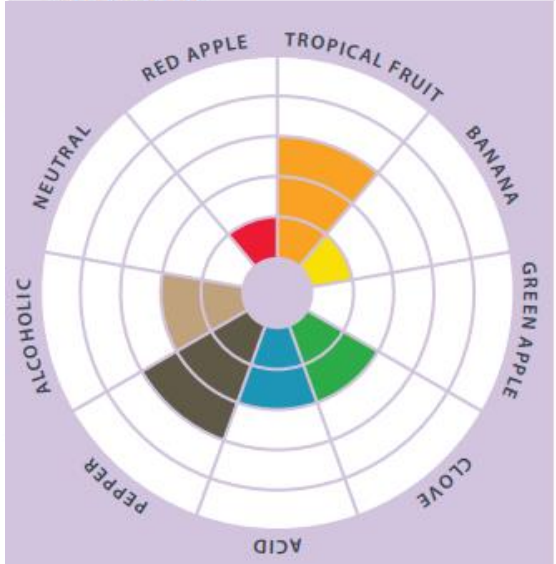
In addition to the traditional IPA yeast strains, many brewers are experimenting with alternative yeast strains to produce hoppy beer styles. The **LalBrew Koln™** strain produces an excellent fruity ester profile and has β-glucosidase activity levels similar to the **LalBrew New England™** strain. The **LalBrew Voss™** strain produces citrus aromas and has high β-glucosidase and medium-low β-lyase activity. The **WildBrew Philly Sour™** strain is ideal for Sour IPAs – kettle bittering hops can be used with this hop tolerant *Lachancea* yeast species capable of producing lactic acid and ethanol during primary fermentation. The **ABV Aromazyme™** pure β-glucosidase enzyme gives the brewer greater control over biotransformation activity.

STRAINS BY BEER STYLE	TRADITIONAL IPA STRAINS ▶	BRY-97	NEW ENGLAND	NOTTINGHAM	VERDANT IPA	WINDSOR	▶ ALTERNATIVE IPA STRAINS	KÖLN	VOSS	PHILLY SOUR	▶ HOP AROMA ENZYMES	AROMAZYME
BLACK IPA		✓		✓	✓				✓			✓
BRUT IPA		✓		✓					✓			✓
DOUBLE IPA		✓	✓	✓	✓	✓		✓	✓			✓
ENGLISH IPA				✓	✓	✓						✓
NEW ENGLAND IPA		✓	✓		✓	✓		✓	✓			✓
SESSION IPA		✓	✓	✓	✓	✓		✓	✓			✓
SOUR IPA		✓	✓	✓	✓	✓		✓	✓	✓		✓
WEST COAST IPA		✓		✓					✓			✓

BELGIAN/SAISON

ATTENUATION

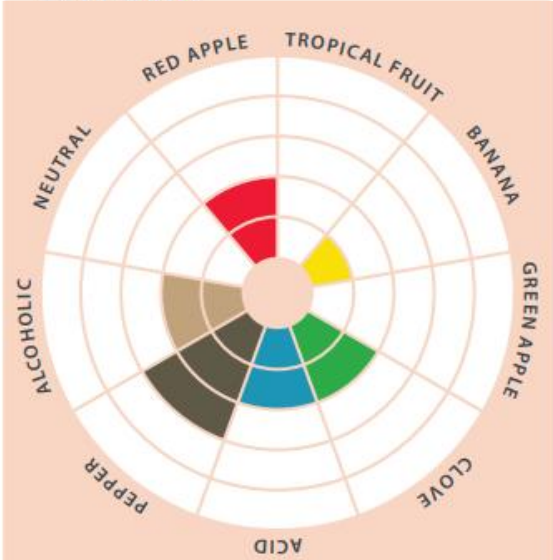
High



Clove, pepper, fruit notes

ATTENUATION

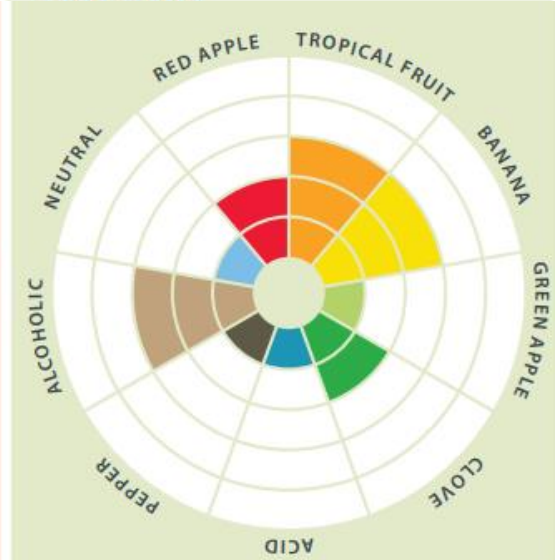
Very high



Citrus, pepper

ATTENUATION

High



Spicy, fruity, tropical, banana

BELGIAN/SAISON

ATTENUATION
High

STA1 GENE
Negative

SUGARS METABOLIZED
Glucose, maltose, maltotriose

FLOCCULATION
Low

FERMENTATION RANGE
22 - 30°C (72 - 86°F)

ALCOHOL TOLERANCE
13% ABV

ATTENUATION
Very high

STA1 GENE
Positive

SUGARS METABOLIZED
Glucose, maltose, maltotriose, Dextrins

FLOCCULATION
Low

FERMENTATION RANGE
20 - 35°C (68 - 95°F)

ALCOHOL TOLERANCE
15% ABV

ATTENUATION
High

STA1 GENE
Negative

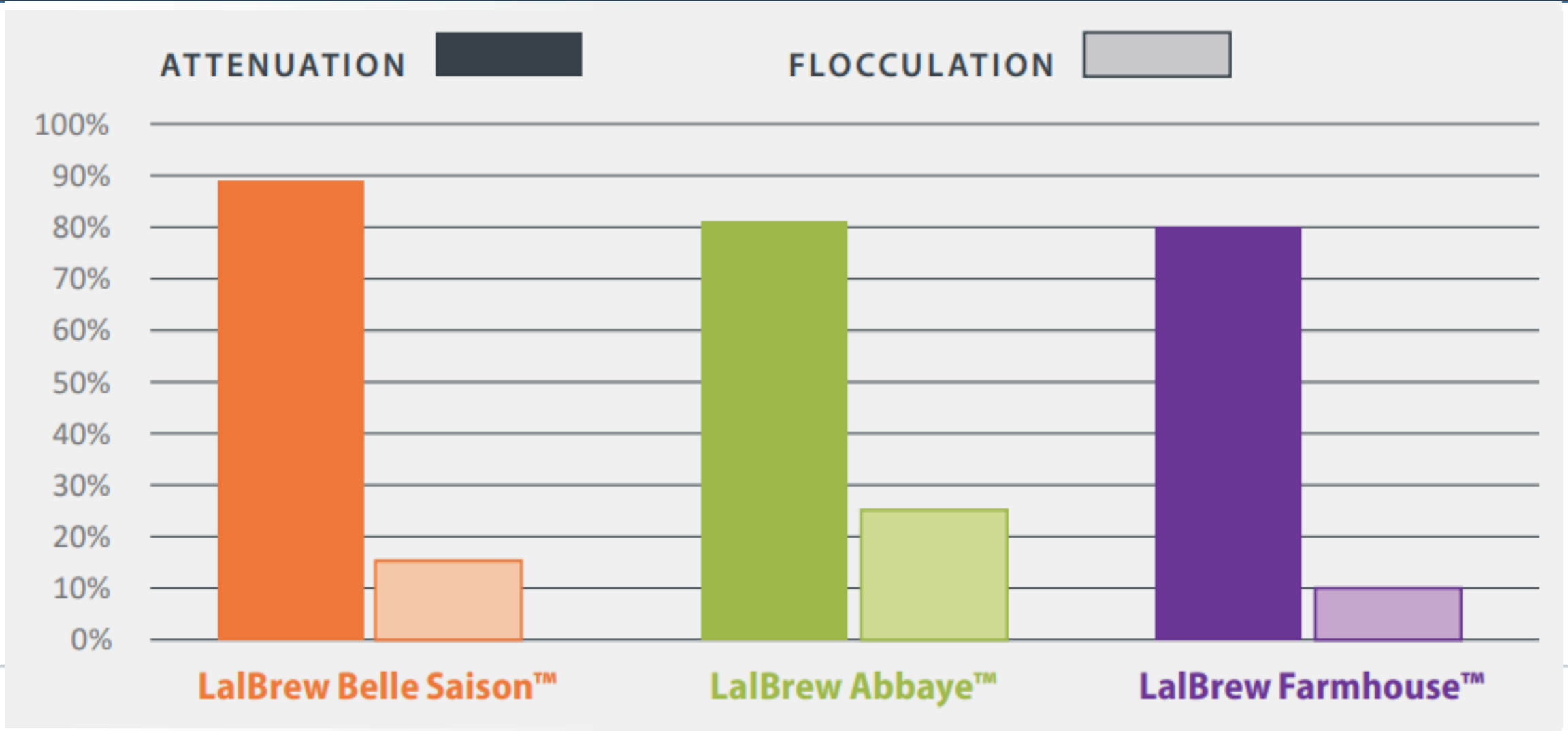
SUGARS METABOLIZED
Glucose, maltose, maltotriose

FLOCCULATION
Medium to high

FERMENTATION RANGE
17 - 25°C (63 - 77°F)

ALCOHOL TOLERANCE
14% ABV

BELGIAN/SAISON

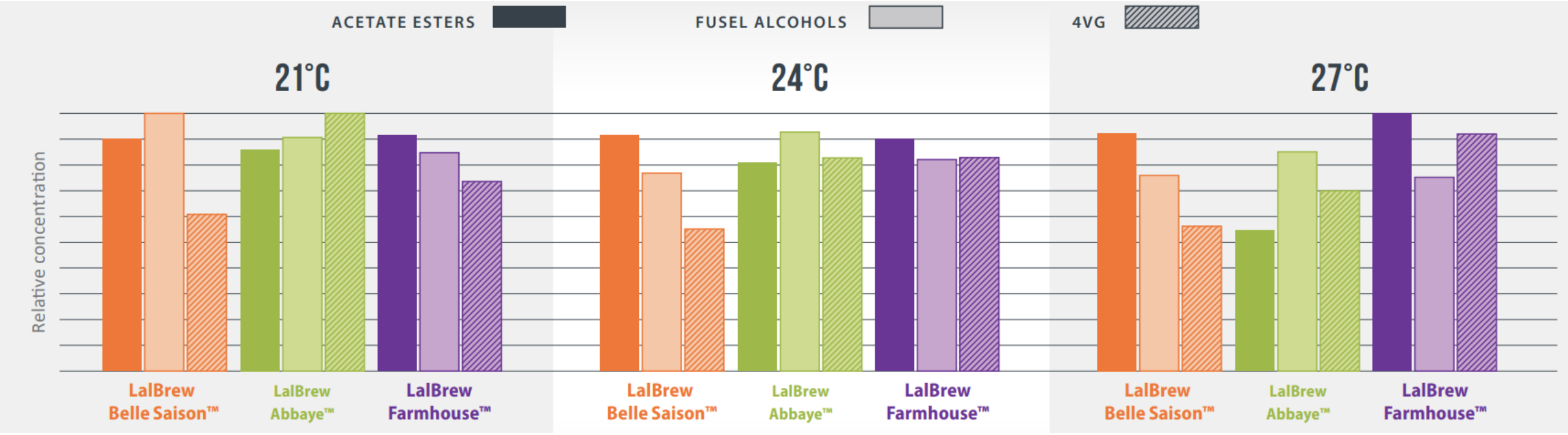


BELGIAN/SAISON

FLAVOR CONTROL: ESTERS AND PHENOLICS

The yeast-derived flavor profile of each yeast strain is influenced by many factors. In general, higher levels of esters are achieved by pitching less yeast, fermenting at a higher temperature or addition of adjunct sugars. Higher levels of phenolic compounds such as 4-vinyl-guaiacol (4VG) can normally be achieved by using a combination of barley and wheat malts and performing a ferulic acid rest (~45°C) during the mash. Fusel alcohol levels tend to be positively correlated with fermentation temperature. We have provided below a snapshot of the flavor compounds produced by **LalBrew Belle Saison™**, **LalBrew Abbaye™** and **LalBrew Farmhouse™** in laboratory fermentations using a standard wort. Flavor development is complex and there are exceptions to these general rules, so brewing trials are recommended in order to optimize the recipe and brewing process to achieve the desired flavor profile.

BELGIAN/SAISON



BELGIAN/SAISON

YEAST STRAIN BY BEER STYLE CHART

A traditional Saison yeast strain such as **LalBrew Belle Saison™** is used to produce dry Belgian beer styles, whereas non-diastaticus Belgian yeast such as **LalBrew Abbaye™** are used to produce malty, full-bodied Belgian ales. When using a modifed process and recipe as described above, **LalBrew Farmhouse™** and **LalBrew Abbaye™** can be used to produce beer styles normally produced only by traditional Saison yeast. ✓

STRAINS BY BEER STYLE	BELLE SAISON	ABBAYE	FARMHOUSE
BELGIAN BLOND ALE		✓	✓
BELGIAN DARK STRONG ALE		✓	✓
BELGIAN GOLDEN STRONG ALE		✓	✓
BELGIAN PALE ALE		✓	✓
BELGIAN QUAD		✓	✓
BELGIAN TRIPEL		✓	✓
BERLINER WEISS	✓	✓	✓
BIÈRE DE GARDE		✓	✓
FARMHOUSE ALE	✓	✓	✓
GOSE	✓	✓	✓
SAISON	✓	✓	✓
WITBIER		✓	✓

LAGER

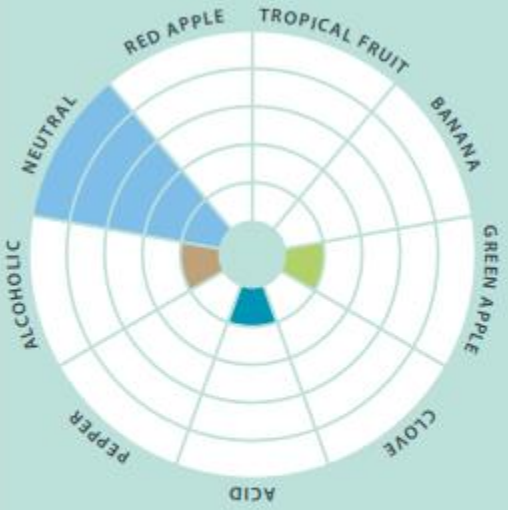
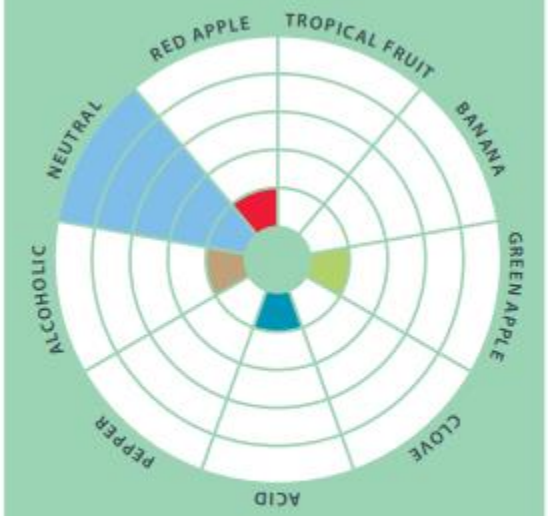
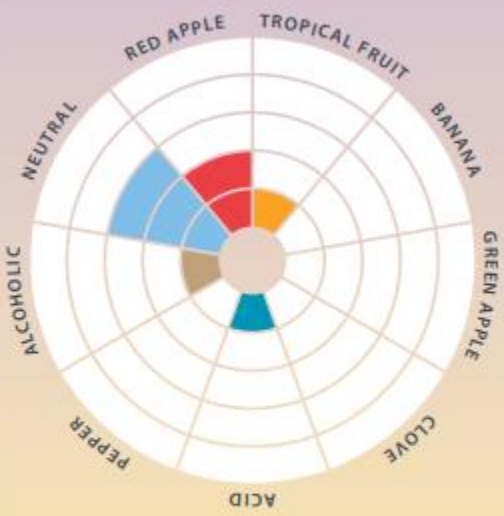
QUICK FACTS

SPECIES	*Saccharomyces pastorianus*	*Saccharomyces cerevisiae*	*Saccharomyces pastorianus*
LAGER CLASSIFICATION	Group II (Frohberg)	Pseudo-lager	Group III
HYBRID GENOMIC COMPOSITION	50% *S. cerevisiae* 50% *S. eubayanus*	100% *S. cerevisiae*	75% *S. cerevisiae* 25% *S. eubayanus*
MELIBIOSE UTILIZATION	+	-	+
ATTENUATION RANGE	77-83%	78-84%	78-84%
FLOCCULATION	High	High	Medium
TEMPERATURE RANGE	10-15°C (50-59°F)	10-25°C (50-77°F)	10-20°C (50-68°F)
ALCOHOL TOLERANCE (ABV)	13%	14%	13%
PITCHING RATE	100-200 g/hl	50-100 g/hl	50-100 g/hl

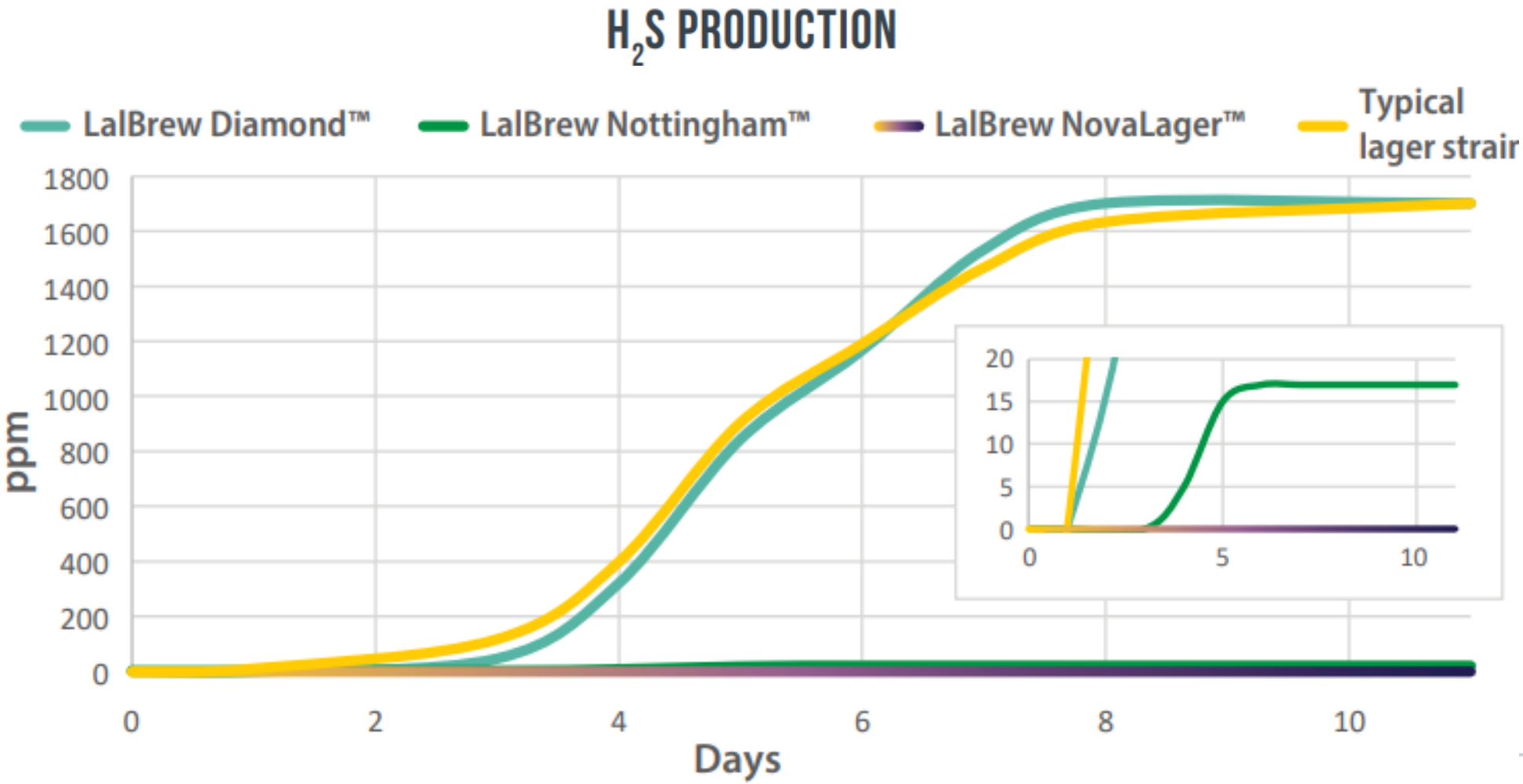
LAGER

QUICK FACTS

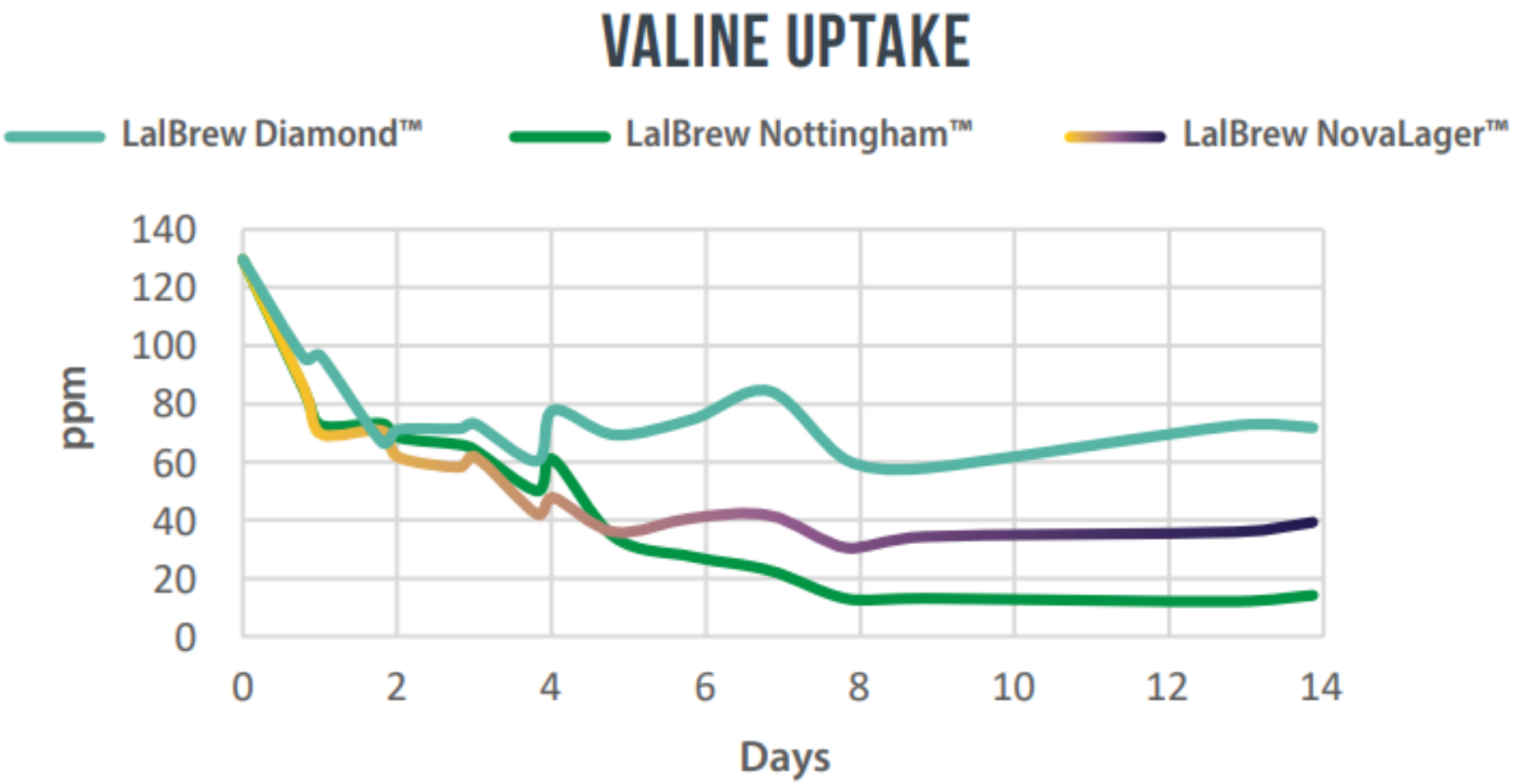
FLAVOR & AROMA

			
			
	Neutral	Slightly fruity, neutral	Clean, low to medium ester, no sulfur
PITCHING RATE	100-200 g/hl	50-100 g/hl	50-100 g/hl

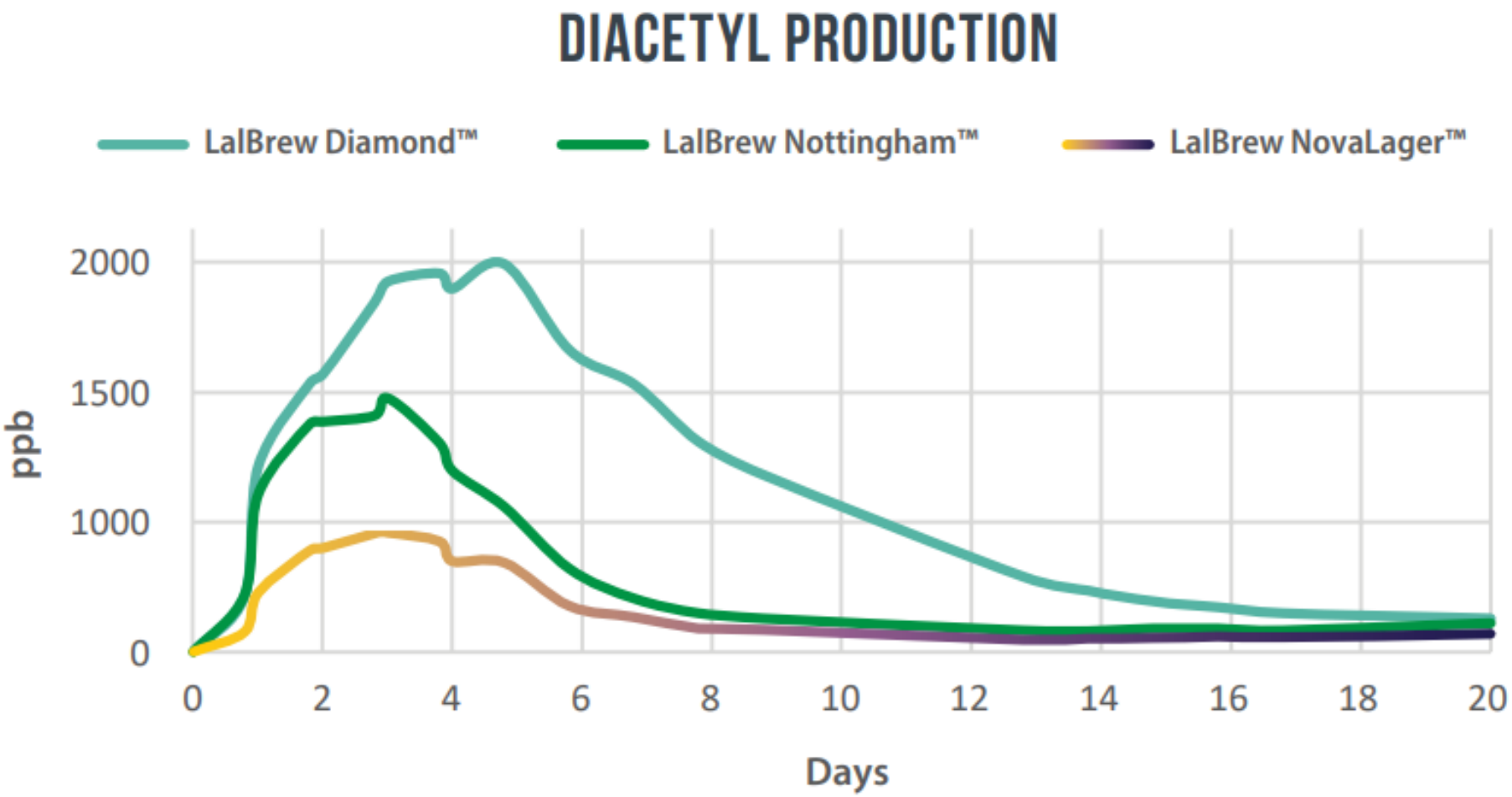
LAGER


H2S PRODUCTION
LalBrew Diamond™
LalBrew Nottingham™
LalBrew NovaLager™
Typical lager strair
ppm
1800
1600
1400
1200
1000
800
600
400
200
0
0
2
4
6
8
10
Days
20
15
10
5
0
0
5
10

LAGER


VALINE UPTAKE
LalBrew Diamond™
LalBrew Nottingham™
LalBrew NovaLager™
ppm
140
120
100
80
60
40
20
0
0
2
4
6
8
10
12
14
Days

LAGER


DIACETYL PRODUCTION
LalBrew Diamond™
LalBrew Nottingham™
LalBrew NovaLager™
ppb
2000
1500
1000
0
0
2
4
6
8
10
12
14
16
18
20
Days

STRAIN SELECTOR – LALBREW APP

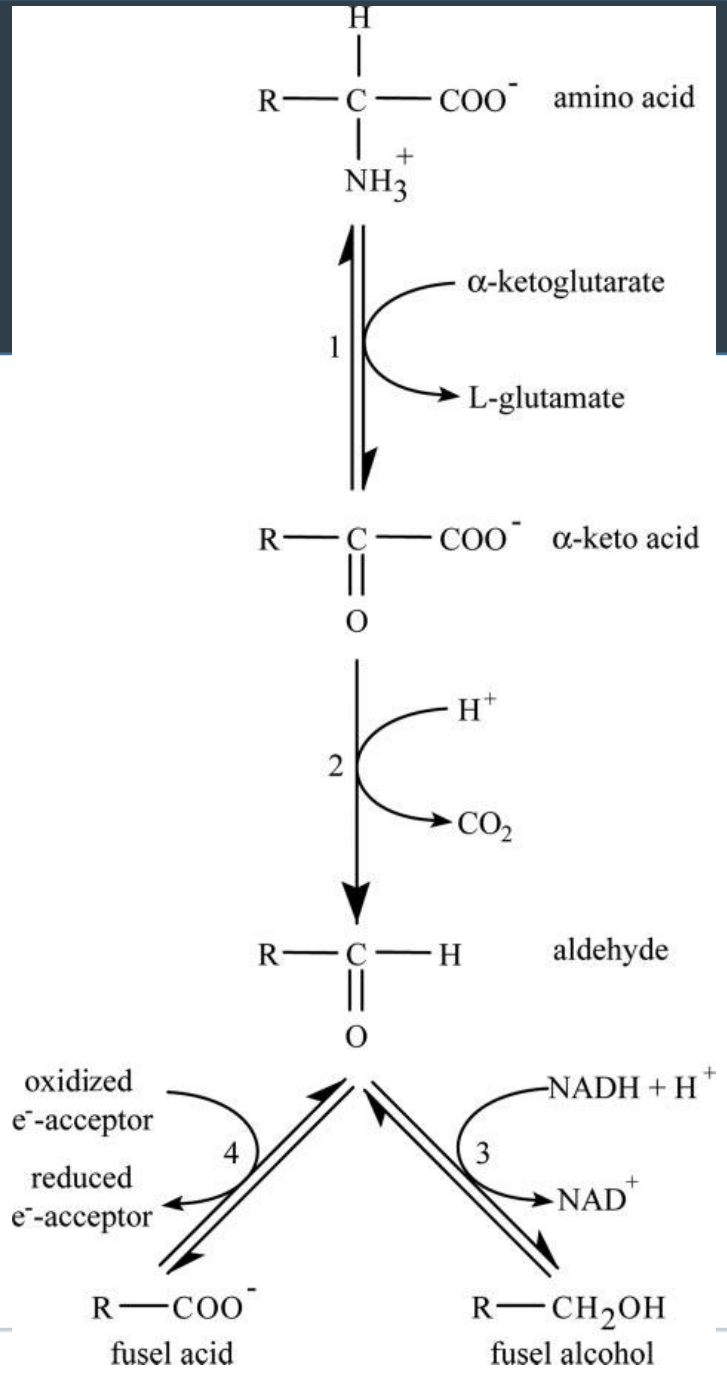
YEAST NUTRITION

✓	Nitrogen	DAP Amino Acids Concentration
	Sterols	
	Trace Factors	Vitamins Mg, Zn
	Oxygen	

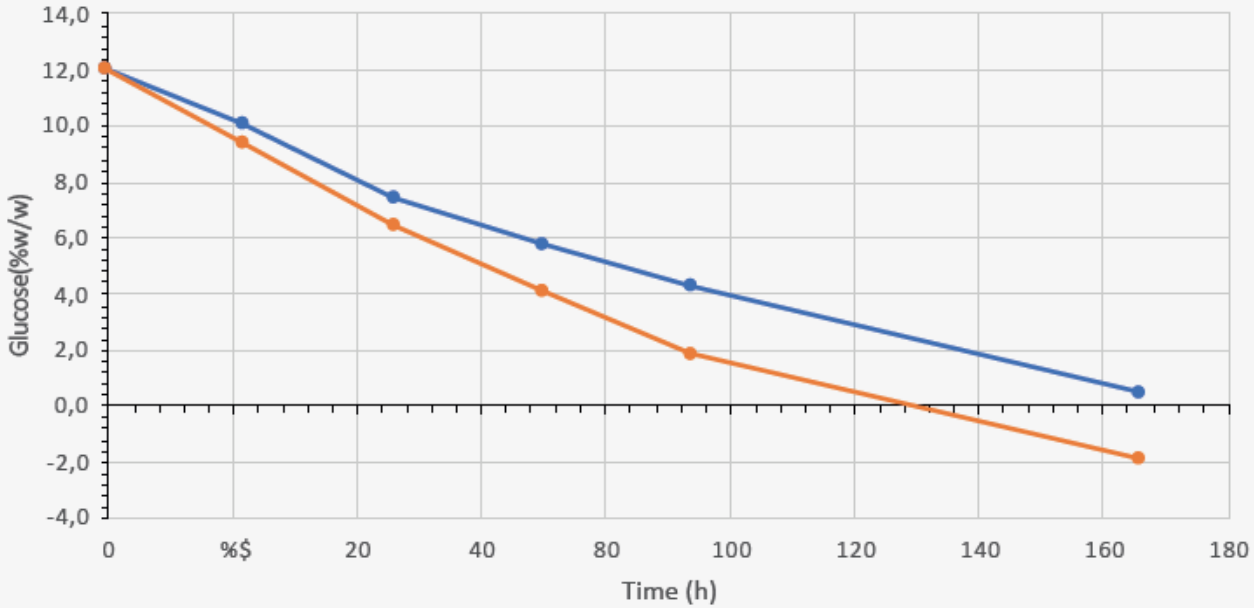
WORT FAN

- Free assimilable nitrogen = FAN
  - Amino acids, Ammonia, DAP etc
- FAN is consumed during fermentation
  - Production of enzymes for glycolysis
  - Manufacturing of cell components in yeast growth
- Certain branched chain amino acids (BCAA) contribute to aroma
  - Erlich pathway

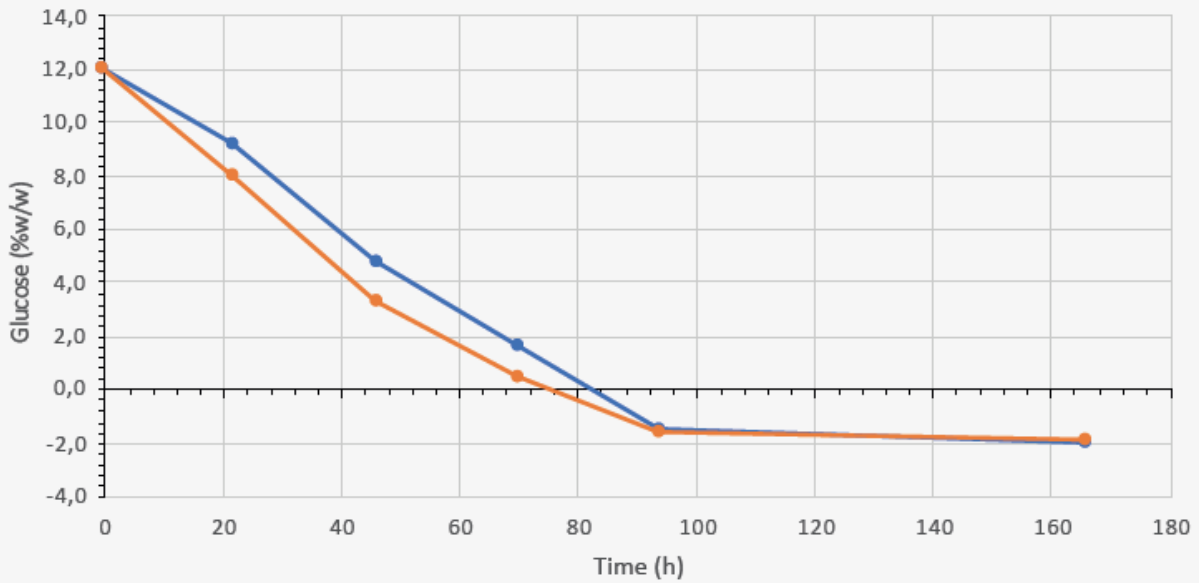
WORT FAN


amino acid
α-ketoglutarate
L-glutamate
1
α-keto acid
2
H^+
CO_2
aldehyde
oxidized
e⁻-acceptor
reduced
e⁻-acceptor
4
NADH + H^+
3
NAD^+
fusel acid
fusel alcohol

MORE FAN = BETTER FERMENTATIONS (TO A LIMIT)



100 g/hL YeastLife O™



250 g/hL YeastLife O™

50 g/hL Yeast
100 g/hL Yeast

Literature:

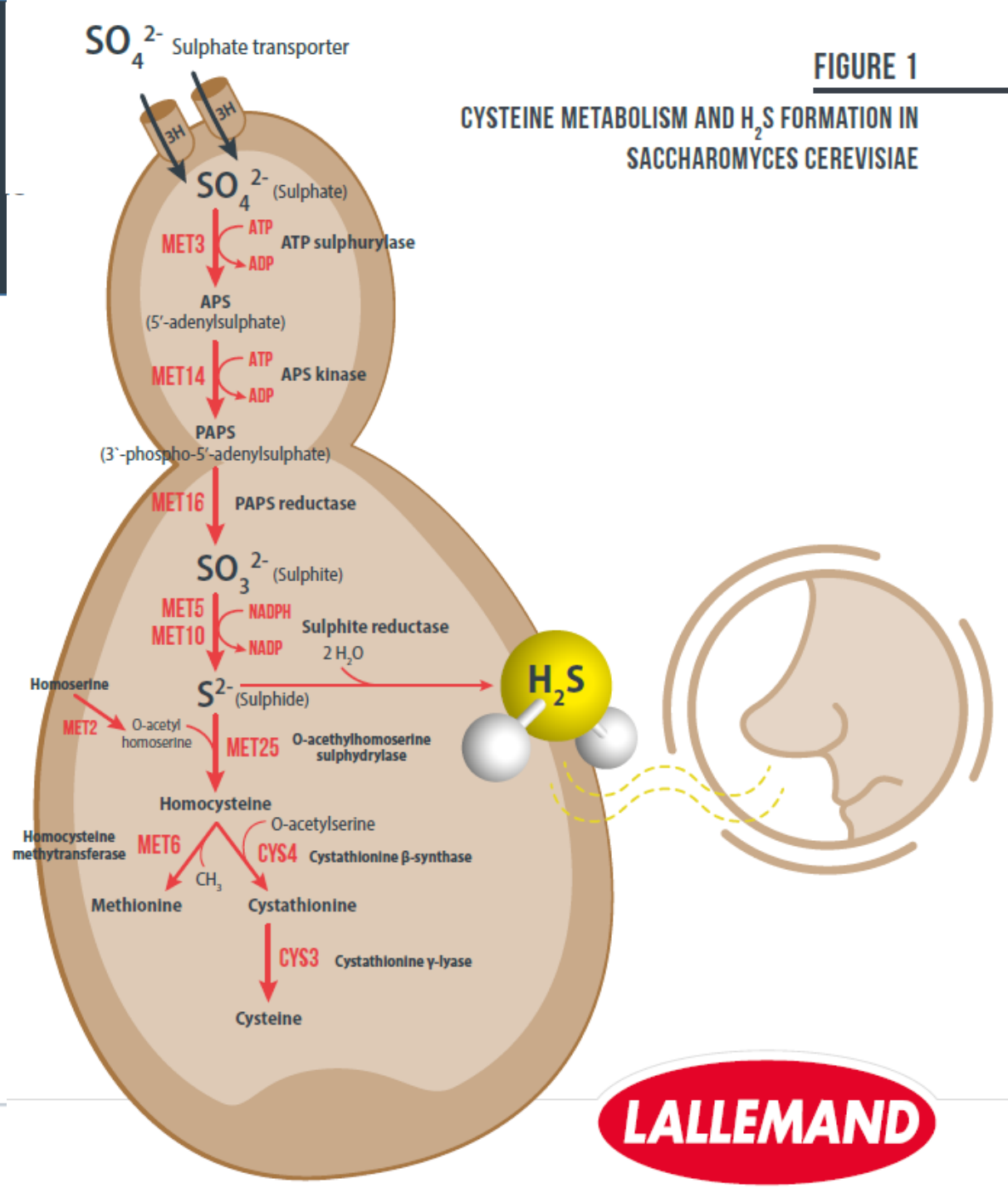
- 150-250 mg/L (ppm) FAN for a successful fermentation (12-28 Plato)

FAN AND H_2S

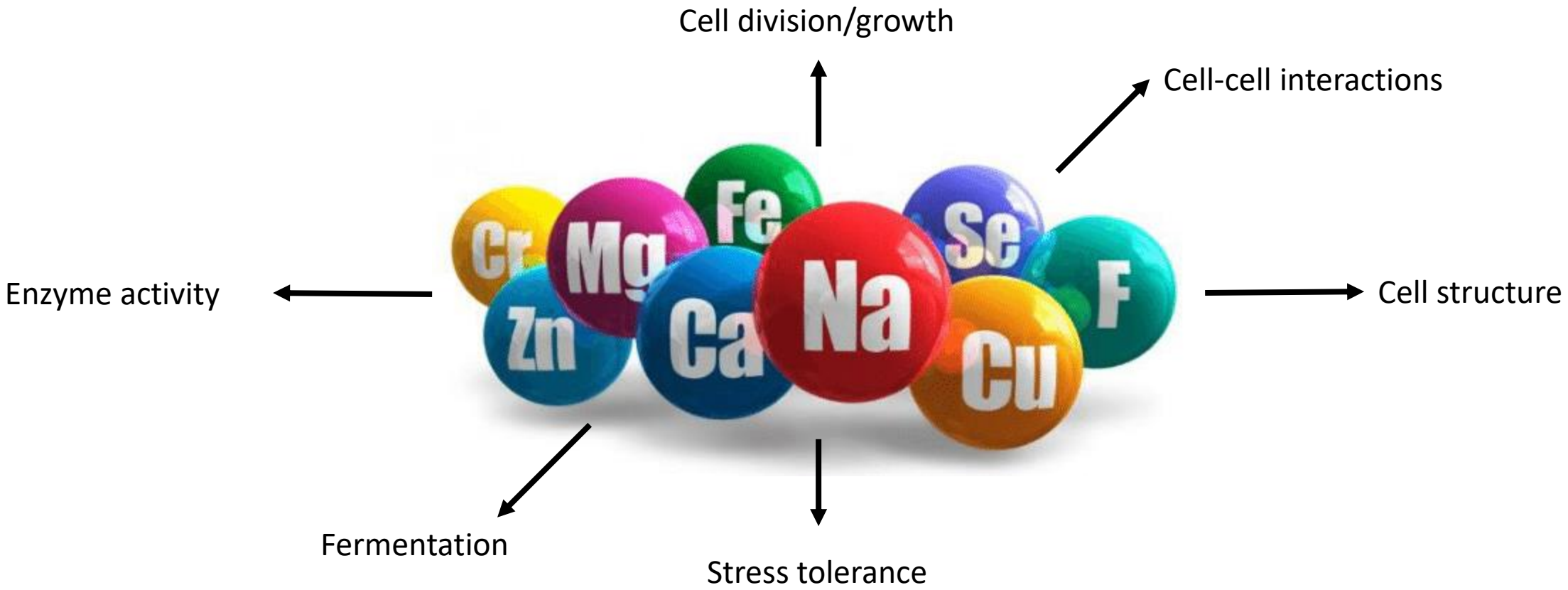
- Formation of cysteine and methionine.
  - sulfur reduction sequence (SRS) enzymes
- Enough nitrogen = H_2S uptake.
- Yeast can be induced to liberate H_2S by starvation of assimilable nitrogen.
  - If nitrogen is limiting, insufficient precursors are available, and free H_2S can accumulate in the cell and diffuse into the fermentation.
- Lallemand Brewing – Crowdcast – H_2S podcast and Whitepaper

HOW IS IT PRODUCED?

- Amino acid (sulfur containing) metabolism
- Sulfate ions are reduced for processing into amino acids
- Large amount of H^+ = acidic
- H_2S helps mitigate the acidity
- Not enough nitrogen
- Not enough vitamins

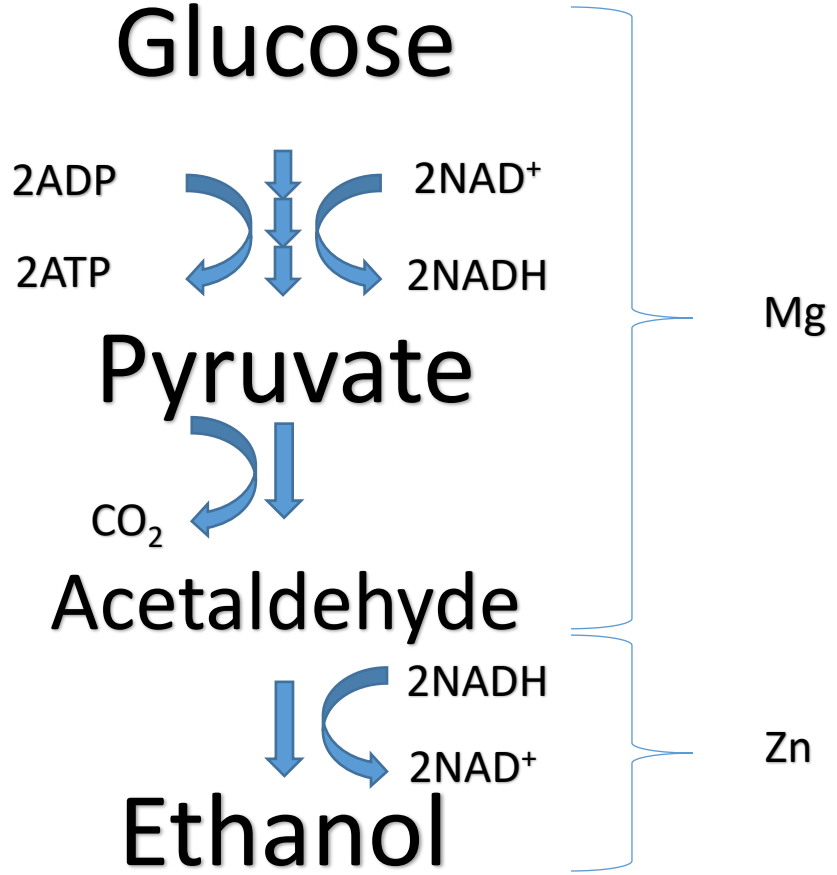


WORT COMPOSITION - MINERALS



MINERALS – MG, ZN

- Glycolysis
  - Enzymes depend on Mg
- ADH – last step to ethanol
  - Zn

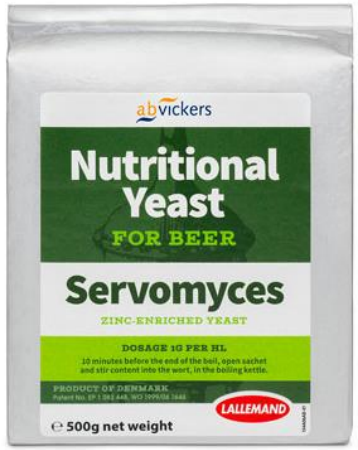


MINERALS - SUMMARY

- Mg, Ca, Zn
  - Important for fermentation
  - Stress resistance
  - Fermentation and Flocculation performance
- Zn is taken up rapidly
  - Low Zn is a problem

COMMERCIAL NUTRIENT PRODUCTS

- Complex Nutrients
  - YeastLife Extra
  - Zn, FAN, fatty acids etc
  - Ticks all the boxes
- Organic Nutrients
  - YeastLife O
  - FAN, fatty acids
  - Sugar fermentation – hard seltzers
- Specific Nutrients
  - Servomyces
  - Zn



COMMERCIAL NUTRIENT PRODUCTS

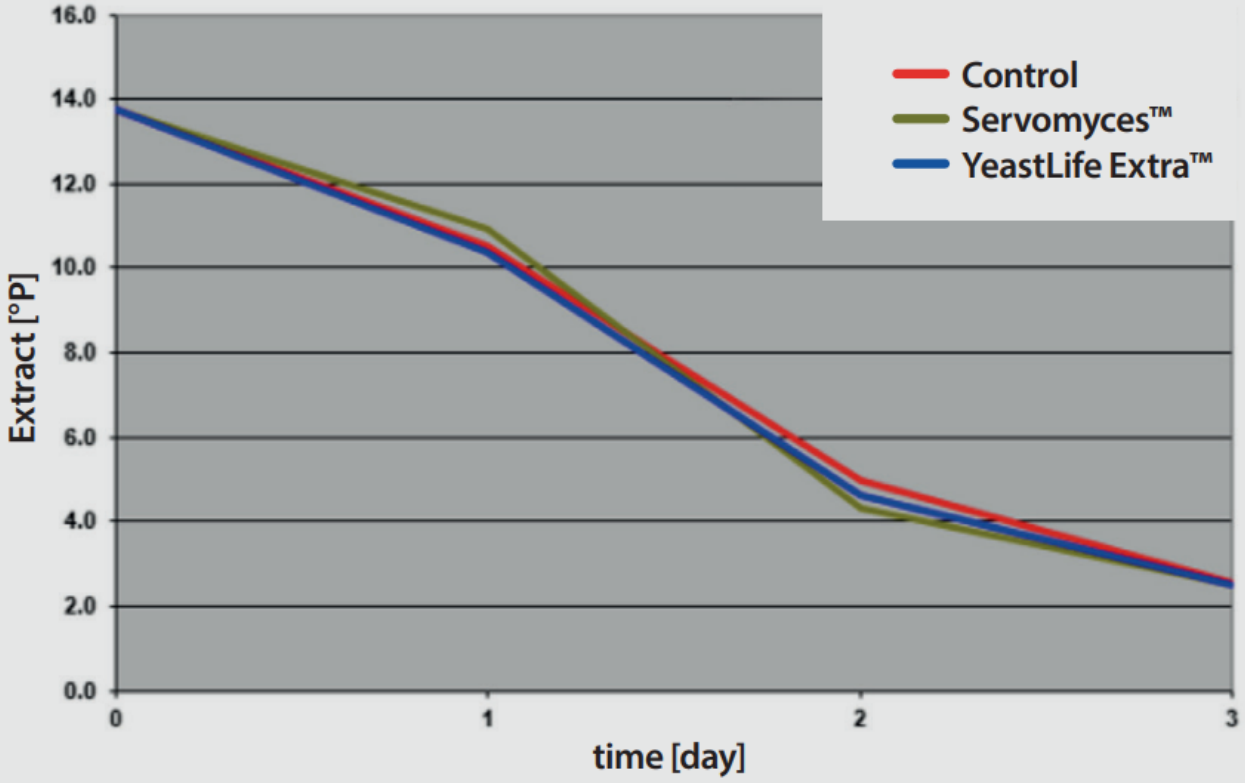


Figure 1: All-malt wort - Generation 1

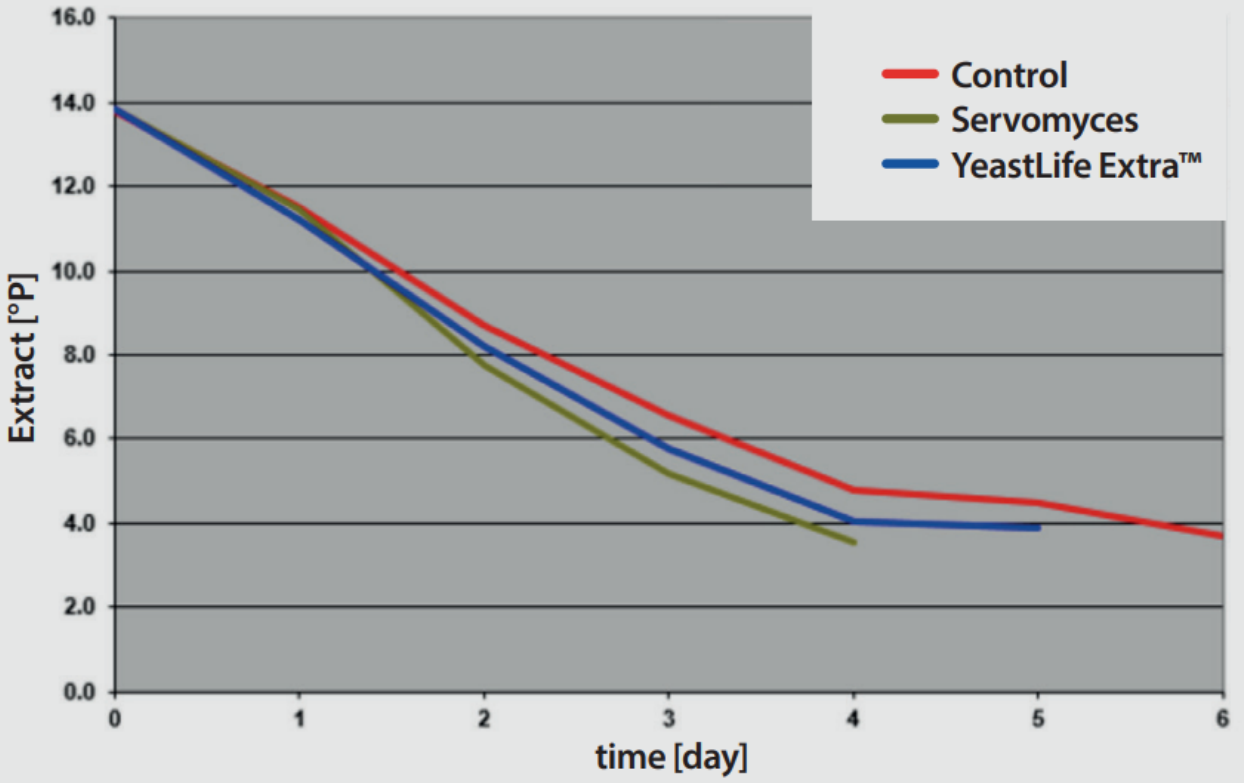


Figure 2: All-malt wort - Generation 8

COMMERCIAL NUTRIENT PRODUCTS

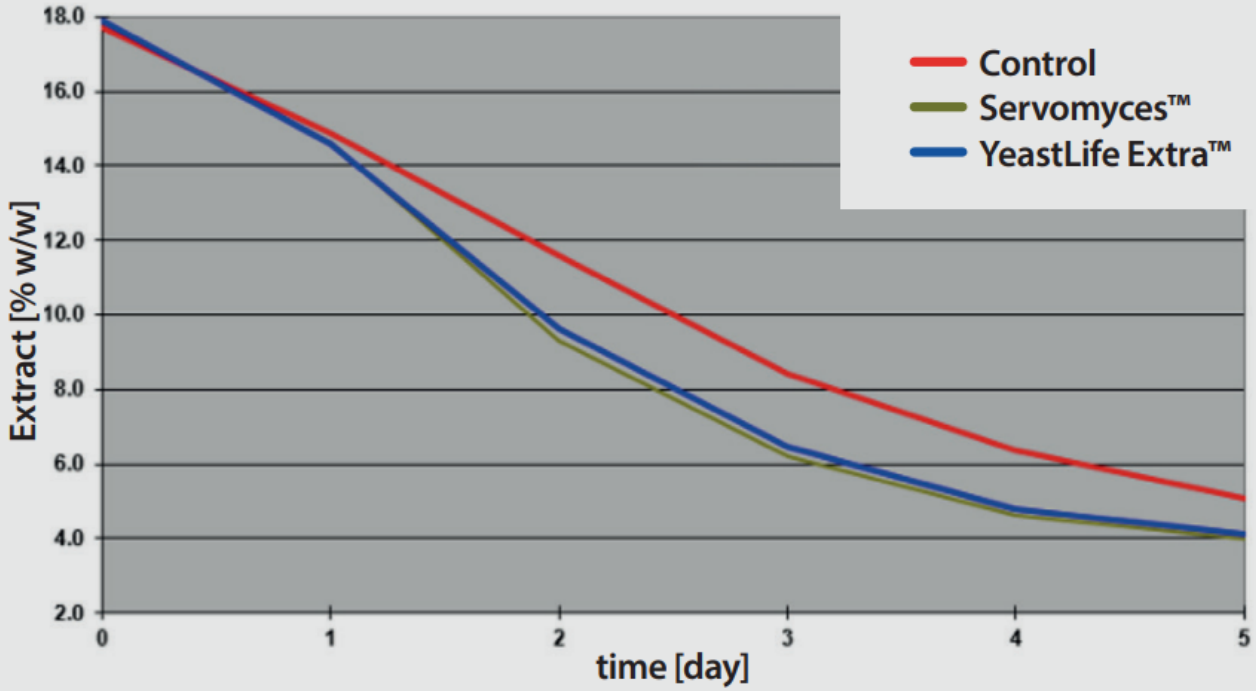


Figure 3: High gravity, high adjunct wort - Generation 1

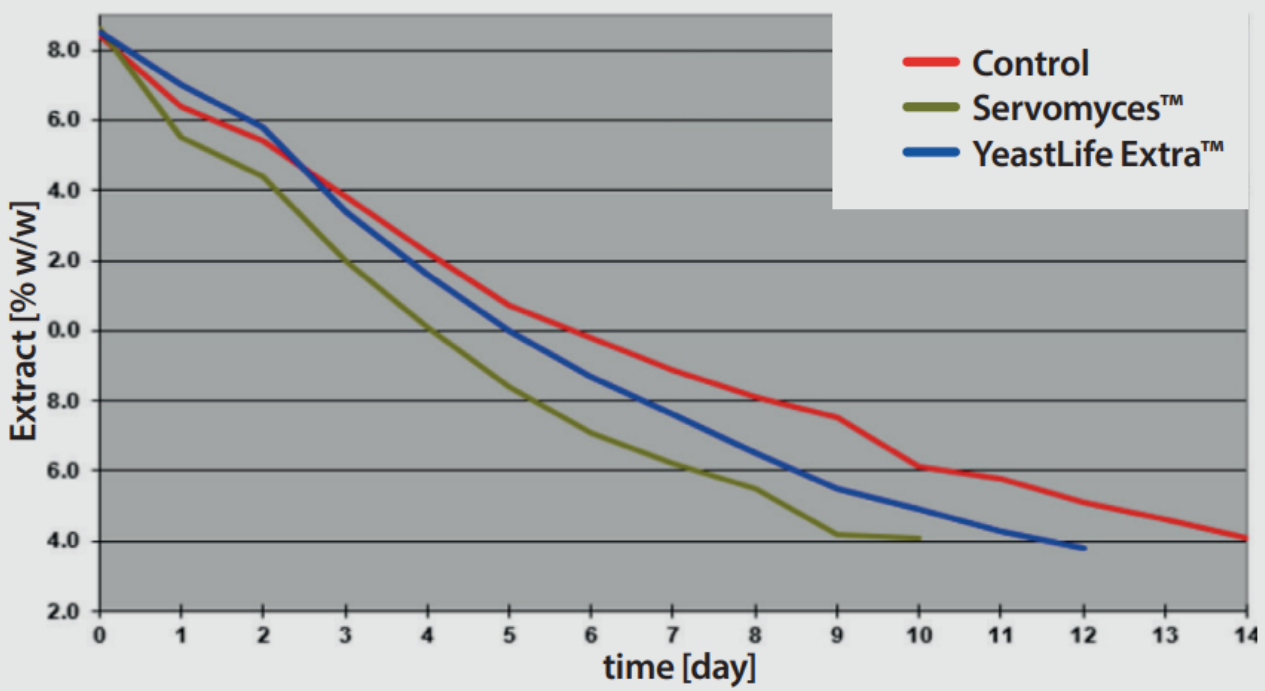
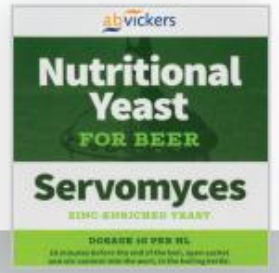
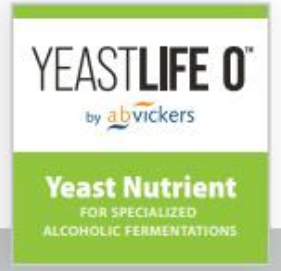


Figure 4: High gravity, high adjunct wort - Generation 8

Contains 60% malt extract 40% high maltose corn syrup

COMMERCIAL

QUICK REFERENCE TABLE

			
Description of products	- A pure strain of active brewing yeast enriched in Zinc, with higher efficiency than mineral zinc for fermenting yeast.	- Complex nutrient blend containing organic and inorganic nitrogen, minerals (ZN, Mg, Ca) and vitamins.	- 100% Yeast autolysates blend to provide bioavailable nitrogen (organic nitrogen), vitamins and minerals.
Benefits	- Avoid sluggish and stuck fermentation - Improve yeast sedimentation	- Avoid sluggish and stuck fermentation - Support adjunct and high gravity brewing	- Avoid sluggish and stuck fermentation. - Avoid o flavors - Improve mouthfeel
When to use?	- Re-pitching - Propagation - High gravity brewing	- Low nutrient wort/ high adjunct rates - Poor/variable quality malt - Stuck fermentation/high stress environment	- High gravity sugar fermentations (e.g. hard seltzer, cider and mead) - To ensure clean and more reliable fermentation - Organic fermented beverage applications - Low nutrient wort/ high adjunct rates
Application	Add to kettle about ten minutes before the end of boil.	Add to the kettle at the end of boil, to the whirlpool, or in line to the wort main.	Add to the kettle at end of boil, or dissolve in water prior to dosing in-line during transfer to the fermenter.
Dosage	1-2 /hl	4 to 15g/hl	30- 250 g/hl depending on brewing application.

REMEMBER!

- Yeast growth is coupled to fermentation efficiency
  - Find a balance
- Wort is yeast food – composition is the key
- Good yeast nutrition = good beer

THANK-YOU

WE BREW WITH YOU.™

Questions?

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