

Practical technology from Lallemand Inc., parent of American Yeast Sales, producers and distributors of Eagle® yeast, fresh and instant.



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Using the Right Amount of Yeast

MOST BAKERS adjust the amount of yeast they use to achieve a desired proof time and finished product volume. But the results are not always predictable because there is an interaction between gas production by the yeast and gas retention by the dough. Bakers can take this interaction into account to optimize yeast usage and bakery throughput.

GAS PRODUCTION AND RETENTION

The amount of gas production during proofing and baking depends mostly on proof time, yeast characteristics, and yeast dose rate. The amount of gas retention depends mostly on processing conditions and ingredients. But there are a number of other factors that affect the interaction between gas production and retention:

- **Higher proof temperatures** increase gas production and decrease gas retention. Low temperatures give strong doughs that rise slowly, while high temperatures give weak doughs that rise quickly.
- **Higher water absorption**, above that necessary for dough development, also increases gas production and decreases gas retention. Diluting dissolved solids makes yeast more active, but diluting gluten reduces dough strength.
- **Sugar** increases gas production at levels up to about 5 percent but decreases gas production at higher levels because of osmotic pressure.
- **Salt** decreases gas production because it increases osmotic pressure even more than sugar.
- **Calcium propionate** decreases gas production, especially in acidic doughs with low pH.
- **Flour protein** and added gluten increase gas retention and tolerance.

- **Dough development** has an optimum for gas retention where the gluten structure of the flour is strong enough to hold the gas in small bubbles but flexible enough to expand without collapsing.
- **Oxidation level** also has an optimum for gas retention and tolerance.
- **Fiber content** or whole grain content reduces gas retention and tolerance because the fiber interferes with the gluten structure.


YEAST DOSE AND PRODUCT VOLUME

The graph below shows the effects of varying the amount of yeast used in a white pan bread made by a typical flour brew process. The dotted line is the amount of gas produced and shows that increasing the yeast amount gives a similar increase in gas production over the whole range of doses. The solid line is the finished product volume and shows that increasing the yeast has a different effect on volume at different dose ranges. In the middle range, increasing the

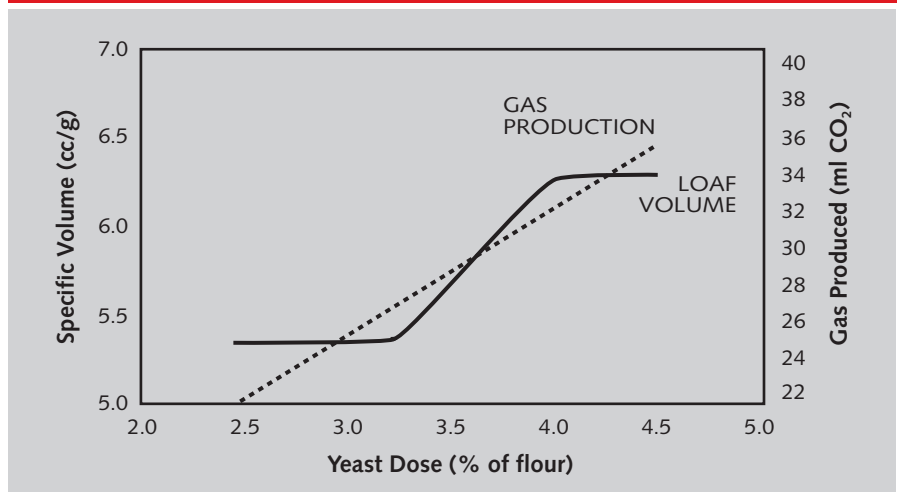
yeast gives a similar increase in volume, but at low and high dose ranges it has no effect.

Increasing yeast doesn't always increase finished product volume, because there is a limit to gas retention. Conditions that affect gas production move the yeast/volume curve left or right so that more or less yeast is required for the same finished product volume. Conditions that affect gas retention move it up and down so that both the amount of yeast required and the attainable finished product volume are affected.

In the middle range of the yeast/volume curve, the finished product volume is very sensitive to the yeast dose and to conditions that affect gas production. This is a good place to operate to be able to respond to factors that affect gas retention (like flour quality). The baker can use yeast dose to control finished product volume and compensate for recipe or process variations.

At the high range of the yeast/volume curve, the finished product volume is very sensitive to conditions that affect gas retention. This is a good place to operate to minimize factors that affect gas production (such as yeast stability in frozen dough). 

EFFECT OF YEAST DOSE ON GAS PRODUCTION AND LOAF VOLUME



International Perspective:

EUROPEAN PROOFING COMPARISON

European artisanal bakers use yeast amounts and proofing conditions that are much different from American wholesale bakers. In some cases the reason is a traditional product whose characteristics depend on the way it is produced. But in other cases the differences just represent another way of achieving the same result. The following table compares yeast and proofing data for four typically European products:

	FRENCH BAGUETTE	GERMAN MIXTBROT	DANISH DANISH	ENGLISH DR. ALLINSON
Yeast Dose	2%	2%	5%	2%
Proof Time	4 hrs	1 hr	40 min	40 min
Proof Temp.	78°F	85°F	77°F	85°F


French baguettes require low yeast levels and long proof times. German Mixtbrot is an especially dense product that needs little gas production. Danish Danish is a relatively high yeast dose to give a short proof time despite high sugar. Dr. Allinson does not require much yeast because of the one-hour prefermentation and an unusually high water absorption. Overall, the biggest difference in European systems compared with American is their lower proof temperatures. European proof temperatures typically range from about 75° to 90°F, while U.S. and Canadian wholesale bakeries range from about 100° to 115°F.

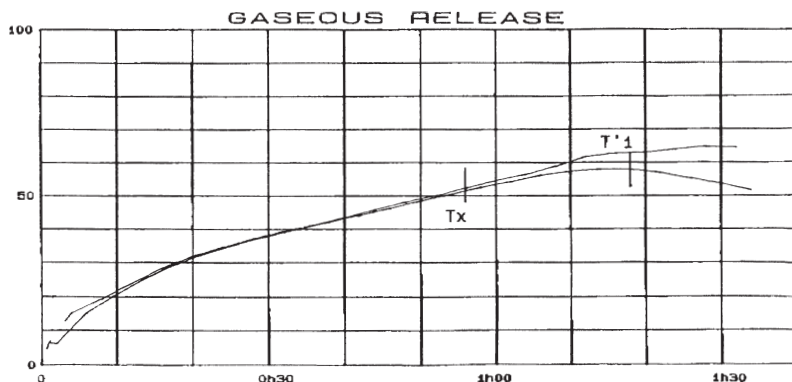
Measuring Gas Production and Gas Retention

THE INTERACTIONS between gas production and retention make them difficult to measure properly. Fermentometers measure gas production by pressure or volume, but not gas retention. The Farinograph and similar devices measure the dough rheology that affects gas retention, but not under proofing conditions.


The Chopin Rheofermentometer is a new instrument that simultaneously measures gas production and gas retention under realistic proofing conditions. It consists of a sealed chamber where a dough piece is placed under a weighted piston. As the dough rises, the piston movement is measured to determine the rate of expansion and the strength of the dough. At the same

time, the total gas production by the yeast is measured along with the amount that escapes from the dough into the chamber. Subtracting the amount released from the total gives the amount retained.

The Rheofermentometer is controlled by a microprocessor, which calculates the results and produces graphs for "Development of the Dough" and "Gaseous Release." The Gaseous Release graph reproduced below shows the results for a whole wheat bread. The top line represents total gas production and the bottom line, gas retention. The T'1 value is the time to maximum volume; Tx is the time when permeability appears. A retention coefficient is calculated by dividing the retained volume by the total volume, which in this case was 94%. 



Yeast Optimization Checklist

- Choose the right yeast.** Usually this is the yeast that works best (allows the lowest dose) in the most demanding application.
- Determine proof time.** Calculate the maximum proof time possible to keep up with the oven and achieve the required throughput.
- Determine the yeast needed for the sponge or brew.** Yeast added to the pre-ferment (sponge or brew) contributes more activity than yeast added to the dough, so it should be optimized for the highest volume products.
- Optimize dough-side yeast additions.** For products that share a common pre-ferment, determine the additional yeast "spike" required to make up for poor gas production or retention characteristics.
- Consider gas production and gas retention effects when making adjustments.** When gas production is limiting, adjusting the yeast dose affects proof time and finished product volume. When gas retention is limiting, adjusting the yeast dose may not have an effect and changes in process or ingredients may be needed. 

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BAKING UPDATE

Lallemand Baking Update is produced by Lallemand Inc. to provide bakers with a source of practical technology for solving problems. If you would like to be on our mailing list to receive future copies, or if you have questions or comments, please contact us at:

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