

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




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## Cryoresistance of Yeast

The stability of yeast in a frozen dough (its cryoresistance) is key to obtaining good results with frozen dough. Yeast cryoresistance seems to be partly associated with the presence of trehalose, a cryoprotective compound found in yeast. High levels of trehalose can be induced by strictly controlling growth conditions and choosing a cryoresistant strain for yeast production.

Since high trehalose levels (up to 15 percent) mean lower levels of protein and thus lower levels of enzymes in yeast, the gassing power of cryoresistant yeast is usually lower. Yeast with high cryoresistance tends to stay dormant longer and becomes activated more slowly when it is mixed into a dough. Keeping trehalose levels in yeast high at the time the dough is frozen is important for cryoresistance and is accomplished by using low dough temperatures and short times between dough mixing and freezing.

Yeast cryoresistance not only differs greatly among various yeast strains and various yeast suppliers, but also can vary among batches from the same supplier. Cryoresistance is more difficult to control than are other yeast quality parameters. Also, a trade-off exists between a quick-starting yeast with high initial gassing power but low cryoresistance versus a slow-starting yeast with lower gassing power but excellent cryoresistance.

The table (see reverse) compares initial proof times for six yeast samples with their proof times after ninety days of frozen dough storage. The samples began with an average proof time of 54 minutes, which rose to 93 minutes after ninety days, showing that on average they retained only about 60 percent of their activity. The amount of activity retained is a measure of cryoresistance, and for these samples it varies from a low of 48 percent to a high of 72 percent. As expected, the yeast samples with the shortest initial proof times tended to lose activity fastest and have the lowest cryoresistance values. 

## How Frozen Dough Affects Bread Quality

**T**HE USE OF frozen dough saves time, space, and equipment costs for the small retail or in-store baker who freshly bakes a wide variety of bread on the premises. Despite additional costs for freezing, transportation, and frozen storage, the use of frozen dough can be attractive, especially when producing freshly baked products of high added value at relatively expensive locations.

A major shortcoming of frozen dough is that its breadmaking quality can deteriorate substantially as time in frozen storage increases. Bread quality depends largely on the stability of yeast in the frozen dough (cryoresistance) during storage. The cryoresistance of yeast differs greatly among yeast samples, which can be seen in the table on the reverse.

To optimize yeast cryoresistance, yeast activity needs to be minimized as much as possible before freezing. This is done by using a no-time process, which has a low dough temperature and a short time between mixing and freezing. Such a process maximizes the cryoresistance of yeast during frozen storage, but it can result in sub-

optimum bread quality. However, by choosing the right ingredients and process parameters, excellent bread can be produced from frozen doughs stored up to three months or longer—with quality indiscernible from that of bread made from scratch.

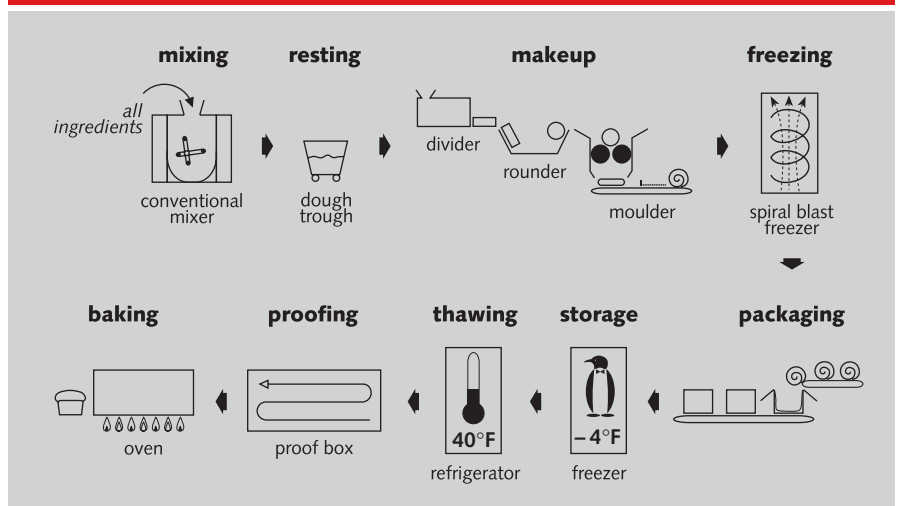
Many of the critical factors affecting frozen dough quality are interrelated. Overall quality greatly depends on the process and ingredients used for preparing frozen doughs and the subsequent freezing, storing, thawing, proofing, and baking steps.

**Process.** The most important objective of a frozen dough process is to optimize yeast cryoresistance by reducing fermentation before freezing, while optimizing dough development during mixing. Following are some ways to achieve this objective:

- Cool ingredients and water or use ice to achieve a dough temperature after mixing of about 68°F.
- Keep the time between mixing and freezing short, preferably less than thirty minutes.
- Use small batches to reduce variation in time between mixing and freezing within a single batch.

*Continued*

### FROZEN DOUGH PROCESS



## DIFFERENCES IN CRYORESISTANCE AMONG YEAST SAMPLES

Yeast Sample	Frozen Dough Storage Test		90 Days/ Initial
	PROOF TIME (MIN)		
	Initial	90 Days	
A	67	93	72%
B	60	89	67%
C	55	98	56%
D	51	93	55%
E	46	88	52%
F	47	98	48%

Yeast Sample	Eagle® Quick Test		Stressed/ Initial
	GAS PRODUCTION (UNITS)		
	Initial	Stressed	
A	30.0	22.4	75%
B	30.0	20.1	67%
C	26.2	16.5	63%
D	33.3	19.7	59%
E	30.7	14.4	47%
F	40.0	18.3	46%

## How Frozen Dough Affects Bread Quality

(Continued)

- Use delayed addition of salt to improve dough development during mixing.

- Use delayed addition of yeast to minimize yeast activation before freezing.

**Ingredients.** The correct use of ingredients can improve bread quality by increasing gas retention of doughs. With the possible exception of bromate, ingredients don't affect cryoresistance of yeast.

- Use high levels of oxidants compatible with a no-time dough process. At least 60 ppm, preferably 90–120 ppm of ascorbic acid is advised for optimum oxidation. Oxidation requirements may increase during frozen dough storage because reducing compounds may leak from dead yeast cells. When using reducing agents such as L-cysteine to reduce mixing time and to speed up dough development during mixing, additional oxidation is required for optimum results.

- Use a strong, high-quality flour or add vital wheat gluten.

- Reduce water absorption by about 2 to 4 percent to facilitate the handling of the doughs after thawing.

- Use moderate to high levels of shortening (up to 5 percent) and emulsifiers with good dough stabilizing effects such as SSL, DATEM, or EMG.

- Use enzyme-based dough conditioners but avoid those containing proteolytic enzymes (e.g., malt), which can affect dough stability during thawing and proofing.

- Increase yeast levels to 4 to 6 percent to compensate for the lower rate of gas production after thawing, and use cryoresistant yeast suitable for frozen dough. Frozen dough formulations require high yeast levels to compensate for the intrinsic lower gassing power of cryoresistant yeast, the loss of some yeast activity during freezing and subsequent frozen storage, and the low

dough temperatures during final proof. If a less cryoresistant yeast is used for frozen dough, then higher yeast levels are required because of a faster loss of activity during frozen storage. The most important reason for using high yeast levels in frozen dough is a low dough temperature during final proof. Because of the excellent insulating properties of dough, the temperature of a thawed dough piece increases slowly in the proof box; this low dough temperature reduces the gas production by yeast. Frozen dough is better suited to smaller dough pieces because large dough pieces will attain the much higher temperature of the proof box slowly.

**Freezing, storing, thawing, proofing, and baking.** Here are some ways to optimize bread quality from frozen dough during these steps:

- Use gentle freezing methods such as blast freezing. Rapid freezing methods such as cryogenic freezing are quicker but potentially more detrimental to yeast in frozen dough.


- Store at approximately  $-4^{\circ}\text{F}$ , the optimal storage temperature for frozen dough.

- Avoid uncontrolled temperature variations. A constant temperature during transportation and storage is essential for consistent bread quality from frozen doughs.

- Use a first-in, first-out scheme when using frozen dough pieces.

- Never refreeze frozen dough pieces once thawed.

- Use an overnight thawing step at approximately  $35^{\circ}$  to  $40^{\circ}\text{F}$  for larger dough pieces. In case of an unexpectedly large demand, small dough pieces can be proofed directly without a prior thawing step.


- Extend final proof time to compensate for any loss in gas production of yeast during frozen storage. 

## Eagle® Quick Test

CONVENTIONAL frozen dough storage tests require preparation of several identical frozen dough pieces, which are then stored for several months and evaluated periodically for proof time or yeast activity. The time and effort involved limits the usefulness of these tests to product development and quality control.

The Eagle® quick test for yeast cryoresistance subjects small dough pieces to three consecutive cryogenic freeze/thaw cycles at  $-112^{\circ}\text{F}$ . Yeast activity is measured before and after the stress of the freeze/thaw cycles, and a cryoresistance value is calculated as the ratio of final activity to initial activity.

The Eagle® quick test is reliable, takes approximately four hours, and correlates well with conventional storage tests. The table above shows similar cryoresistance values for six yeast samples from various sources when they were subjected to a ninety-day frozen storage test and the Eagle® quick test.

The Eagle® quick test shortens the turnaround time for evaluating process improvements and allows quality control checks for consistent frozen dough performance before yeast is used. 

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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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