



Yeast Starter and Yeast Washing Class

Yeast Terms

Attenuation: Apparent attenuation is the percent of sugars available that were fermented. A high level of attenuation is said to produce a dry or digestible beer and a low level is said to be sweet.

Apparent Attenuation = $(OG-FG)/(OG-1)$ ie. $(1.040-1.010)/(1.040-1) = .75$ or 75%

Flocculation: How fast yeast cells clump together and fall to the bottom. A high flocculation indicates the beer clears quickly.

Viability: Viability is how much yeast is still alive as a percentage of the whole. Dry yeast loses viability at around 20% per year and liquid around 20% per month.

Dry Yeast: Dry yeast are very convenient and have a long shelf life. The rigors of the dehydration process limit the number of strains that are available. Dry yeast typically has 18 billion cells per gram for a total of 207 billion cells in a 11.5 gram packet. The best way to prepare them is to rehydrate in about 4 oz of 80°F water for 30 minutes.

Liquid Yeast: Liquid yeast come in a much larger variety provided by both White Labs and Wyeast. White Labs claims 70-120 Billion cells and Wyeast 100 Billion. The wyeast smack pack is not a starter but a method to determine living yeast exists. Wyeast does contain a nutrient to allow yeast metabolism to begin in the pack.

Yeast Nutritional Needs

Oxygen: Yeast reproduce into more numbers with oxygen. Dissolve oxygen by shaking or direct injection below 80°F. Hot oxidation can allow oxygen to bind with wort compounds and be release later oxidizing your finished beer with wet-cardboard and sherry flavors.

Nitrogen, Amino and Fatty Acids: All-grain malt beers have plenty, corn sugar has none. Malt Extracts have some. Consider using yeast nutrients if Extract brewing or brewing with lots of sugar.

- If you use ion-exchanged softened water for brewing, the water may not have adequate calcium, magnesium, and zinc for some of the yeast's metabolic paths.

Di-ammonium Phosphate - This is strictly a nitrogen supplement that can take the place of a lack of FAN.

Yeast Nutrient or Energizer - The name can vary, but the intent is a mixture of di-ammonium phosphate, yeast hulls, biotin and vitamins. These mixtures are a more complete dietary supplement for the yeast and what I recommend.

What do Yeast Do? Yeast take wort (Sugars, amino acids, peptides, proteins, vitamins, nucleic acids, ions and many other compounds) and complete a process called fermentation which converts wort to CO₂, alcohol and hopefully desirable flavor and aroma compounds. The most important factors that affect yeast performance that a brewer can control are:

- Wort gravity
- Temperature
- Pitch rate
- Oxygenation/Aeration
- Yeast strain
- Nitrogen content
- Nutrient content
- Grain bill/Mash program (spectrum of fermentable sugars)
- Sanitation/Technique

Yeast Growth Phases

Lag Phase: Yeast becomes acclimatized to the environment. They require oxygen for significant growth. Internal cellular energy reserves fuel the yeast until their membrane become permeable to wort sugars.

Log Phase: Exponential growth of cells. Yeast produce asexually by budding and the daughter cell is a genetic clone. Nitrogen, sugar, amino acids and nutrients are consumed. Many aromatic and flavor compounds are formed during this phase. A brewery can limit the esters by pitching more yeast or fermenting colder.

Stationary Phase: Yeast population reaches maximum density and yeast cells begin to build energy reserves as sugar content gets lower. If a brewer allows the beer to rest at temperature (or rise for lagers) the yeast will convert or reduce some less than desirable compounds such as diacetyl.

Yeast Pitching Rates: The general consensus is to pitch 0.75 million yeast cells per milliliter per degree Plato for an Ale and 1.5 million for a lager. (Jamil Zainasheff, White Labs General Recommendation)

The Math:

Plato = SG/4 ie. 1.048=12 °Plato (drop the 1 and the decimal ie, 1.048= 48)

5 gallons= About 19,000 milliliters (Lets just use 20,000 because I like to have a little more than 5 gallons)

For a 1.048 Ale we need:

.75 x 20,000 x 12 = 180 Billion Cells

That's 2 smack packs or 1 Dry Yeast Pack!!!

For a 1.048 Lager we need:

1.5 x 20,000 x 12 = 360 Billion Cells

4 smack packs or 2 dry yeast packs!!!

Brewing a Belgian Strong or Imperial IPA with an OG of 1.080 (20°Plator) We need:

0.75 x 20,000 x 20 = 300 Billion Cells

3 Smack Packs or 1.5 dry yeast packs!!!!

Yeast Starter: Making a yeast starter allows you to build up cell count to a level ready for pitching. To make a starter, we make a small batch of beer and grow the yeast. This is normally done in wort around 1.030-1.040. To make a starter, combine Dry Malt Extract, Water and yeast nutrient in a 2 liter or bigger glass flask. The ration is 1 cup DME, 1 Liter Water, and ½ tsp yeast nutrient.

-The preferred method is to boil the flask directly on a gas burner or in a water bath if you have electric.

Alternatively you can boil the mixture in a kettle and add it to a sanitized flask after cooling. This mixture will foam, so 5 Star Defoamer is recommended.

-After boiling for 10 minutes chill in an ice bath to 70°F. Pitch your yeast and cover with sanitized foil. Do not use an airlock. Oxygen is your friend in making a starter.

- If you have a stir plate, your yeast will propagate more rapidly. If not, shake the starter multiple times a day.

How Big of a Starter? There are quite a few factors that determine how big to make the starter. First, is your OG and second, how old and what type of yeast. www.mrmalty.com or <http://www.brewersfriend.com/yeast-pitch-rate-and-starter-calculator/> are good sites for estimating starters.

Using an example of a 1.048 wort with a one month old liquid yeast package, and a 2 liter flask that you will shake often, we need 1.25 liters of wort to propagate to the 180 billion cell level. Using a stir plate drops the level to .6 liters.

A stir plate increases capacity. With a 1 month old yeast pack, we could propagate enough yeast with a 2 liter starter for up to 1.072 OG.

Multi-step starter: You can step up propagation by executing a starter, allowing the yeast to settle, empty the liquid on top and adding fresh wort. Brewersfriend.com has a calculator to help with this.

Under pitching, Over Pitching or Allowing Temperature To Rise? Based on the description of the Log phase, you can see how important yeast count and temperature are to flavor. This can be especially true with highly phenolic or ester levels of Belgian style beers. Consider most Belgian breweries allow the temperature to rise well into the 70s during this phase. Or consider intentionally slightly under pitching to achieve the flavor and aroma compounds you desire.

From John Palmer, in a BYO article, 2008, under-pitch a beer that is characterized by the yeast(English, Belgian sour), and over-pitch a clean beer(American Pale, North English Brown). Same with lagers.

Some Helpful Pitching Rates (in Million per Milliliter Per °Plato):

Ommegang: 1 Million

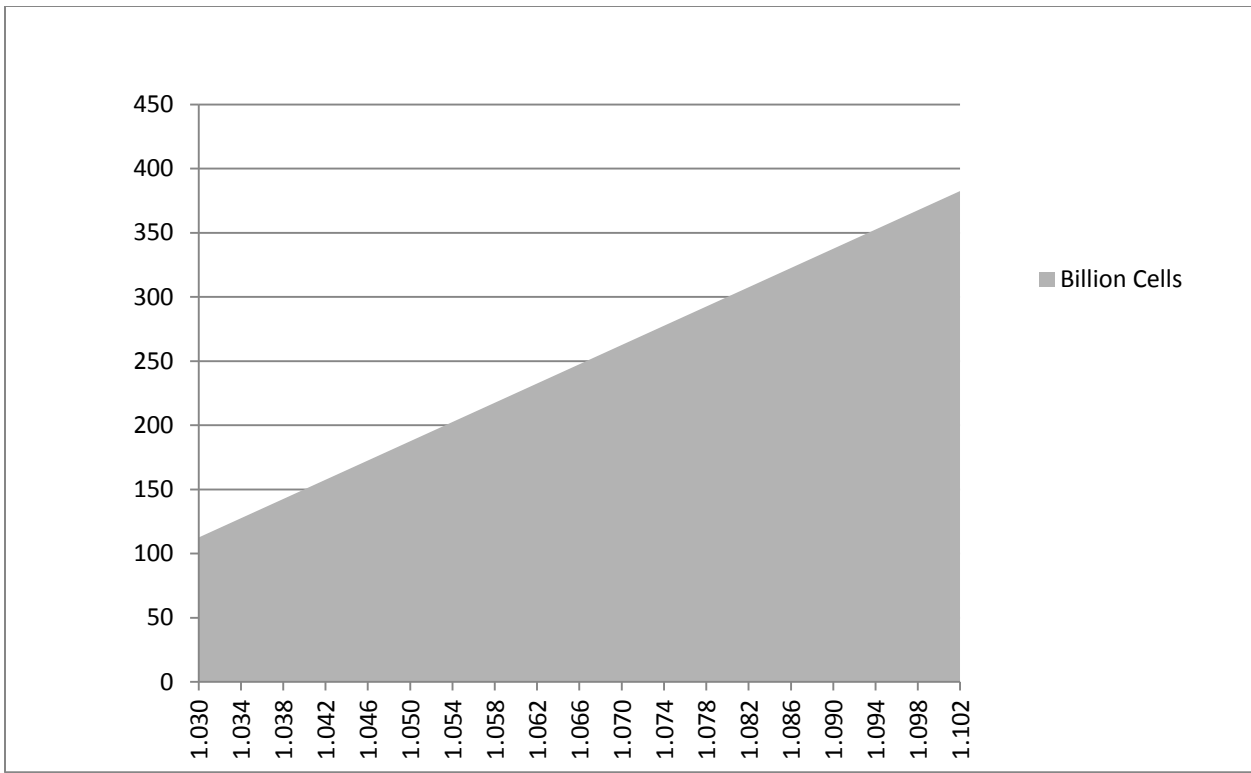
Moortgat(Duvel): 0.44 Million

Orval: 0.74 Million

Re-Pitching at Bottle Conditioning?

Not many homebrewers do it, but if we took the Belgians lead, we would do it more. If you've aged your beer, lagered to clear or made a strong beer, it is something to consider. Most Belgian breweries pitch at 1-3 million cells per milliliter of finished product. This equates to around 20-60 Billion cells.

Ale Yeast Pitching Count for 5 Gallons



Lager Yeast Pitching Count for 5 Gallons

