LALLEMAND
BAKING UPDATE
VOLUME 1 / NUMBER 3

Yeast Characteristics

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

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Lean Dough Biochemistry

Yeasts produce carbon dioxide from sugar by a series of enzymatic reactions known as glycolysis. In some recipes the sugar comes from high fructose corn syrup or sucrose, but in lean doughs the primary sugar available to yeast is maltose. The way a yeast strain utilizes maltose affects how well it works in lean dough.

Maltose consists of two glucose molecules linked together and is formed from the damaged starch in flour by the naturally occurring enzymes *alpha-* and *beta-*amylase:

$$\text{Damaged starch} \xrightarrow{\textit{alpha}\text{-amylase}} \text{Dextrins}$$

$$\text{Dextrins} \xrightarrow{\textit{beta}\text{-amylase}} \text{Maltose}$$

Utilization of maltose by yeast requires the two enzymes maltose permease and maltase. The permease transports maltose into the yeast cell from outside, and the maltase cleaves it into two glucose molecules. The yeast then uses glucose for glycolysis just as it would sugar from any other source:

$$\text{Maltose} \xrightarrow[\text{Maltase}]{\text{Maltose permease}} 2\ \text{Glucose}$$

$$\text{Glucose} \xrightarrow{\text{Glycolysis}} 2\ \text{Ethanol} + 2\ CO_2$$

All *Saccharomyces cerevisiae* yeast are able to ferment maltose, but there are two kinds of strains. Most are known as "adaptive" because their maltose utilization depends on environmental factors. These strains do not make maltose permease and maltase enzymes if glucose is present, so can only use maltose after any glucose has been used up. Some bakers yeast strains are known as "constitutive" because their maltose utilization is independent of environmental factors. Constitutive strains tend to have better lean dough performance.

Choosing the Right Yeast

YEAST FROM MOST suppliers is used interchangeably by most bakers, but there are differences between yeast plants, between suppliers, and over time. Some of the differences are the result of tradeoffs that yeast producers and bakers have to make to use a single type of yeast for several different applications. Bakers can take advantage of the differences and tradeoffs to improve their own quality and consistency and reduce costs.

The potential characteristics of a particular bakers yeast are determined by its strain. There are six hundred different species of yeast that have been identified in nature, but only *Saccharomyces cerevisiae* is commonly used for baking. An unlimited number of *Saccharomyces cerevisiae* strains are possible, and there are several thousand that have already been selected for baking. All *Saccharomyces cerevisiae* yeasts have certain similarities, including the substances they use for growth, how they reproduce, and their appearance under the microscope. But individual strains also have important differences, like how much sugar they will tolerate, how quickly they grow, and how sensitive they are to calcium propionate.

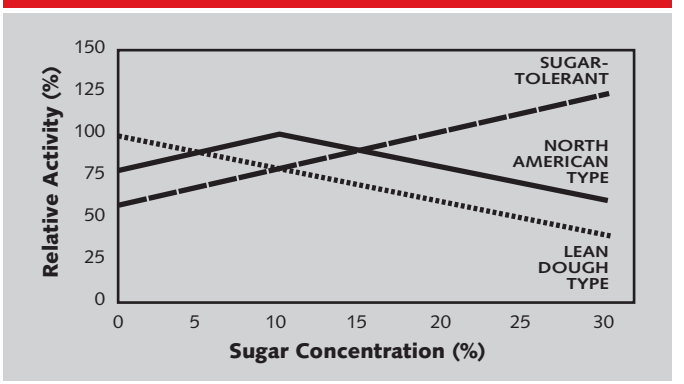
The actual characteristics of bakers yeast from a particular strain are determined by its composition. Bakers yeast is grown on molasses by starting with a small culture of the desired strain and controlling the temperature, nutrients, and aeration so that it multiplies. The growth conditions affect how fast the yeast multiplies and how much protein and carbohydrate it accumulates. Rapid growth usually means more protein, more enzymes, and more initial activity. Slow growth usually means more carbohydrate, lower initial activity, and better stability.

Baking recipes and ingredients affect yeast performance. Lean doughs require yeasts with high maltase enzyme activity because maltose sugar from flour is the primary energy source. Sweet, salty, and low-absorption doughs require yeasts with good osmotic tolerance because the amount of available water is limited. Recipes with sours, fruit, calcium propionate, and natural mold inhibitors also inhibit different yeasts to different degrees.

Baking processes also affect yeast performance. Straight and no-time doughs work best with fast yeasts that adapt quickly to give good oven spring. Sponge and dough systems work best with slower yeasts to retain sufficient activity for the final proof. Frozen dough systems work best with slow yeasts that retain their activity well.

Yeast producers make tradeoffs that affect performance in different applications. The strain choice determines sweet versus lean dough performance and influences suitability for different baking processes. The yeast composition optimizes for either activity or stability, and also influences suitability for different baking processes. The graph above shows the relative activity of

EFFECT OF SUGAR ON YEAST ACTIVITY



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International Perspective:

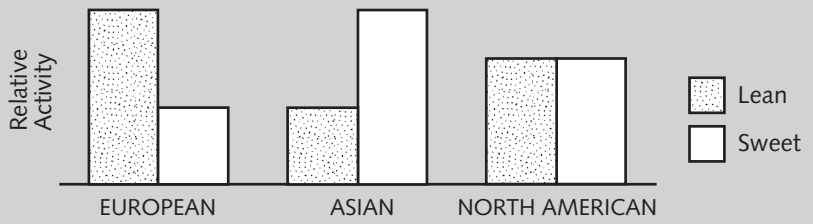
REGIONAL CHARACTERISTICS AND PREFERENCES

Sugar tolerance is one of the main characteristics that affects yeast performance, and one that varies the most between countries. The graph below shows the relative sugar tolerance of typical yeast strains used in Europe, Asia, and North America. It shows that European yeasts have been optimized for lean dough, Asian yeasts for sweet dough, and North American yeasts for a compromise between sweet and lean.

There are other performance differences that also reflect optimization for local practices. French yeasts tend to be slow-acting because long proof times are used for traditional breads. Dutch yeasts may be sensitive to calcium propionate because its use is not permitted. English yeasts are usually fast-acting because of the short Chorleywood process and are relatively resistant to calcium propionate because of its widespread use.

Some yeast characteristics seem to vary by country just because of local preference. U.S. and Canadian bakers like their cake yeast to be light in color, dry to the touch, and friable (easy to crumble). Portuguese bakers like their cake yeast dark, moist, and pliable. Most other bakers prefer, or have gotten used to, something in between.

SUGAR TOLERANCE OF TYPICAL YEAST STRAINS



Lallemand Yeast Products

LALLEMAND Inc. is a privately held company producing yeast since since 1923. The company owns and operates manufacturing facilities in North America and Europe that produce bakers yeast, wine yeasts, yeast extracts, specialty yeasts, and bacteria.

Lallemand is a leading producer of yeast and baking ingredients, and supplies a full range of products to the baking industry through its subsidiaries Lallemand Distribution and American Yeast Sales.

YEAST

- Lallemand fresh yeast blocks and bags
- American fresh yeast blocks and bags
- Eagle® fresh yeast blocks and bags
- Bulk liquid cream yeast and installations
- Fermipan® instant yeast
- Instaferm® instant yeast

DOUGH CONDITIONERS

- Essential® PBR natural potassium bromate replacers for conventional and frozen doughs
- Essential® LCR natural L-cysteine and sulfite replacer
- Fermaid® potassium bromate replacers for conventional and frozen doughs
- Fermaid® Relax and Fermaid® P natural L-cysteine and sulfite replacers
- Eagle® CM potassium bromate replacer for continuous mix

OTHER BAKING INGREDIENTS AND PRODUCTS

- Chemical leaveners
- Yeast foods and oxidizers
- Preservatives
- Sugars and syrups
- Shortening
- Dairy and egg products
- Spices, nuts, fruits, and flavors
- Specialty flours and grains
- Emulsifiers
- Trough grease, oven and depanning oils.

Choosing the Right Yeast

(Continued)

typical sweet, lean, and combination yeast strains that have each been grown for optimal composition.

Bakers can take advantage of yeast differences to optimize the tradeoffs in their specific applications. Here are some recommendations:

- ***Evaluate yeasts in different applications.*** Combinations of recipes and processes affect different yeasts differently.
- ***Choose the yeast that works best in the most demanding application.*** A frozen dough producer should choose a slow yeast with good stability, because adding less of a faster yeast may not work. A no-time dough producer should choose a fast yeast with good oven spring because adding more of a slow yeast may not work.
- ***Adjust yeast dosage in the other applications.*** A no-time dough producer that also makes sponge and dough should use a fast strain and reduce the yeast dosage in the sponge.
- ***Watch for signs of overdosing.*** Dosage is not always interchangeable between yeasts. Poor oven spring, burn-out, or other symptoms may be caused by overdosing a faster or more active yeast.

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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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