Yeast management and current trends…

Presented by Laura Burns with Omega Yeast

Nanocon

October 25th, 2024

Who are we?

Omega Yeast Labs
Chicago, IL / St. Louis, MO

High quality, pitch-ready liquid yeast. Handful of microbiologists, homebrewers, professional brewers and craft beer fans who made it our express purpose to make brewing easier and better for everyone.

- Be Helpful
- Be Creative
- Be Fresh

Laura Burns
Director of R&D

w w w . o m e g a y e a s t . c o m

OMEGA YEAST

What we will cover today...

1. Yeast Management
2. Yeast and Hops

Part 1: Yeast Management

1. Choosing Your Yeast
2. Repitching/Harvesting/Storage
3. Propagation

Why is Yeast Management Important?

When it Goes Wrong

- Slow, stalled or incomplete fermentations
- Production of off flavors:
  - Diacetyl
  - SO2
  - Acetaldehyde excess
  - Fusel Alcohols
- Poor yeast viability and health:
  - Autolysis flavor
  - poor foam stability/clarity

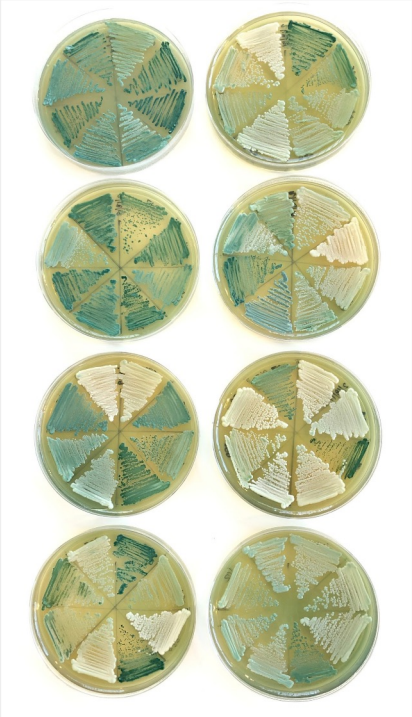
When it Goes Right

- Predictable fermentations
- Consistent ABVs
- Aroma and appearance true to style
- Minimal off flavor production
- Shorter diacetyl rest and reliable turn times
- SAVES MONEY!
- GOOD BEER!

Choosing your Yeast

Practical Considerations:

- Versatile
- Suit your production needs
  - Turn time
  - Repitching schedule
  - Easy to harvest/store
- Reliability
  - Predictable
  - Consistent flavor
- Source
  - Lead times
  - Quality
- Cross contamination risk
  - Phenolic
  - Diastatic
  - Brettanomyces



Strain characteristics:

- Turn time
  - Ale (kveiks)
  - Lager
- Turbidity
  - Haze promoting
  - Bright
- Metabolites produced
  - Off flavors
  - Esters/phenols
  - Biotransformation?
  - Organic acids
- Attenuation/alcohol tolerance
- Nutrient/oxygen requirements

Common Yeast Strains for Hop-forward Beers

Clean

Strain	Description	Haze	Esters	Attenuation	Other?
OYL-106	German Lager I	Neutral	Low	++	Prone to sulfur
OYL-044	Kolsch II	Positive	Low	++	Prone to sulfur
OYL-004	West Coast Ale	Neutral	Low	++	Prone to diacetyl
OYL-052	DIPA	Neutral	Med – apricot/peach	++	Prone to diacetyl
OYL-061	Voss	Positive	Med – citrus/orange	++	Kveik
OYL-011	British V	Positive	High – banana/pear	+	Requires high oxygenation
OYL-200	Tropical IPA	Neutral	High – pineapple/bubblegum	+++	Diastatic

Juicy

Repitching: Best Practices

Consistency and quality!

- Timing, viability, healthy fermentation, generation number, storage time, contamination-free

Determining pitching rate:

- Wort - temperature, plato, oxygen, nutrients
- Flavor profile - ester, phenols, off flavors
- 0.5 - 2 million/ml/°P
- Kveik < Belgian < English/American < Lager

Methods for measuring your pitch:

- Volume < Weight < Percent Solids < Live Cell Counts
  - Volume - in line flow meter
  - Mass - load cells on brink, mass flow meter
  - Live Cell Counts - Aber PerfectPitch

Repitching: Know Your Yeast

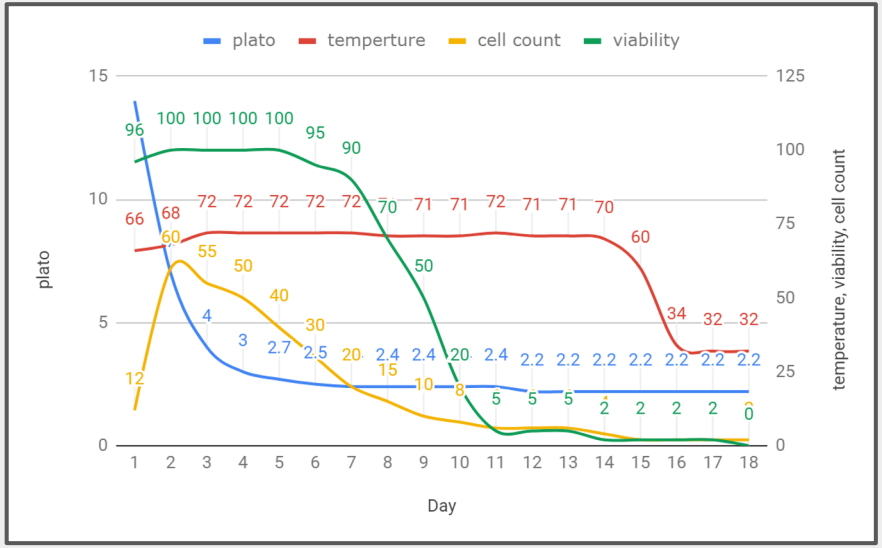
Track your data:

- Yeast source
- Generation number
- Diacetyl clearance times
- Harvest dates
- Dry Hop
- Crash Cool

Contamination checks:

- Yeast pitch
- 24hrs post pitch
- Bright beer tank
- Package

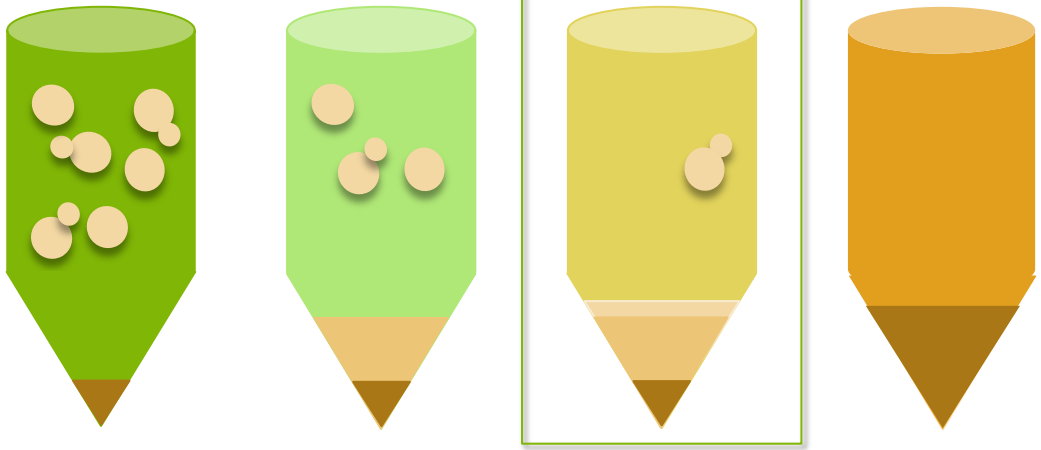
Daily Cellaring Records:



Gravity, pH, temperature, cell count, viability
***variations can indicate yeast stress or ageing

Repitching: Timing Harvest

Days post pitch	1-3	3-5	5-7	10+days
Viability	>90%	>90%	>90%	<50%
Flocculation	low	low	high	high
Diacetyl	high	high	med-low	low
Acetaldehyde	high	high	low	low
Plato to FG	>8°P	2-5°P	<0.5°P	0°P



Repitching by volume or weight

Protocol:

1. Dump trub and bottom layer of dark yeast
2. Perform sensory on your yeast
3. Sample yeast from brink or a representative sample from the cone
4. Degas sample
5. Dilute yeast sample 1:500 and mix well
6. Stain for viability (mix 1:2 in 0.01% methylene blue or 0.4% trypan blue)
7. Count live/dead cells in 4-4x4 grids
8. Calculate barrels or kilograms to pitch

Accuracy:

- Aim for 70-200 cells/4x4 grids
- Count from both chambers
- Recount if >15% variability

The Math:

% viability = (live cells/ total cell count) x 100

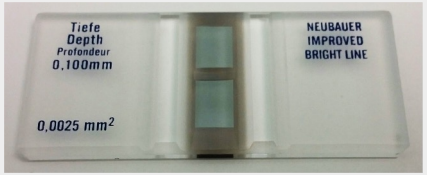
Dilution factor = 1000

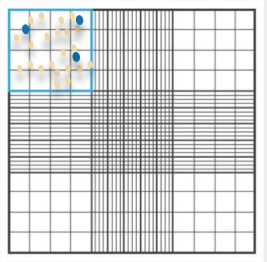
Cells/ml = dilution factor x live cell count 4x4 grid x 10^4

$$\text{BBLs to pitch} = \frac{\text{batch volume (BBL)} \times °P \times \text{pitching rate}}{\text{cell concentration}}$$

$$\text{Slurry density} = \frac{\text{weight of degassed sample}}{\text{Volume (L)}}$$

$$\text{Kgs to pitch} = \frac{\text{batch volume (L)} \times °P \times \text{pitching rate} \times \text{density}}{\text{cell concentration}}$$





4x4 grid = $1/10^4$ ml

How Many Strains for Optimal Repitching?

Rule of thumb:

<u>Kveik (some British Ales)</u>
14-18 day turn time
2.5 fermenters per strain

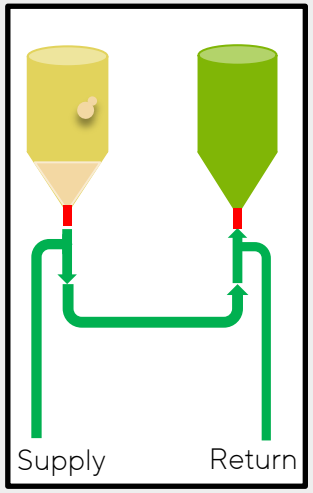
<u>Standard Ales</u>
18-21 day turn time
3 fermenters per strain

<u>Quick Lagers</u>
21-28 day turn time
4 fermenters per strain

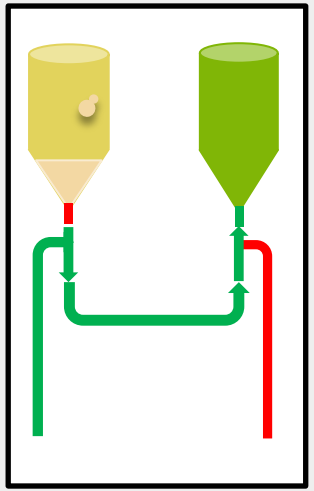
Easy Method for Repitching

Cone to Cone

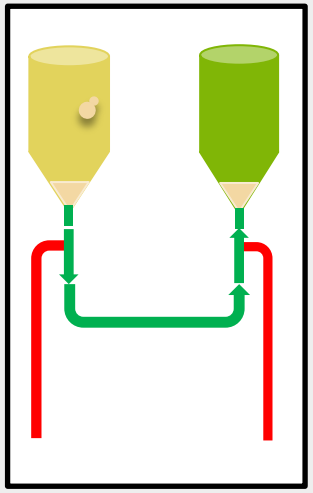
1. Sani and Chase Sani



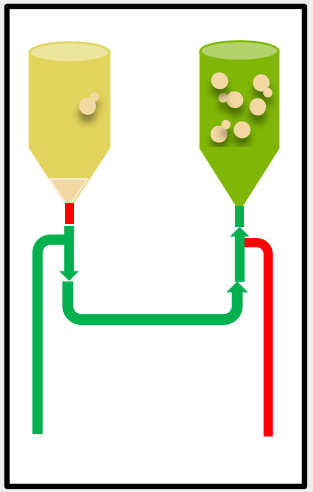
2. Wort Transfer



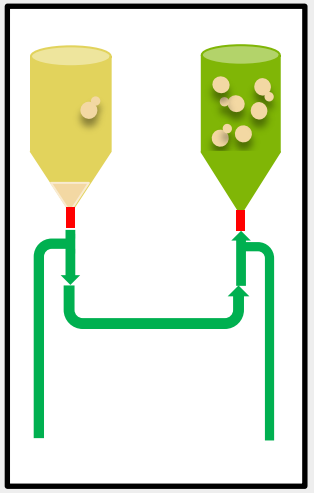
3. Pause Transfer and Pitch Yeast



4. Wort Transfer and Water Chase



5. Rinse and CIP

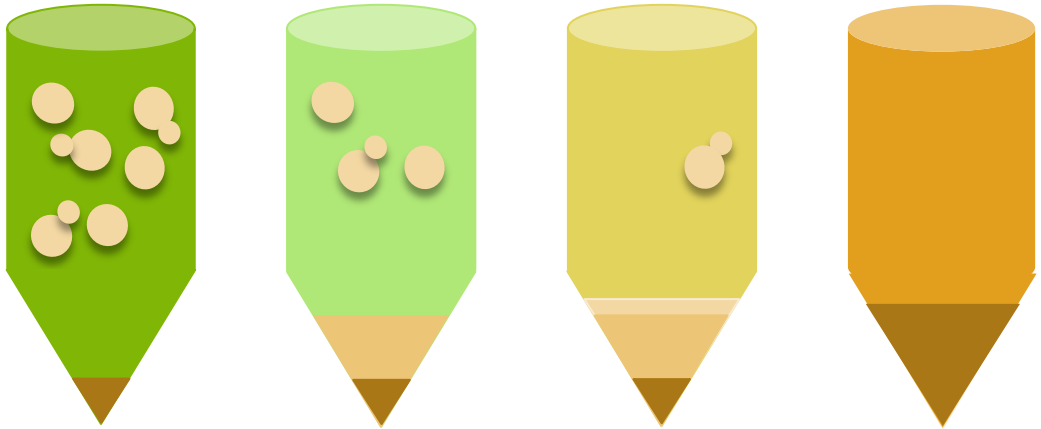


Tips:

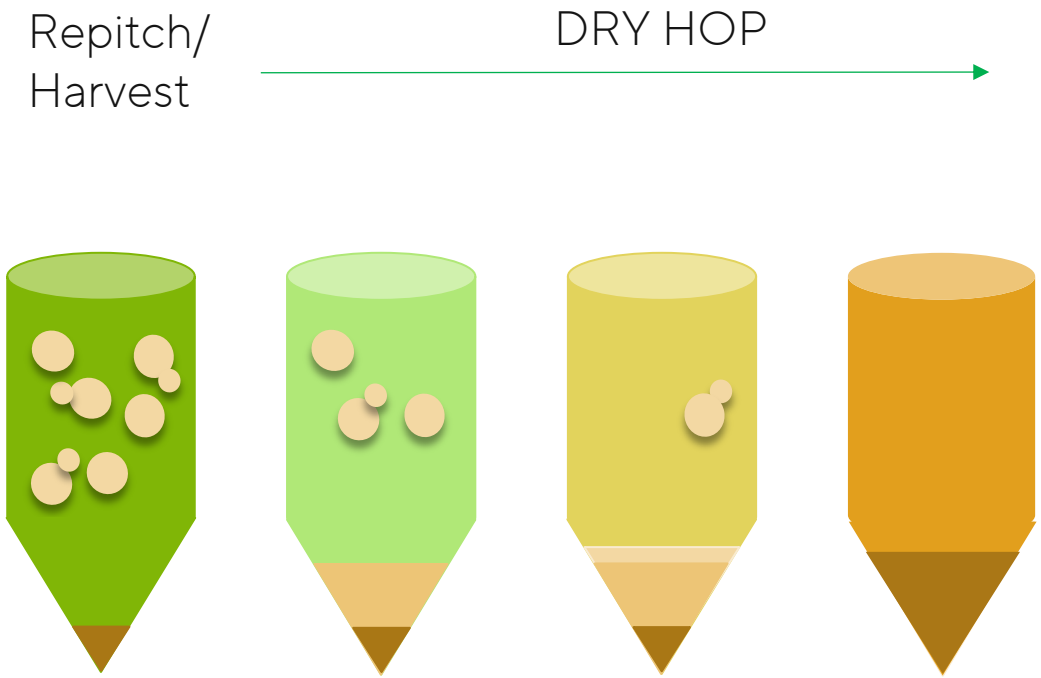
- Mix and transfer sanitizer from the whirlpool
- Don’t draw off too quickly, beer will punch through the yeast slurry
- Use sight glasses at each tank to watch yeast slurry transfer
- COUNT YEAST AND VIABILITY BEFORE SANITIZING TRANSFER LOOP

Harvesting From the Cone for Late Fermentation Dry Hopping

Do not dry hop → Repitch/ Harvest → DRY HOP



Top Cropping for Early-Mid Fermentation Dry Hopping



Developed by Jessica Young:

Serial Repitching Method for New England IPAs with Midfermentation Dry Hopping. MBAA TQ vol 58, no. 2, 2021

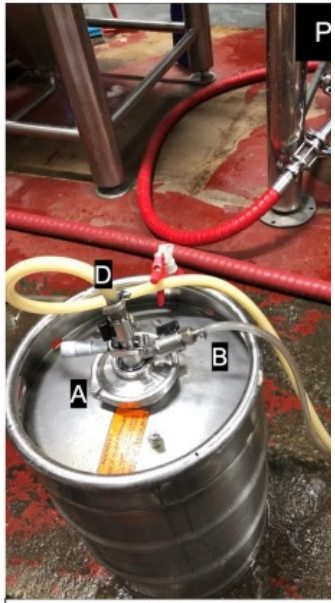
Harvest basics:

1. Connect CO2 to racking arm and fresh blow-off hose to blow-off arm.
2. Put opposite end of blow-off hose into modified keg.
3. Push CO2 into tank until slurry comes out of hose.
4. Seal.

Pitch basics:

1. Attach CO2 to headspace portion of keg coupler.
2. Attach 1.5 in tri-clamp to bottom of cylindroconical vessel.
3. Use CO2 to push yeast into tank.

open and sitting underneath
sealed
the racking arm
yeast for testing



(A) Sealed SABCO 4" stem connection with keg c
(B) CO_2 pushing into the headspace section of the
(C) Keg filling hose connected to the bottom of the
(D) Keg filling hose connected to the stem of the c

OMEGA YEAST

Repitching: Yeast Storage

Vessel:

- Yeast brink, repurposed fermentor, kegs
- Easily CIP and bonus to steam
- Method to measure fill volume/weight
- Mixing and sampling options

Method:

- Harvest yeast at peak viability
- No acid washing
- Store at 0-4°C
- Keep under CO_2 and with 2-3 psi head pressure
- Storage time varies by yeast strain
    - 2 days to 2 weeks
- Option: feed to rouse/wake yeast prior to pitching (6-8°P sterile wort)

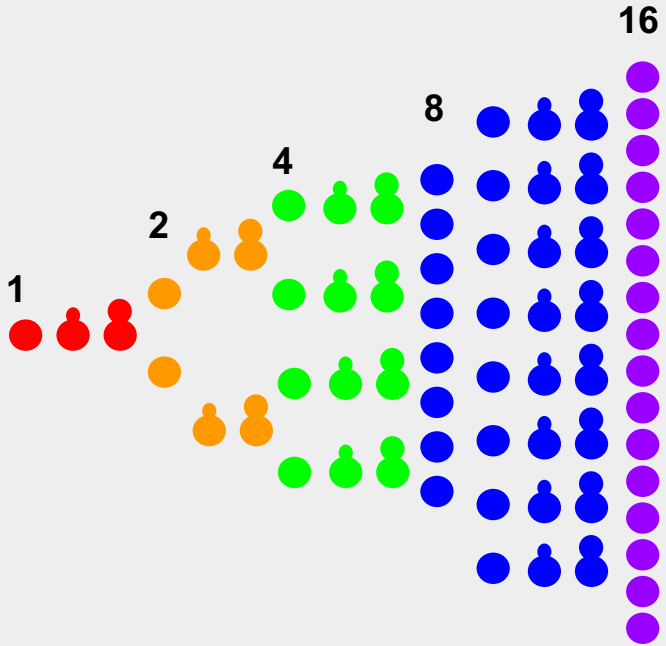
Yeast Propagation

Advantages:

- Fresh yeast at peak activity
- Flexibility when managing multiple yeast

Disadvantages:

- Equipment costs
- Knowledge and expertise
- Higher degree of hygiene and quality control required



Propagation: in the lab

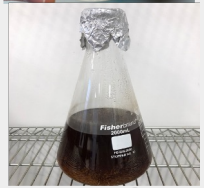
Equipment

- -80°C freezer
- laminar flow hood
- dedicated space (positive pressure room)
- shaker table
- incubator
- autoclave

Rely on your yeast supplier

- Labor! 6-7 days to scale to brewery
- Equipment costs
- Higher level of hygiene is required
- Knowledge and expertise

STAGE 1: THE LAB



Glycerol stock -80°C

↓

Petri dish

↓

Step up cultures (2-3 times)

↓

Carlsberg flask or bioreactor

Propagation: in the brewery

Propagation tank

- Agitator or circulation loop
- Aeration
- CIP and option to steam
- Glycol jacket
- Load cell/flow meter/fill level probe

Wort

- 10 to 12°P
- Zinc 0.2 mg/L
- FAN 200 mg/L
- 1/10th volume of fermentation

Quality Control

- Cell counts/biomass
- Plato/pH/FAN
- Contamination

STAGE 2: THE BREWERY

Yeast QC Lab Setup

1. Counts/viability
2. Micro testing
3. Lab on a budget tips
4. Things to watch out for!

Lab setup: cell counts/viability

Equipment:

- Brightfield compound microscope with 40x objective
- Hemocytometer
- Micro-pipettor (p20, p1000)
- Stir plate
- Graduated cylinders and beakers

Viability Stain:

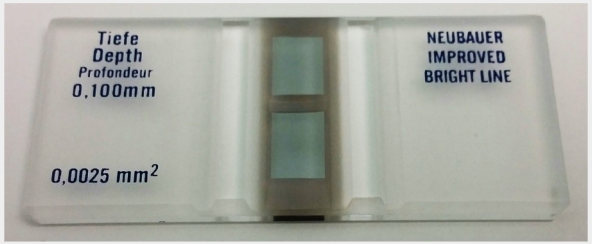
- 1% Methylene Blue stock (use at 0.005%)
- 0.4% Trypan Blue stock (use at 0.2%)

Consumables:

- Pipet tips
- 50 ml conicals
- Eppendorf tubes

Alternatives:

- Automated cell counters $$$



Lab setup: Yeast Micro QC

Equipment:

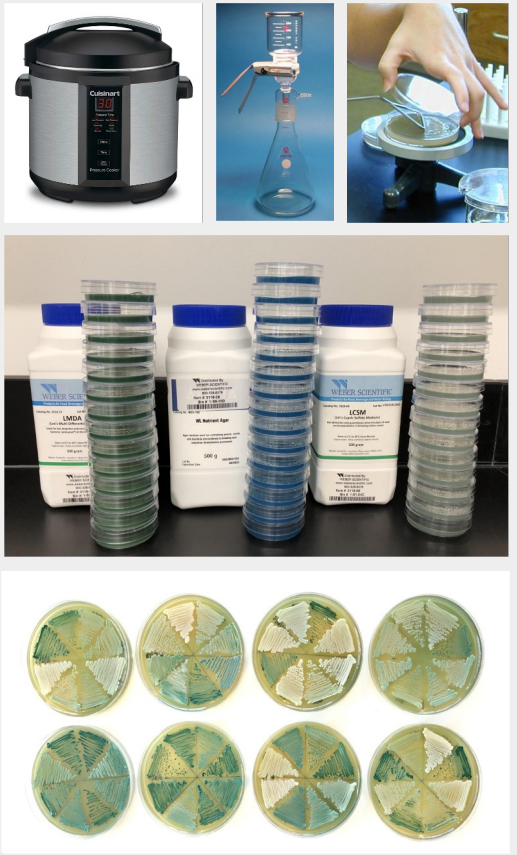
- Pressure cooker (15 psi, 120C)
- Filtration apparatus and 0.45um MCE filters
- Glass spreader
- Flame

Media

- LMDA: bacterial contamination
- WLN: pure culture or yeast contaminant
- LCSM: STA1+ diastaticus yeast and wild yeast

Methods for Identification

- Traditional: gram stain, catalase, oxidase, morphology
- PCR: endpoint, qPCR
- Sequencing: 16S rRNA gene (bacteria), ITS region (yeast/molds)



Insider Tips for Stocking a Lab on a Budget

If an item or reagent has a use outside of a lab environment...

...there is likely a more cost-effective option.

Insider Tips for Stocking a Lab on a Budget

Anaerobic Chamber

$0.62/pack

$6.40/pack

Insider Tips for Stocking a Lab on a Budget

Agar

From Amazon = $0.07/g

From Lab Supplier = $0.62/g

Insider Tips for Stocking a Lab on a Budget

10 quart electric pressure cooker

$100

25 quart pressure cooker All American

$300

Hirayama HVA-110

$15,000

Low Cost Preventative Measures - Forced Wort

About $0.08 per unit.

Whirl-paks for checking sanitation of wortway, aeration setup, fermenter, etc.

Important to use sterile air filters and check valves on aeration setup.

Steaming aeration setup and/or hot SIP for wortway is ideal

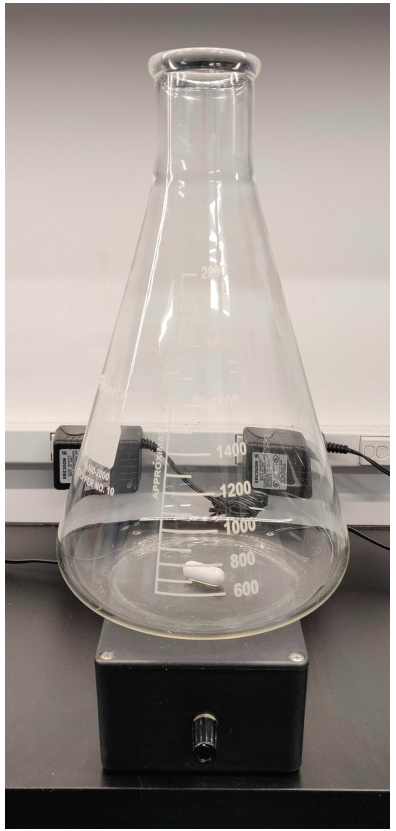
Low Cost Preventative Measures – Forced Fermentation

Ideal for testing fermentability of wort.

Stalled/sluggish fermentations can be an indication of:

1. Poor yeast health, oxygenation issues or low pitch rate
2. Mash conversion issues and poor wort fermentability

Note: does not always match final gravity of batch. Diastatic strains will often finish higher in forced fermentations. Dry hop creep isn't accounted for in forced fermentations.



Things to watch out for...
Off Flavors

Off Flavor	Aroma/Sensory	Normal	Not Normal
Acetaldehyde	Green apple, cut pumpkin, grassy	Early in fermentation with lagers or underpitch, “green beer”	Yeast is struggling to finish fermentation, stress
Hydrogen Sulfide	Rotten egg	Low amounts in lagers	Underpitched or lacking nutrient, fermentation temperature too low
Diacetyl (2,3 butanedione)	Butter, butterscotch, buttered popcorn	Early in fermentation, low amounts in English ales or Czech lagers	Yeast is unhealthy, or hop creep occurring later in packaged product
4-Vinyl Guaiacol	Clove, spicy	Belgian styles, German Hefeweizen	POF+ contamination in American styles, English styles, and Lagers.
Autolysis	Savory, meaty, chalky, soy sauce	Never	Yeast after fermentation is not removed from the beer
Fusel Alcohol	“hot”, harsh alcohol	Never	Fermentations are too warm
Ethyl Acetate	Nail polish remover, solvent	Small amounts, more pleasant sweet fruity	Wild yeast contamination, fermentations are too warm

Things to watch out for... Diastatic Yeast

Widely used brewing strains

- Belgian, weizen, tropical IPA...

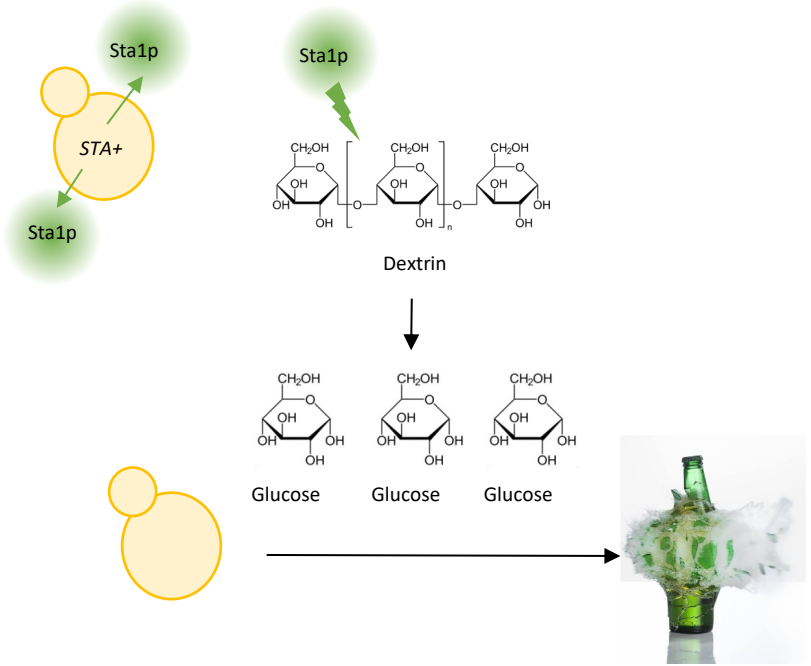
Brewery contaminant

- Ferment dextrins
- Risks: hyperattenuation, off flavors, out of spec ABV/CO2 and exploding packaged product

What makes *S. cerevisiae* diastatic?

- STA1, STA2, STA3 genes

STA+ strains secrete an α-glucosidase



Many standard belgian strains are diastatic!

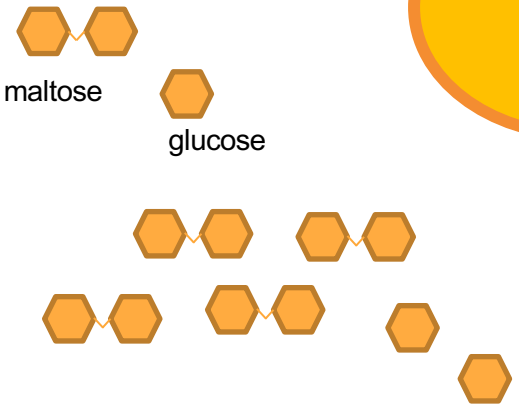
Strain Source	Omega #	Attenuation	*STA+*	*uasΔ*
Belgian Ale D	OYL-019	+	yes	yes
Bavarian Wheat	OYL-025	+	yes	yes
French Saison	OYL-026	+++	yes	no
Belgian Saison I	OYL-027	+	yes	yes
Jovaru	OYL-033	++	yes	no
Biere de Garde	OYL-039	++	yes	no
Belgian Saison II	OYL-042	+	yes	yes
Belgian Golden Strong	OYL-056	+++	yes	no
Tropical IPA	OYL-200	++	yes	yes
Saisonstein's Monster	OYL-500	+++	yes	no
Gulo	OYL-501	++	yes	no

Alternative yeasts for “Saison” or dry Belgian styles

- Yeast hybrids bred to maintain the Saison/Belgian ester profile but no longer have the *STA1* gene
- Other traditional Belgian strains (Trappist yeast)
- Yeast engineered to remove the *STA1* gene

*additional enzymes will be needed to achieve the attenuation rates >85

Things to watch out for… Hop Creep



Refermentation!

CO_2

ABV

Diacetyl

OMEGA YEAST

Part 2: Yeast and Hops

1. Dry Hop Creep
2. “Haze-positive” Yeast

HOP CREEP: A LITTLE HISTORY

1893 Horace T. Brown “Freshening Power of Hops”

1941 Janicki et al. “Maltase in Hops”

2017, and 110 years later… “Hop Creep”

Shellhammer Lab, Allagash, Bell’s, Russian River …
Hop diastase enzymes and refermentation in dry hopped beers

Horace T. Brown.

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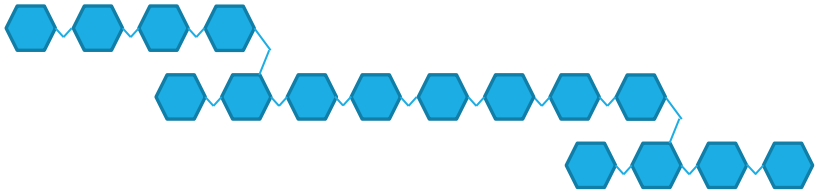
CURRENT UNDERSTANDING OF HOP CREEP

Finished beer

Unfermentable dextrin/maltodextrin



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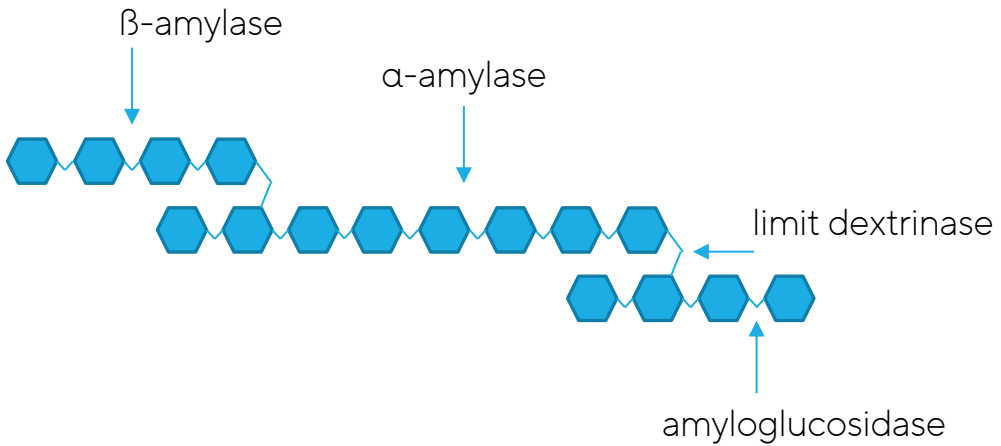
CURRENT UNDERSTANDING OF HOP CREEP



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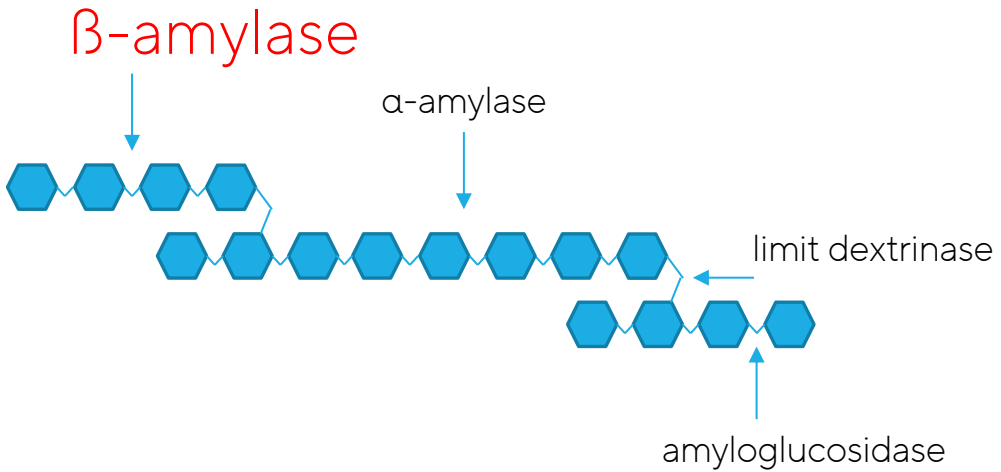
CURRENT UNDERSTANDING OF HOP CREEP



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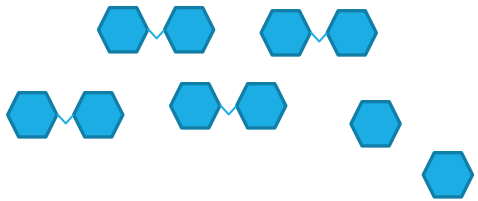
CURRENT UNDERSTANDING OF HOP CREEP



Refermentation!

CO_2

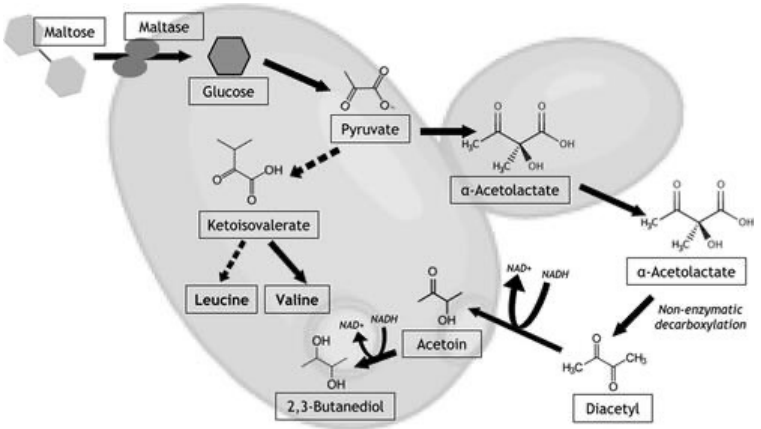
ABV

Diacetyl

OMEGA YEAST

WHAT VARIABLES IMPACT HOP CREEP: YEAST

- Certain yeast are prone to diacetyl
  - Lager
  - Chico
  - English Strains
- Not correlated to flocculation
- Yeast engineered to prevent diacetyl formation!



James Bruner, UC Davis/Creature Comforts

OMEGA YEAST

WHAT VARIABLES IMPACT HOP CREEP: YEAST ATTENUATION

Attenuation – how much of the glucose, sucrose, fructose, maltose and maltotriose is fermented

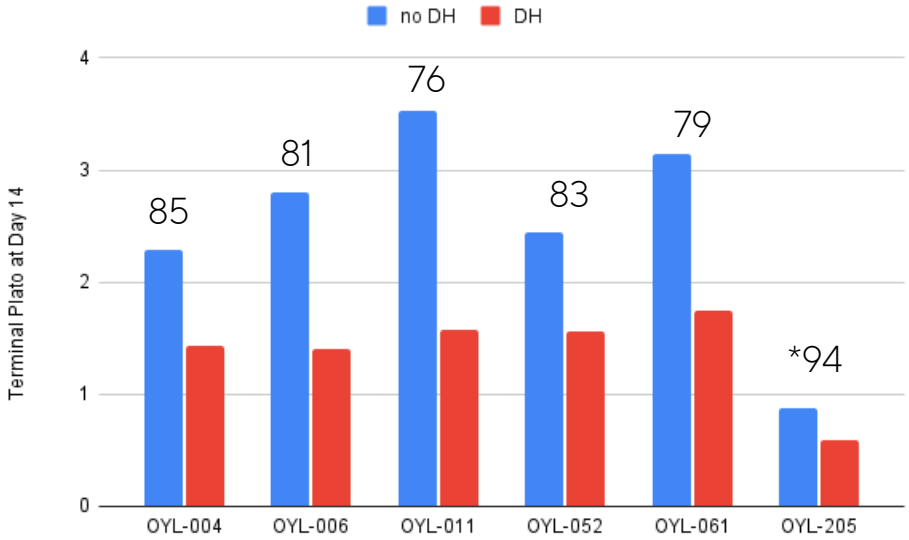
West Coast Ale I – high 85%

British Ale V – low 75%

Larger degree of hop creep with:

Lower attenuating yeast

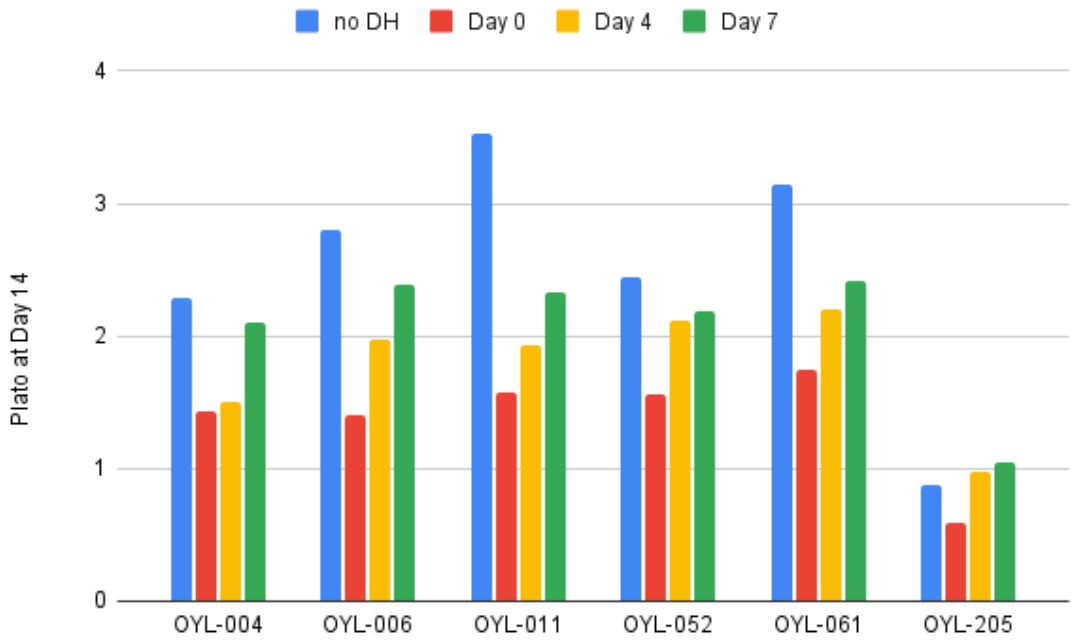
Less fermentable wort (mashing high)



dry hopped samples attenuated 88-90%

WHAT VARIABLES IMPACT HOP CREEP: DRY HOP TIMING

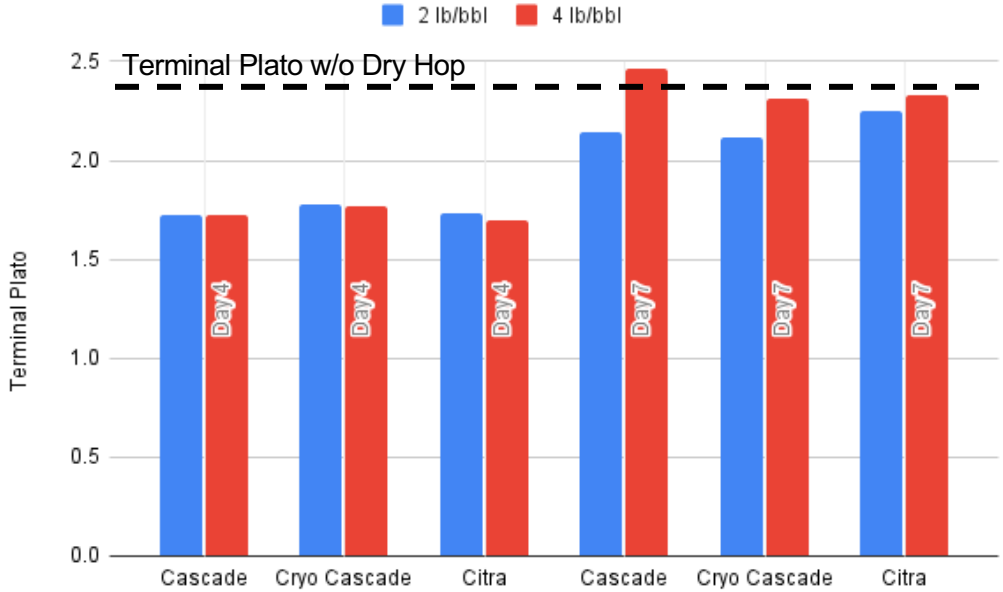
- Early Dry Hop (Day 0) allows hop creep to coincide with fermentation
- Late Dry Hop (Day 7) results in incomplete hop creep and slower diacetyl clearance



Flask were all dry hopped at 2 lb/bbl, and terminal platos were measured at day 14.

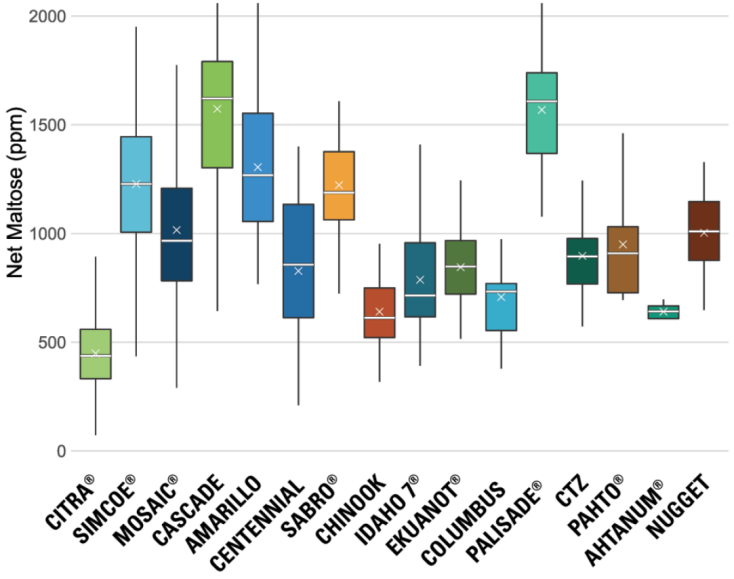
WHAT VARIABLES IMPACT HOP CREEP: DRY HOP RATE

Larger dry hopping rates at the end of fermentation can delay hop creep even further… consistent between varieties.



WHAT VARIABLES IMPACT HOP CREEP: HOPS

- Variety
  - Ex. Citra low, Cascade high
- Hop Products
  - Extracts < Cryo < T90
- Processing/Handling
  - Kilning
  - Storage
- Agricultural Influences
  - Terroir
  - Crop Year



Rob Ring, Yakima Chief

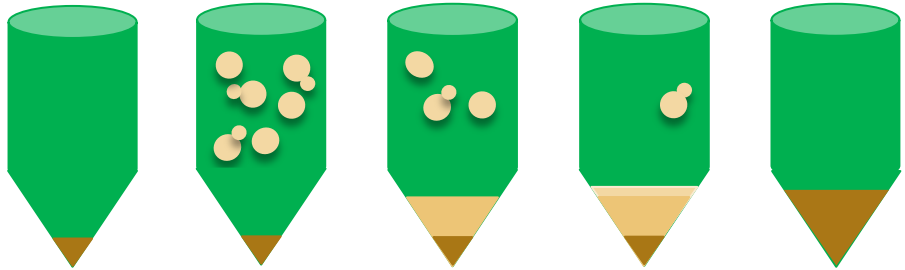
OMEGA YEAST

METHODS TO MITIGATE HOP CREEP

- Limit Potential
  - Use hops with high diastase activity in the whirlpool, and low diastase activity for the dry hop
  - Target more conversion in the mash
  - An early charge of dry hop can minimize creep potential of later additions
- Ride it out
  - Time dry hop for when yeast is still active (pre-diacetyl rest)
- Prevent it with a cold, short dry hop
  - Little risky if enzymes have a chance to convert later in warm storage
- Pasteurize/Inactivate hop enzymes
  - Either direct inactivation of hops (sous-vide trials)
  - Very low PU targets with a flash pasteurizer can be used to inactivate enzymes

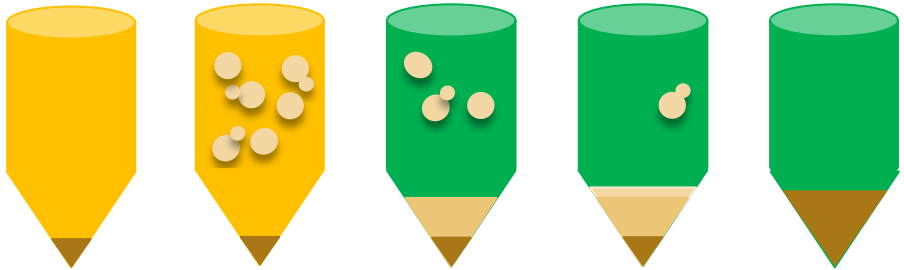
METHODS TO MITIGATE HOP CREEP

Limit Potential: Early Dry Hop Charge



Hop enzymes are active during fermentations

Ride it out: Mid-Late Dry Hop



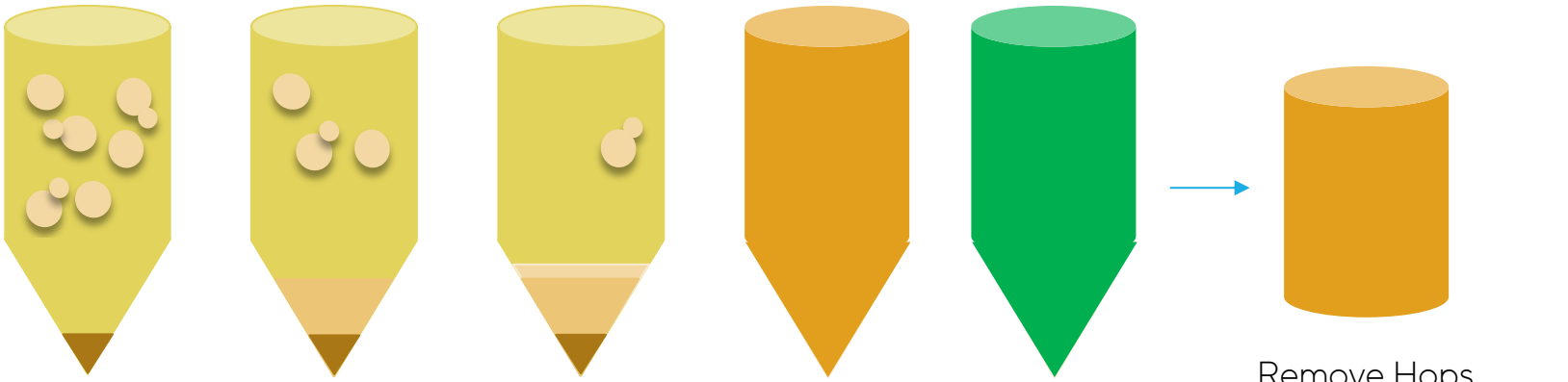
Try and harvest yeast, but still have some fermentation activity

OMEGA YEAST

METHODS TO MITIGATE HOP CREEP

Prevent: Cold, Short Dry Hop:

Dry Hop cold 24-48 hour

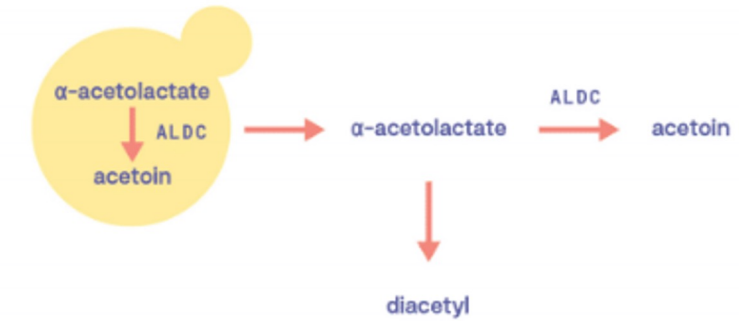


Finished/Cleared VDK
Crash and Drop Yeast

Remove Hops
(maybe flash pasteurize)

OMEGA YEAST

ALDC-EXPRESSING YEAST



ALDC in cell converts α-acetolactate directly to acetoin; without ALDC α-acetolactate is excreted and becomes diacetyl OR with exogenous ALDC, it becomes acetoin in the beer.

Circumvents the production of diacetyl!

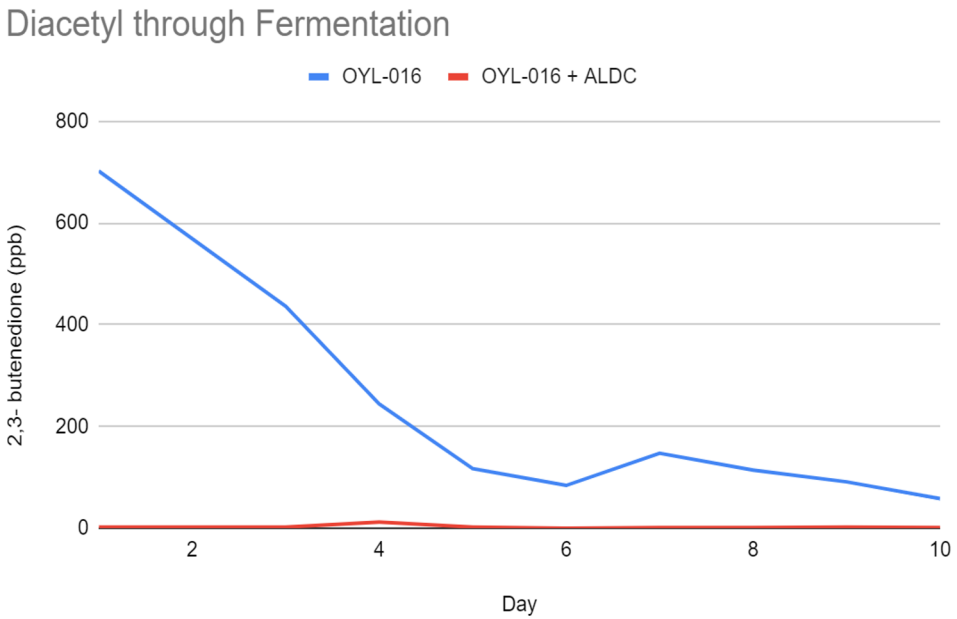
Not a band aid for poor yeast management

ALDC does not reduce diacetyl, but prevents the formation of diacetyl

Applications:

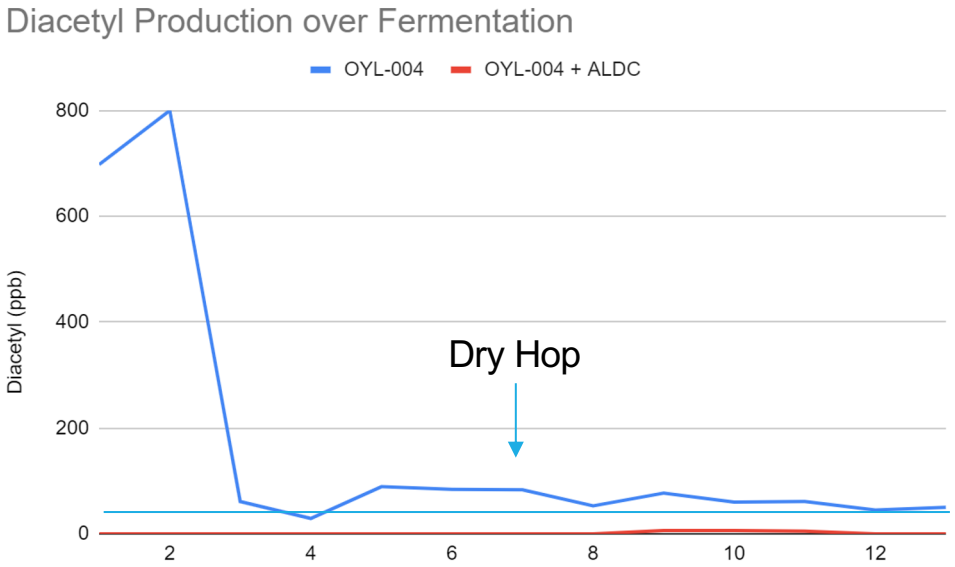
- Strains with elevated diacetyl production
- Lagers for faster turnaround
- Dry hopped beers

ALDC-EXPRESSING YEAST



1. OYL-016 or the classic “ESB” yeast, is prone to diacetyl production.
2. With endogenous expression of ALDC, diacetyl levels are nearly undetectable and never reach sensory threshold.

ALDC-EXPRESSING YEAST



1. Tailing issues with diacetyl as a result of hop creep are circumvented with ALDC-expressing yeast

YEAST AND HAZE

- Malt, Hops and YEASTall impact haze.
- Certain “haze-positive” yeast strains are better at promoting haze in dry-hopped beer styles

Maplewood Brewery & Distillery. Chicago, IL

Haze – Yeast Choice and Dry Hop Timing

Haze Positive
OYL-011
British V, London III

Dry Hop Timing

Haze Neutral
OYL-004
West Coast Ale I, Chico

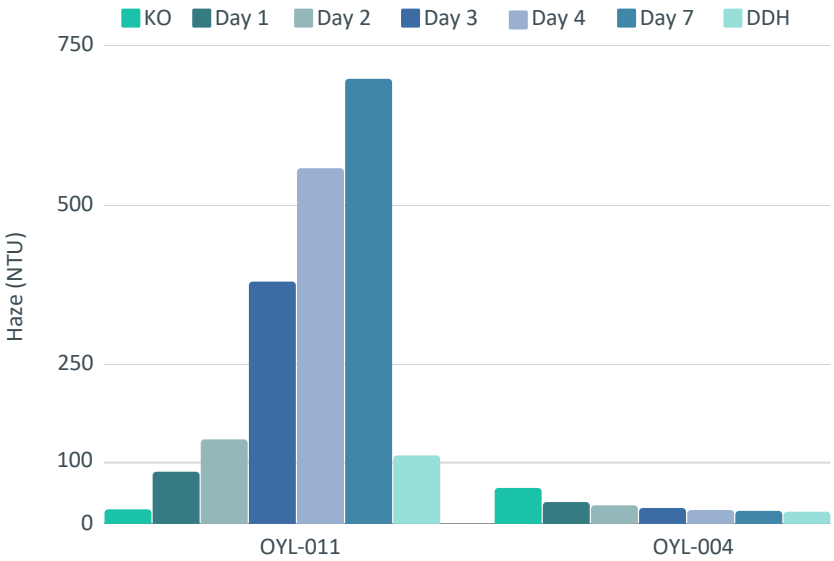
Dry Hop Timing

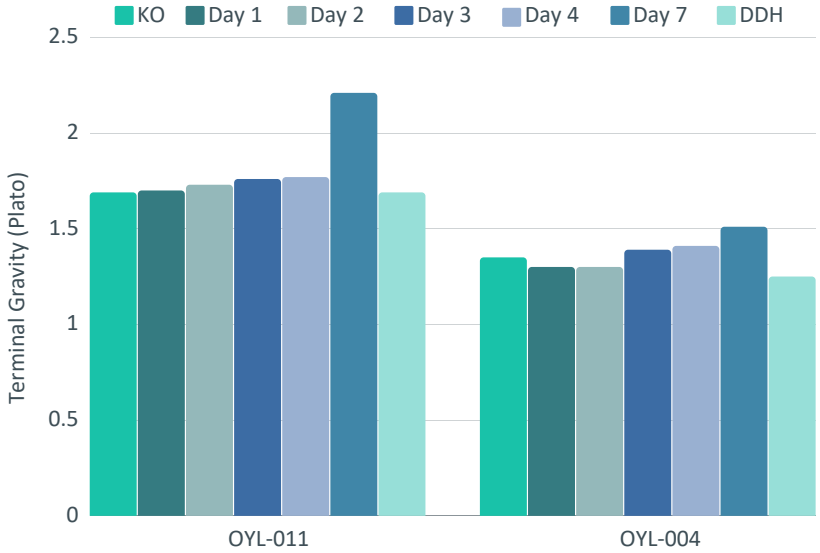
Pictures at 14 days from left to right:

Control (no dry hop)
Day 0 "Knockout"
Day 1
Day 2
Day 3
Day 4
Day 7
DDH (Day 1 and 7)

OMEGA YEAST

Haze – Yeast Choice and Dry Hop Timing





OMEGA YEAST

Which strains are Haze Positive?

Haze Positive

Hazy IPA strains/Hefe/Kolsch

- OYL-011 British V (Juice/London III/Foggy London)
- OYL-017 Kolsch I
- OYL-032 East Coast Ale
- OYL-061 Voss Kveik
- OYL-043 Point Loma
- OYL-015 Scottish Ale
- OYL-005 Irish Ale
- OYL-021 Hefeweizen
- OYL-044 Kolsch II
- OYL-006 British I

Haze Neutral

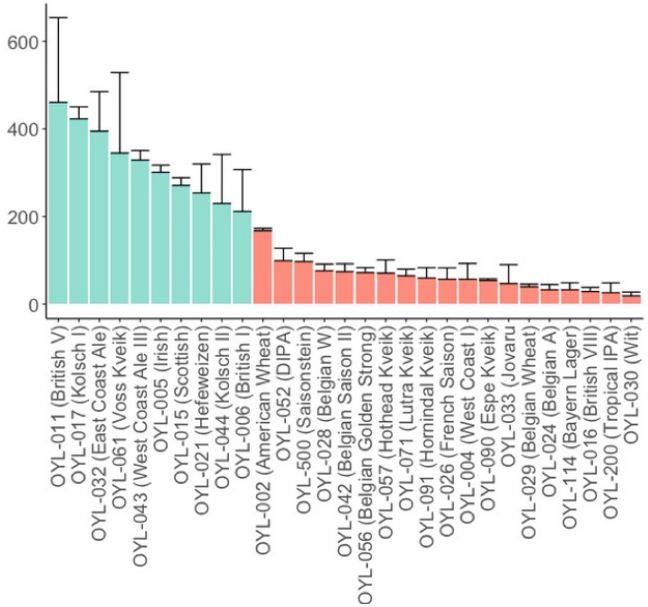
American IPA strains

- OYL-004 West Coast I (Chico)
- OYL-052 DIPA Ale (Conan)
- OYL-200 Tropical IPA

Other Strains

- OYL-030 Belgian Wit
- OYL-024 Belgian Ale
- OYL-071 Lutra Kveik
- OYL-016 British Ale VIII (Fullers)
- OYL-091 Hornindal Kveik
- OYL-057 Hothead Kveik
- OYL-114 Bayern Lager

Haze (NTU) with 2 lb/bbl dry-hop addition at day 7



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TAKEAWAYS

- Hop creep happens and it is manageable!
- Think about changing your yeast strain and/or approach if you continue to see stubborn diacetyl or trailing fermentations on tanks.
- Choose the right yeast and dry hop timing for hazy or non-hazy beer styles
- Yeast management can be flexible and work with both early and late dry hopping.

	Hop Creep	Haze	Repitching
Early (<25% attenuation)	Fast	Reducing	Top cropping
Mid (2-5°P to terminal)	Fast	Promoting	Top cropping
Late (at or post terminal)	Slow	Promoting	Bottom cropping

OMEGA YEAST

Thank you!!

The Omega Yeast Crew

Contact:

Laura Burns, PhD

laura@omegayeast.com

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