LALLEMAND

BAKING UPDATE

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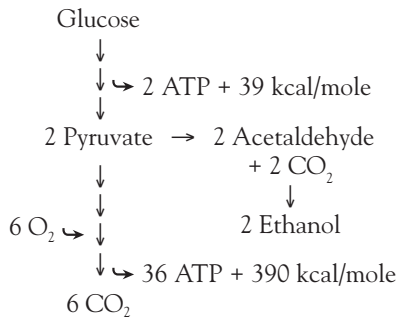
Fresh Yeast Handling and Dosing

Practical technology from Lallemand Inc.

How Oxygen Affects Yeast

Yeast consumes sugar (glucose) to produce compounds it needs for growth and to generate energy for other reactions. The glucose molecule contains stored energy in the bonds between its six carbon atoms. The energy is released as the glucose is broken down into smaller fragments by a series of enzyme-catalyzed reactions. Some of the stored energy is converted into chemical energy through the formation of adenosine triphosphate (ATP), and the rest is released as heat.

Yeast uses two metabolic pathways for consuming glucose. Both result in the formation of two molecules of pyruvic acid (three carbon atoms each) per molecule of glucose. Without sufficient oxygen, yeast ferments and converts each molecule of pyruvic acid to one ethanol and one carbon dioxide. In the presence of sufficient oxygen, yeast respires and breaks the two molecules of pyruvic acid down completely into six molecules of carbon dioxide.



The amount of available energy is greater with respiration than with fermentation. Fermentation releases about 56 kcal/mole of glucose, of which about 30 percent is recovered as ATP and the rest is released as heat. Respiration releases about 680 kcal/mole of glucose, of which about 42 percent is recovered as ATP and the rest is released as heat. This tenfold greater heat release explains why oxygen has such a dramatic effect on the shelf life of fresh yeast.

Yeast Handling in the Bakery

TIME, TEMPERATURE, and oxygen reduce fresh yeast performance. Bakers can get the most out of their yeast by following handling guidelines that take these factors into account.

YEAST STABILITY

Yeast is at its best immediately after it has been grown. The individual yeast cells are intact with an optimum content of protein and carbohydrate to provide the desired leavening, conditioning, and flavor. As yeast ages, it feeds off its carbohydrate reserves and becomes less active. Its own enzymes also start "autolyzing" the yeast by breaking proteins down into amino acids, eventually rupturing the cells. The loss of protein reduces activity, the ruptured cells die, and the free amino acids promote bacterial contamination.

YEAST HANDLING GUIDELINES

- **Inspect yeast when received**
- **Avoid contamination**
- **Store at 32°F to 40°F (0°C to 4°C)**
- **Use oldest yeast first**
- **Keep closed and cool until used**
- **Keep cream cool and clean**
- **Avoid ingredients that shock yeast**

Time. With normal handling, cake, granular, and cream yeast can be stored for at least two weeks before a decline in their performance is noticeable. Even with the best handling, a performance decline and mold growth are usually noticeable after four to six weeks. With improper handling, yeast may already show signs of age by the time it is delivered to the bakery.

Temperature. Elevated temperature accelerates ageing by speeding up yeast metabolism, which generates heat, which further speeds up metabolism. The warmer the yeast gets, the harder it is to cool it down again, and the greater the potential damage to its performance. For best results, yeast should be packed as cool as possible, chilled down as soon as possible, and then stored at a consistent 32°F to 40°F (0°C to 4°C) until used. Freezing doesn't affect performance but can make the yeast mushy and dark.

Oxygen. Oxygen accelerates ageing by encouraging the type of yeast metabolism (respiration) that generates the most heat. This makes the combination of oxygen and elevated temperature especially undesirable. The problem is greatest with granular yeast in open bags, least with cream yeast in large tanks, and in-between for well-wrapped cake yeast. The problem with granular yeast can be reduced by using properly sealed bags.

Other factors. Old baking and yeast references mention typical shelf lives of two weeks or more for yeast stored at 75°F (24°C) or higher. This may apply to the old European types of slow-acting cake yeast for lean, straight-dough applications, but it certainly does not apply to modern American types of fast-acting granular yeasts for sugar-containing sponge-and-dough applications. In general, sugar tolerance declines faster than lean-dough performance, and initial gassing activity declines faster than final proof time.

YEAST HANDLING GUIDELINES

Inspect yeast when received. Temperature, appearance, odor, and taste should be normal. There are few absolutes, because temperature measurements vary depending on how they are taken, and the other properties are subjective. Most American bakers prefer yeast with a light color and a dry texture. Old or damaged yeast frequently appears dark and gummy, but even good yeast varies between suppliers and over time without affecting performance. Odor should be fresh and pleasant without musty or fruity smells that can indicate spoilage. Taste should be mild and slightly sour, except if defoam oil has been added, which can be bitter.

Continued

Yeast Dosing Considerations

BAKERS adjust yeast dosing to optimize fermentation time. Yeast condition, the breadmaking process, recipe ingredients, and temperature all have an effect.

Fermentation time is inversely related to yeast dose, so reducing yeast increases fermentation time, and increasing yeast reduces fermentation time. In most cases, a reduction in yeast dosage will be directly proportional to the increase in fermentation time. For example, if the optimum fermentation time for a given flour and recipe is three hours with 3 percent yeast, using 2 percent yeast will extend the time to about four hours, while using 4 percent yeast will reduce it to about two hours.

Yeast condition affects gas production, gas retention, and flavor. It is possible to make up for some of the effects age and mishandling have on gas production by increasing the yeast dose. But yeast that has begun to autolyze, or break down, has a negative effect on gas retention. In this case, adding more yeast does not improve proofing—it makes the problem worse. Even fresh yeast in good condition can contribute an overly strong "yeasty" flavor at dose rates above about 10 percent (compressed) or 17 percent (cream). Old, mishandled, or contaminated yeast can have noticeable off-flavors at much lower levels. The effects of yeast condition are especially apparent in sweet goods, where the yeast becomes more sensitive to osmotic stress, and in frozen dough, where the yeast loses its cryoresistance.

Breadmaking process affects dose rate, with longer processes generally requiring less yeast and shorter processes, more yeast. The fermentation steps in breadmaking processes are designed to activate the yeast, develop the dough, and contribute flavor. Yeast dose adjustments to optimize the final proof time are usually made at the dough stage. Adding more yeast to a preferment may increase dough development and flavor but can also reduce product volume by over-developing the dough or over-activating ("burning out") the yeast. Adding more yeast to frozen dough helps make up for the activity loss during storage and the effect of cold dough on the final proofing.

Sugar has an important effect on yeast activity and dose rate. Lean dough requires the yeast to break down the maltose sugar in flour into the glucose sugar that it needs to produce carbon dioxide. The sucrose or high fructose corn syrup added to sweet dough creates osmotic stress, which inhibits the yeast's ability to produce carbon dioxide. Most fresh yeasts produced for industrial bakeries work well in lean and sweet doughs containing up to about 20 percent sugar. Increasing the yeast dose helps speed up the start of fermentation in lean doughs and helps make up for the effect of osmotic stress in sweet doughs.

FRESH YEAST DOSE RATES

	Compressed	Cream
Sponge and dough	2–3%	3–5%
Flour brew	3–4%	5–7%
Water brew	3–4%	5–7%
Straight dough	3–5%	5–9%
No-time dough	4–6%	7–10%
Frozen dough	4–6%	7–10%

Flour percent, based on total flour.
1% compressed at 30% solids = 1.7% cream at 18% solids.

Salt contributes to osmotic stress and has an effect similar to sugar. Because of this, it is usually left out of sponge or brew fermentations to speed up dough development and yeast activation. Salt also has a stabilizing effect on gluten and so is sometimes added to the sponge or brew to help strengthen the dough. In this case, adding part of the yeast, or "spiking," at the dough side can be used to adjust the final proof time.

Preservatives, like vinegar, raisin juice, cultured wheat starch, and calcium propionate, are added to inhibit mold in the finished product, but also inhibit yeast activity during proofing. Acidic conditions increase the effect, with a pH decrease of 0.3 doubling the inhibitory effect of calcium propionate and other short-chain fatty-acids-containing preservatives. Depending on the dough pH, calcium propionate levels of 0.25 to 0.5 percent can require a 10 to 20 percent increase in yeast dose to maintain the same proof time.

Temperature affects both the time required to attain maximum yeast activity and the maximum rate of gas production. Generally, the gas production rate increases about 1.5 to 2 times for every 20°F (11°C) increase in temperature, up to a maximum of 100°F to 110°F (38°F to 43°C). Within a normal range of proofing temperatures, yeast dosing can be adjusted up or down to maintain proof time.

Yeast Handling In the Bakery *(Continued)*

Avoid contamination. Do not use yeast if there are signs of damage or tampering. Keep foreign material off the yeast packages, and reseal holes after taking temperature readings.

Store at 32°F to 40°F (0°C to 4°C). Measure both yeast and cooler temperatures. Yeast can be cooled to 31°F (–1°C) without freezing, but coolers are usually set at 34°F to 37°F (1°C to 3°C).

Use oldest yeast first. Use the producer's date code to rotate stock. If the producer does not provide an open date code, use the date received.

Keep closed and cool until used. Leave the bags, boxes, or cakes sealed and in the cooler until right before use. Remove only the amount needed, and reseal the package to protect the remainder.

Keep cream cool and clean. Keep cream yeast below 40°F (4°C), use within two weeks, and follow the system manufacturer's cleaning procedures. Keep slurried yeast below 50°F (10°C), use gentle agitation once the yeast has been suspended, and clean the system frequently.

Avoid ingredients that shock yeast. Yeast should not come into direct contact with concentrated salt, vinegar, calcium propionate, or other chemical or natural preservatives.

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Lallemand Baking Update is produced by Lallemand Inc. to provide bakers with a source of practical technology for solving problems. You can find the latest issues online at www.lallemandbaking.com.

If you have questions or comments, please contact us at:

LALLEMAND Inc.
1620 Préfontaine
Montréal, QC H1W 2N8 Canada
tel: (800) 840-4047 (514) 522-2133
email: solutions@lallemand.com
www.lallemand.com

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