

# Yeast Pitching

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# Quick Poll + Definition

What's everyone doing?

- Ales vs lagers
- Liquid yeast vs dry yeast
- Low/normal gravity vs high gravity
- Current methods (calculators, # packets, weight, volume)
- Wort oxygenation

## **What is pitch rate?**

Pitch rate is effectively how much yeast you pitch into your wort

# Why do we care about pitch rate in the first place?

- Yeast is a sensitive living organism
- Happy yeast makes good beer
  - **“Brewers make wort, yeast makes beer”**
- No single pitch rate suits all beers. It is highly variable.
- There are many factors to consider when determining ideal pitch rate

# Under-pitching

- Longer lag phase
  - Delayed pH drop
  - Higher chance of contamination taking over
- Slow, lazy fermentation
  - Yeast might not clean up diacetyl and acetaldehyde
  - Possible stuck fermentation (doesn't reach FG)
- Off flavors from yeast stress and autolysis (yeast cell death)
  - Phenols (clove, band-aid, smoky, plastic, medicinal)
  - Yeasty, meaty, umami, soy sauce from autolysis
  - Sulfur compounds (rotten eggs)
- More growth per cell. Increased cell growth/reproduction increases:
  - Higher alcohols (fusel alcohol) - can be solventy and hot
  - Esters (banana, pear, apple etc.)
  - Sulfur compounds (and less cleanup of them)

# Over-pitching

- Decreased growth/reproduction = decreases esters and fusels
- Under attenuation
  - Premature flocculation
  - Possible reduced late sugar (maltotriose) uptake - higher FG than intended
  - Low cleanup - acetaldehyde and diacetyl risk
- Over attenuation
  - Lower body
  - Higher ABV
- Residual sulfur
  - If you ferment fast and then cap the fermenter, you'll trap the volatile sulfur in
- Lower final viability %
  - Bad if you're re-pitching
- More yeast = higher chance of autolysis

# Pitch Rate Formula

How many cells to pitch?

Targets are given in units of:      Million cells / mL / °P

Style	Gravity	Pitch rate (million cells/mL/°P)
Ales	$\leq 1.060$	0.75–1.0
High Gravity Ales	$> 1.060$	1.0-1.25
Lagers	$\leq 1.060$	1.25–1.5
High Gravity Lagers	$> 1.060$	1.5-2.0

# Million cells / mL / °P - What does this mean?

This is X million cells for every mL, and for every degree Plato

To calculate the # of cells required to meet this pitch rate, multiply the rate by the volume (mL) and gravity (°P)

Ex. Standard Ale 68°F, 5 Gallons, 1.050 OG, target pitch rate of 0.75 M cells/mL/°P

1. Convert units (use an online calculator for SG to Plato)
  - 5 Gallons = 18927 mL (mL = Gallons \* 3,785.41)
  - 1.050 SG = 12.5 °P    °P = (-616.868) + (1111.14\*SG) - (630.272\*SG<sup>2</sup>) + (135.997\*SG<sup>3</sup>)
2. Calculate target cell count
  - **0.75 \* 18927 mL \* 12.39 °P = 176 million cells**

# Hold on, this is America

Style	Pitch rate (million cells /mL/°P)
Ales	0.75–1.0
High Gravity Ales	1.0-1.25

Let's convert Million cells / mL / °P to something more useful

Take the middle of the ale pitch rate of **1.0 M** cells / mL / °P

1 Gallon = 3785.41 mL, Approximate °P  $\approx$  SG points / 4 (1.050 SG = 50 SG points)

1. Convert mL to gallons in the formula
  - a.  $(1.0 * 10^6 \text{ cells/mL/°P}) * (3.785 * 10^3 \text{ mL/gallon}) = 3.785 * 10^9 \text{ cells/gallon/°P}$
2. Convert Plato to SG points
  - a.  $3.785 * 10^9 \div 4 = 9.46 * 10^8 \text{ cells/gallon/SGpoint}$
3. Round up slightly to get nice units
  - a.  **$9.46 * 10^8 \approx 1 * 10^9 = 1 \text{ Billion cells / gallon / SGpoint}$**

**Target # cells is simply: (# Gallons \* SGpoints) billion cells**

Example: 5G batch of 1.050 ale =  $5 * 50 = 250$  billion cells

# Examples

Using 1.0 M cells / mL / °P approximation of 1.0 B cells / gallon / SGpoint

5 Gallons of 1.042:  $5 * 42 = 210$  billion cells

5 Gallons of 1.068:  $5 * 68 = 340$  billion cells

15 Gallons of 1.068:  $15 * 68 = 1020$  billion cells

It also scales linearly to other pitch rates

0.75 M cells / mL / °P  $\approx$  0.75 B cells / gallon / SGpoint

5 Gallons of 1.042:  $0.75 * 5 * 42 = 157.5$  billion cells

1.5 M cells / mL / °P  $\approx$  1.5 B cells / gallon / SGpoint

5 Gallons of 1.042:  $1.5 * 5 * 42 = 315$  billion cells

Style	Pitch rate (million cells /mL/°P)
Ales	0.75–1.0
High Gravity Ales	1.0-1.25
Lagers	1.25–1.5
High Gravity Lagers	1.5-2.0

NOTE: because of the approximations, this is usually a 5-10% overpitch

# Determining # Cells in Your Packet

Check the vendor specs to determine how many cells are in the package

White Labs Next Generation liquid pouches: ~150B cells

White Labs dry packet: ~100B cells

Wyeast liquid smack packs: ~100B cells

Omega Yeast packs: ~150B cells (manufacturer states 150-500B)

SafAle US-05 11.5g dry packet: ~200B cells (manufacturer simply states  $\geq 69B$ )

SafLager 34/70 11.5g dry packet: ~200B cells (manufacturer simply states  $\geq 69B$ )

To complicate things, manufacturers might put more cells in the package to account for some of them dying. Investigate this carefully.

# Cell Viability

When determining how much to pitch, you need to consider how many of those cells are still alive.

Old or mishandled yeast will have low viability. This drops VERY quickly.

Liquid yeast: Assume 20% death per month under good conditions (stable refrigeration, NOT freezing)

Dry yeast: No cell death if refrigerated or frozen and used within a year (or longer)

Example: White Labs WLP001 NextGen pouch that is 2 months old

1. Lookup vendor spec - 150B cells per packet to start
2. Subtract 20% for each month.  $100\% - (2 * 20\%) = 60\%$  remaining.  
 $150B * 0.6 = 90B$  live cells in your packet

# Full Example - Ale 0.75 B cells / Gallon / SGpoint

How many packets do we need for the following?

5 Gallons, 1.050 OG, ale pitch rate of 0.75 B cells / Gallon / SG point  
Liquid WLP001 yeast, 150B cells, 2 months old

1. Calculate required cells

a. Required cells =  $0.75 * 5 * 50 = 187.5$  billion cells

2. Calculate viable cells in each pack of yeast

a. WLP001 2 months old = 60% of 150B cells = 90B cells / packet

3. Calculate number of packets needed

a. Required cells / cells per packet

b.  $187.5B / 90B = 2.08 \approx 2$  packets

# Example - High OG Lager 1.75 B cells / Gallon / SGpoint

5 Gallons of Doppelbock, 1.100 OG, pitch rate of 1.75 B cells / Gallon / SG point

Liquid Wyeast 2206 Bavarian Lager, 100B cells, 3 months old, \$14/packet

1. Calculate required cells
  - a. Required cells =  $1.75 * 5 * 100 = 875$  billion cells
2. Calculate cells in each pack of yeast
  - a. WY2206 3 months old = 40% of 100B cells = 40B cells / packet
3. Calculate number of packets needed
  - a. Required cells / cells per packet
  - b.  $875B / 40B = 21.875 \approx 22$  packets
  - c.  $22 \text{ packets} * \$14/\text{packet} = \$308$  

WAIT.... WHAT???

# Example - High OG Lager 1.75 B cells / Gallon / SGpoint

5 Gallons of Doppelbock, 1.100 OG, pitch rate of 1.75 B cells / Gallon / SG point

Dry SafLager 34/70 11.5g packet, 200B cells, \$8/packet

1. Calculate required cells
  - a. Required cells =  $1.75 * 5 * 100 = 875$  billion cells
2. Calculate cells in each pack of yeast
  - a. Dry SafLager 34/70 retains 100% viability = 200B cells / packet
3. Calculate number of packets needed
  - a. Required cells / cells per packet
  - b.  $875B / 200B = 4.4 \approx 4$  packets (keep in mind our B cells/Gal/SGpoint approximation estimates high, so it's safe to drop down from 4.4 to 4 packets)
  - c.  $4 \text{ packets} * \$8/\text{packet} = \$32$  

Dry yeast saves the day

# Yeast Starters

What if I want to use that fancy German lager yeast that is only sold in liquid form to brew my doppelbock?

You need to make a starter.

My favorite way to do this is to brew a smaller beer first.

Example:

Brew a full 5G of Vienna Lager of 1.050 OG

Re-use this yeast cake for your 5G of Doppelbock at 1.100 OG

You can rack off and onto the yeast cake in the same fermenter if your sanitation practices are good and you're not getting a lot of trub in the fermenter.

Do NOT re-use yeast from a high gravity batch. Toss the yeast from the Doppelbock.

# Calculators

In practice, just use an online calculator

This one is my favorite:

<https://www.brewersfriend.com/yeast-pitch-rate-and-starter-calculator/>

You specify liquid vs dry yeast, OG, pitch rate, and volume. It tells you how many cells you need, and how big your starter needs to be (if you need one)

If making a starter, ensure you select whether it's on a stir plate or not. This makes a massive difference in the final cell count.

### Yeast Pitch Rate:

Units:  US - Gallons / oz  
 Metric - Liters / g

Sugar Scale:  Gravity (1.xxx)  
 Plato °P

Wort Gravity (OG):  (1.xxx)

Wort Volume:  Gallons

Target Pitch Rate:  (million cells / ml / degree plato)

Yeast Type:

Liquid Packs:  (packs/vials)

Mfg Date:  (yyyy/mm/dd)  
*Date yeast pack was made.*

Viability: Yeast is 93 days old, the viability is estimated at 35%

**Cells Available:** 35 billion cells

**Pitch Rate As-Is:** 0.15M cells / mL / °P

**Target Pitch Rate Cells:** 352 billion cells

**Difference:** -317 billion cells

*Needs starter (see below), or more yeast.*

# Other Factors - Temperature

We talked about pitch rates based on gravity, but there are other factors!!!

## Temperature

- Temperature makes a huge difference in yeast activity
- Colder = slower growth rate = slower fermentation
- Remember growth/reproduction = esters and fusels  
Therefore, colder = less growth = less esters and fusels
- This is why you pitch more yeast for lagers and ferment cold  
It's a double whammy - more yeast and colder temps both mean reduced esters
- Slower fermentation allows yeast to clean up as it ferments
- **WARNING** - this is all true to a point, if you go too cold for a specific strain, you can stress the yeast and cause undesired flavors, or premature flocculation

# Other Factors - Top Pressure

Top pressure is another method of controlling the rate of yeast growth

Top pressure is when you cap the fermenter and allow pressure to build up

Top pressure increases the amount of CO<sub>2</sub> in solution. This makes it harder for the yeast to move nutrients in and out of the cell, slowing them down. This slowdown is similar to what happens at colder temperatures.

More pressure = slowed metabolism/growth = reduced ester/fusel production

5-15 psi is the common range of pressure to apply. Different yeast strains will handle the pressure differently.

Ensure you're using a spunding valve to maintain a stable pressure, and you have an emergency pressure relief valve in the system

# Other Factors - Wort Oxygenation

Yeast NEEDS oxygen to reproduce

Boiling physically drives off oxygen (< 1 ppm)

Reduced oxygen = increased yeast stress

Add oxygen back AFTER chilling (target 8-12ppm)

Some dry yeasts may not need it. Fermentis states that their 34/70 dry yeast does not need wort oxygenation. Although for high gravity I still recommend it.

# Exceptions to the Rule

There are times when you might want to intentionally under-pitch, or under-oxygenate.

Styles to maybe under-pitch to increase esters and phenols:

- Weissbier, Dunkles Weissbier (banana and clove)
- Belgian beers (spicy, clove, strawberry, banana)
- Wild sours (Brettanomyces produces more flavors with low pitch rates)

My trick for Weissbier is NOT to under-pitch, but rather ferment cold to stress the yeast out slightly. I ferment my Weissbiers with Wyeast 3068

Weihenstephan at 62°F which is below Wyeast's recommended range of 64°  
-75° F

# Putting It All Together

Yeast	Temperature	OG	Pitch Rate	Notes
Ale	68°F	<= 1.060	0.75	Clean ale fermentation
Ale	64°F	<= 1.060	1.0	Low temp, clean ale
Ale	62°F	<= 1.060	0.75	Low temp, slight intentional stress (Weissbier, etc.)
Ale	68°F	1.060 - 1.080	1.0	Medium-high gravity ale (IPA, Double IPA, etc.)
Ale	68°F	1.080 - 1.100	1.25	High gravity ale (Imperial stout, Barleywine, etc.)
Lager	52°F	<= 1.060	1.5	Standard gravity lager
Lager	58°F	<= 1.060	1.25	Warm ferment lager (Cold IPA, NZ pils, Cream Ale)
Lager	52°F	> 1.060	2.0	High gravity lager (Doppelbock, Maibock, etc.)

# Funky Stuff

## Brettanomyces (aka Brett)

- Brett is a wild yeast that ferments slowly
- It can break down complex sugars that most brewers yeast can't
- Wide range of pitch rate: 200 million cells / mL to 2 billion cells / mL
  - This is a TINY amount on the low side!
  - This is as low as 10mL of slurry in a 5G batch
- Produces fruity, funky, and phenolic flavors
  - Ex. plum, pineapple, cherry, barnyard, leather, horse, smoky, spicy

## Lactobacillus (aka Lacto)

- Lactic acid producing bacteria. Lactic acid = sour
- Used for both clean kettle sours and wild ales
- $10^6$  CFU/mL
  - CFU = colony forming unit
  - Just look at the package to determine CFLs of your lacto source

# Cell Counting

How do professional breweries manage pitch rate?

Microscope + hemocytometer slide

- Hemocytometer provides very controlled volume and visible grid to count cells on
- Solution is diluted to precise ratio
- Cells are counted in the grid
- Cells / mL is reported based on the number of cells and dilution ratio
- Stain (methylene blue, methylene violet, etc.) can be added to test viability
  - Healthy cells do not absorb stain, dead ones do
  - Viability = # healthy cells / # total cells
- Cells / mL = # yeast cells counted \* 5 grid cells \* 200 dilution factor \*  $10^4$  slide volume
- More info: <https://blog.whitelabs.com/cell-counting-your-yeast-culture>