

1. Why Yeast Cultivation Matters

Healthy yeast means better beer. Proper preparation ensures:

- Faster and cleaner fermentations.
 - Reduction of undesirable flavors.
 - Boosts yeast cell count for high-gravity or lager fermentations.
 - Cost savings from reusing yeast over multiple batches.
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2. Yeast Dynamics

Yeast starters are essential for building a healthy cell population before pitching into your wort.

- DAP and other nutrients provide nitrogen and amino acids for robust growth.
- Add nutrients during both starter preparation and primary fermentation.
- Yeast cells divide several times during fermentation, but each division reduces their ability to reproduce.

Dry Yeast and Starters

- You don't "need" to make a starter when you use dry yeast. The commercially-produced dry active yeast is made from highly oxygenized cultures that were at maximal health when harvested and dried. It is fine to sprinkle the dry yeast on top of the oxygenated wort in the fermenter, let the yeast gradually hydrate on the surface without stirring, and then continue.
 - Personally, I generally make a starter anyway: saves money since you get more yeast from a small pack of yeast, better ratio between living and dead yeast since a significant portion of the yeast will have died during the drying process (not a big deal), and allows for saving a little of the starter culture for future brews (saves time and money).
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3. Planning a Yeast Starter

Yeast Cultivation takes time

- General guideline is to start yeast cultivation 3–4 days before brewing for lagers; 2-3 days for ales
- But must consider amount of yeast needed and any required step-ups

Use a yeast calculator (ie, www.yeastcalculator.com) to determine how much yeast is needed for the beer you plan to brew. The calculator will tell you:

- How many cells to pitch for a batch
- How much DME to make simple starter wort

- How much starter wort to use for each kind of aeration (ie, shake, no shake, intermittent shake, stir plate, beer kaiser method)
- How many step-ups are required

Gradually increase starter size to build healthy cell populations without over-stressing the yeast

- Dilute ~1/10 or more up to a 1000-fold increase at a time
 - Either top up a starter with more wort to build it up or decant it first. The important thing is having a volume that can be stirred and aerated well.
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4. Creating a Yeast Starter

- **Materials Needed:**
 - Dry Malt Extract (DME) or canned starter wort.
 - Stir plate (recommended) and aeration method.
 - Yeast nutrients, such as di-ammonium phosphate (DAP), to support growth.
 - Yeast
- **Steps to Prepare a Starter:**
 - Dissolve DME in water at a ratio of 100 grams per liter.
 - Starter wort around 1.037 (but up to 1040 is fine) plus extra nutrient (~0.2 g/liter Diammonium Phosphate, 0.25 mg/liter Zn, or use commercial mix).
 - Duane's souped-up Starter Wort recipe is in section 8 below
 - Dilute old starter or fresh yeast ~1/10 or more (up to 1000-fold dilution).
 - Boil the solution for 10 minutes to sanitize.
 - Cool to at or slightly below the planned beer's starting fermentation temperature and transfer to a sanitized flask.
 - Pitch yeast and place the flask on a stir plate to maximize oxygen exposure.
 - Aerate vigorously and stir about 1.5 to 2 days.
 - Save 100ml in refrigerator for next time, depends on dilution.
 - Let cells settle out in refrigerator one or two days, depends on shape of vessel (i.e., distance from culture surface to the bottom of vessel).
 - Carefully pour off liquid and let cells warm slowly (hour or two) to fermenter temp.
 - Resuspend cells in beer wort at same temp.
- **Aeration Methods:**
 - Stir plates are optimal, creating a vortex that pulls oxygen into the starter.
 - Run stir plate at a speed where the vortex reaches the stir bar at the bottom of the wort.
 - An aquarium pump with a sterile filter can be used to provide additional oxygen through the top of the flask
 - Loosely cover and pump air in through the top using an inline filter coming out of the pump.

- Any aquarium pump will do. Filter should be $\leq .5$ micron but .2 micron might be better (see pictures below).
 - If not aerating, loosely cover the starter with a sanitized piece of aluminum foil (ie, not an airlock).
 - Alternatives include manual periodic shaking
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5. Temperature Control

Maintaining consistent temperature is crucial for yeast health and optimal fermentation.

- **Growth Temperature:**
 - Grow the starter at a low temp at or below the starting temp (at low temp, the dissolved oxygen concentration is higher, and the yeast are making higher amounts of oxidized lipids which will be useful for them during anaerobic growth in the fermenter).
 - For ale yeasts: ideally start around 15°C (59°F).
 - For lager yeasts: ideally start around 10°C (50°F).
 - **DIY Cooling Solutions:**
 - Use a glycol cooling system made from a repurposed freezer and aquarium pump.
 - Keep yeast cultures in a water bath to stabilize temperature.
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6. Sterility and Contamination Prevention

Sterility is critical when handling yeast to prevent contamination from wild yeast or bacteria.

- **Signs of Contamination:**
 - Unusual smells or unexpected sediment in yeast starters.
 - Cells don't settle out as fast as expected
 - Beer attenuates more than expected
 - With proper sterile technique, you should be able to reuse starter at least five times or more.
 - **Test for wild contaminating yeasts:**
 - Prepare 3 tubes of sterile wort. Add 1/10 volume to tube#1 and tube#2. Heat tube #1 for 10min in 127°F bath. Let all 3 tubes grow for couple day until tube#2 is grownup. Should be no growth in Tube#3. No growth in tube#1 is good. Growth in tube#1 means contamination.
 - If contamination is suspected, discard and start with a fresh culture.
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7. Storing and Reusing Yeast

Reusing yeast can save money and improve consistency across batches.

- **Refrigerating Yeast for Short-Term Use:**
 - After fermentation, collect yeast slurry and store in a sanitized jar in the refrigerator.
 - Viability decreases over time, so use within 3 months for best results.
 - **Freezing Yeast for Long-Term Storage (may not be worth it):**
 - Add Glycerol to sample of yeast culture to 15% (weight/volume), depends on how cold your freezer is.
 - I use equal volume of concentrated yeast slurry and 30% (weight/weight) sterile glycerol.
 - Place in insulated containers like Styrofoam boxes, freeze as rapidly as possible, store in the coldest part of a deep freezer (Use a non-frost-free freezer to avoid damage from thaw cycles).
 - Check to make sure yeast are frozen solid (if not solid, try adding a little sterile water and use less glycerol next time).
 - When ready to use, let thaw slowly in refrigerator, warm slowly to culture temp, and add to starter wort (~20x wort).
 - Stir cool room temp until grown up (may take a couple of days or more to recover from freeze trauma).
 - Include identical flask without yeast as a control for contamination.
 - Dilute into more starter and grow as above.
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8. Duane's Souped-Up Starter Wort

Adapt to whatever is practical

- 13 pounds any malted grain (whatever is old and/or abundant), 1.6g MgSO₄, 7g CaCl₂, 8gal RO water
- Mash 40min at 64°C, 20min at 72°C, and 10min at 76°C
- Sparge 5 gal at 76°C
- Boil 60 min adding 5g Ammonium Sulfate, 8ml 15% Ammonium Hydroxide, 100g Peptone, 50g Yeast Extract, 20mg Biotin, 5g DAP, 20mg Zn, 1 tsp Irish Moss
- Adjust to pH-5.8
- Dispense into Bottles
- Pressure cook 15psi 30min

Sanitizing Equipment:

- Pressure cooker 30 min 15psi (Follow canning guidelines to avoid boil-over and ensure an airtight seal)
- Bake glassware in >300°F over for a couple of hours
- Rinse with 10% bleach, then with starsan
- Use starsan, iodophore or boil, and then hope for the best

9. Advanced Techniques

- **Enhancing Growth Media:**
 - Aim for starter water with a moderate level of hardness; target 50-100 ppm calcium and 10-20 ppm magnesium (provides essential nutrients for the yeast).
 - Remove chlorine and/or chloramines from starter water when using tap water (it can inhibit yeast growth).
 - Add yeast extract, peptone, or biotin to create a rich growth medium.
 - Maintain a pH of 5.8–6.0 during starter preparation for optimal yeast growth.
 - **Monitoring Yeast Health:**
 - Use a microscope to identify contamination or count yeast cells.
 - Alternatively, assume $1\text{--}2 \times 10^8$ cells per milliliter in a healthy, saturated starter.
 - **Homemade Equipment:**
 - Build stir plates from computer fans and rare-earth magnets for cost-effective aeration.
 - Create water baths or insulation systems to maintain consistent fermentation temperatures.
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Final Thoughts:

Investing time in yeast cultivation improves the quality and consistency of your beer. With proper tools, techniques, and attention to sterility, you can maintain viable yeast cultures for years, producing great beer batch after batch. If you have questions or want to learn more, connect with our homebrew club for demonstrations and resources.

