LALLEMAND
BAKING UPDATE
VOLUME 3/NUMBER 16

Frozen Dough

Practical technology from Lallemand Inc.

Cryoresistance of Yeast

Cryoresistance refers to the ability of yeast to maintain its gassing activity when frozen. It depends in part on trehalose, a carbohydrate that yeast produce when they are growing to provide reserve energy and protect themselves from stress. All yeasts contain trehalose, but the levels depend on the strain and growth conditions.

When producing bakers yeast, there is a trade-off between the levels of trehalose and protein. Increasing trehalose improves cryoresistance but reduces protein. Increasing protein provides higher gassing power but reduces trehalose. High trehalose yeast is more stable, has a longer shelf life, stays dormant longer, and is activated more slowly when mixed into a dough. High protein yeast has higher initial activity and produces more gas, more quickly, when mixed into a dough.

Yeast freshness and handling are especially important for frozen dough. Bakers yeast consumes trehalose and loses cryoresistance when warm or exposed to oxygen. Proper dough handling is also key. Keeping the dough cold and the time short between mixing and freezing conserves trehalose and optimizes cryoresistance.

Trehalose is only one of the factors influencing cryoresistance, so yeast testing is necessary to predict frozen dough stability. Traditional tests duplicate commercial products and measure proof time at intervals during frozen storage. Accelerated tests use small dough pieces and measure gas production after multiple freeze/thaw cycles.

Frozen dough storage test results can be expressed in absolute terms, like minutes to reach a fixed proof height, or in terms of relative stability, as a ratio of final-to-initial activity. Choosing the yeast with the highest initial activity gives the lowest dose rate. Choosing the yeast with the highest final activity gives the longest storage life. Choosing the yeast with the highest ratio of final to initial activity gives the most consistent bake-off performance.

How Frozen Dough Affects Bread Quality

THE 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, using 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.

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 suboptimum 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 (20°C).
- Keep 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.
- Delay addition of salt to improve dough development during mixing.
- Delay addition of yeast to minimize yeast activation before freezing.

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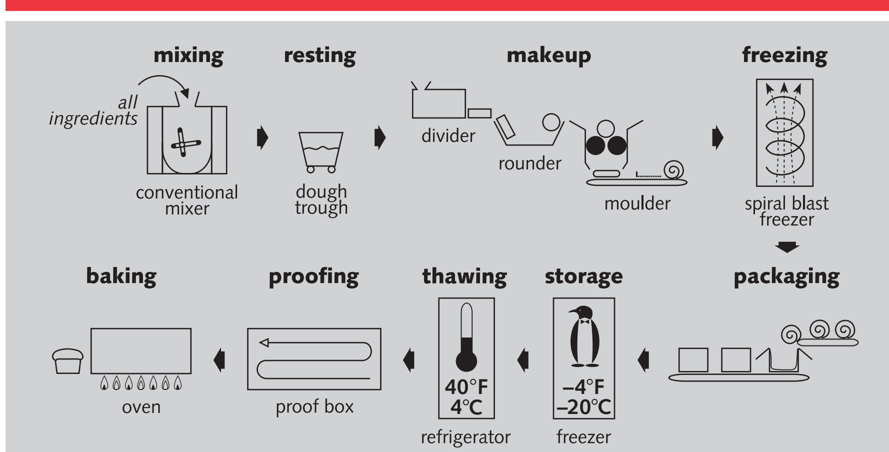
FROZEN DOUGH PROCESS



How Frozen Dough Affects Bread Quality *(Continued)*

Ingredients correctly used can improve bread quality by increasing gas retention of doughs. Except possibly for bromate, ingredients don't affect yeast cryoresistance.

- 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 needed 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 slowly attain the much higher proof box temperature.

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°F (–20°C), 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° to 40°F (2° to 4°C) 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.

Frozen Dough Variations

ONE disadvantage of frozen dough is the long time it takes to thaw, proof, and bake. Variations on the traditional process are aimed at shortening the bake-off portion and making it easier to match production and demand.

PREPROOFED FROZEN DOUGH

Preproofed frozen dough is made by allowing the dough pieces to double in size before freezing. They are placed in a programmable oven while still frozen and baked for about 20 minutes. Most of the carbon dioxide for proofing is produced before freezing, remains in the cold dough, and is released during baking. The process works best with smaller products, like rolls weighing 4 ounces (100 grams) or less that do not require a large final volume. Besides the cost of the specialized oven, the process also has the disadvantages of higher storage cost for the larger dough pieces and shorter frozen shelf life.

FREEZER TO OVEN (FTO)

Freezer-to-oven frozen dough uses specially formulated dough pieces that are processed normally before being placed in an oven while still frozen. Dough is a poor conductor of heat, so the main challenge is for the interior of the product to thaw and proof before the crust sets. Small size, high surface-to-volume ratio, correctly set cuts, and steam in the oven all help to avoid excessive breaking and shredding. Freezer-to-oven avoids some of the problems with preproofing but has similar constraints: product weight is limited to 4 ounces (100 grams) or less, and final product volume is limited to about five times the initial dough volume.

Other processes, like retarder-to-oven and freezer-to-fryer, are alternatives to better match production and demand at the bake-off location. Some products are easier to adapt than others. Croissants and other laminated dough products are good applications for preproofing and freezer-to-oven because the fat layers trap the steam produced during baking and allow the expansion to continue longer.

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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.

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