LALLEMAND
# BAKING UPDATE
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**Preferments**

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

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## Measuring pH and TTA

Bakers measure pH and total titratable acidity (TTA) to monitor the progress of fermentation in a preferment. There is a correlation between fermentation and acidity because the yeast and bacteria in a preferment produce acetic acid, lactic acid, and other weak organic acids. When a simple acid (shown here as HA) dissolves in water, it dissociates into a hydrogen ion or proton ($H^+$) and an anion ($A^-$) according to this general reaction:

$$HA \rightarrow H^+ + A^-$$

Strong acids dissociate completely into hydrogen ions and anions, but weak acids dissociate only partially, and not all of the acid molecules generate hydrogen ions. pH measures hydrogen ion concentration and so gives a good indication of strong acid concentration but a poor indication of weak acid concentration.

When an acid (HA) and a base (BOH) are mixed together in water, they neutralize each other to form a salt (AB) and water ($H_2O$) according to this general reaction:

$$HA + BOH \rightarrow AB + H_2O$$

The amount of strong base required to neutralize an acid depends on the amount of acid present but not on the strength of the acid. This is the basis for the TTA determination, where a 10-gram sample of preferment is diluted in 50 milliliters of water, then neutralized with a 4-gram-per-liter solution of sodium hydroxide (NaOH) to pH 6.6. The resulting TTA value is reported as milliliters of NaOH.

Preferment pH starts at 5.0–5.5 and levels off at 4.0–4.5, with higher flour levels giving generally higher values. pH is important because it affects many of the biological and chemical processes taking place in dough. Lower pH levels decrease carbon dioxide solubility and increase the effectiveness of preservatives like calcium propi-

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## Working with Preferments

PREFERMENT IS THE general term for the sponge or brew step that is used at the start of many breadmaking processes to activate the yeast, contribute flavor, and develop the dough.

There are three basic types of preferments. A sponge or "plastic" preferment usually contains about 70 percent of the total dough flour and ferments in a trough for three to four hours. A flour brew or liquid sponge usually contains about 20 to 50 percent of the total dough flour and ferments in a tank for one to two hours. A water-brew or flour-free ferment usually contains sugar instead of flour and ferments in a tank for about an hour.

### YEAST ACTIVATION

Commercial bakers yeast is made up of dormant yeast cells that have to go through a lag phase before they start producing carbon dioxide gas at their highest rate. The preferment minimizes the lag phase by providing an optimum environment for the yeast. The result is higher gas production later in the process, especially in high-sugar doughs.

Yeast activation can be monitored in the laboratory by counting budding yeast cells or measuring gas production, and in the bakery by checking final proof times and loaf volumes.

Yeast activation takes place during the first 30 to 60 minutes in all types of preferments. Longer preferment times are not necessary for yeast activation, and can have a negative effect because yeast start to lose activity once the available sugar has been consumed. The only reason for longer preferments is for flavor contribution or dough development.

### FLAVOR CONTRIBUTION

Bread taste and flavor precursors are produced in the preferment by yeast and the lactic acid bacteria that accompany yeast and flour. The precursors include alcohols and organic acids that react with other compounds during baking and contribute to the taste and flavor of the finished product. The flavor contribution from water-brew systems is minimal and increases with the amount of flour present in flour-brew and sponge systems.

Flavor contribution can be monitored by measuring the TTA (total titratable acidity) in the preferment—the higher the TTA, the more flavor. The optimum TTA depends on the product, and higher levels can cause a sour off-flavor. TTA and flavor contribution in the preferment can be controlled by

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### PREFERMENT CHARACTERISTICS

| | WATER BREW | FLOUR BREW | SPONGE |
|---|---|---|---|
| **INGREDIENTS** | | | |
| Flour | 0% | 20–50% | 70% |
| Sugar | 2–4% | 0–3% | 0% |
| Yeast | 3.0–4.0% | 3.0–4.0% | 2.0–3.0% |
| **PROCESS** | | | |
| Set Temperature | 80°–85°F | 75°–80°F | 75°–80°F |
| Final Temperature | 90°–95°F | 80°–85°F | 85°–90°F |
| Fermentation Time | 1 hour | 1–2 hours | 3–4 hours |
| **FUNCTIONS** | | | |
| Yeast Activation | Yes | Yes | Yes |
| Flavor Development | Low | Medium | High |
| Dough Development | Low | Medium | High |
| **ACIDITY** | | | |
| pH | 3.8–4.4 | 4.4–4.8 | 4.8–5.2 |
| TTA (ml 0.1N NaOH) | 10–12 | 6–10 | 4–6 |

## Measuring pH and TTA

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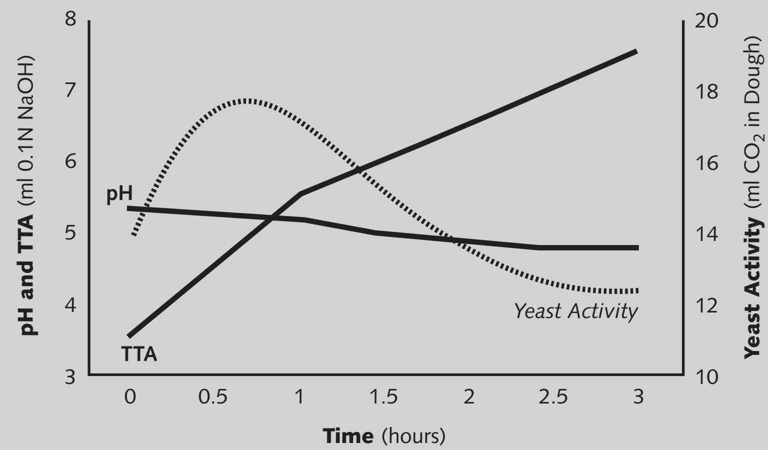
onate. The optimum is 4.2 for gluten swelling and between 4 and 6 for yeast activity.

Preferment TTA starts at 3–4 and continues to increase to 6–12, with higher flour levels giving generally lower values. TTA is a better indicator of fermentation activity than pH is because it continues to increase after pH levels off. Monitoring fermentation progress is important when optimizing the effects of preferments on yeast activity, flavor contribution, and dough development.

The graph to the right shows a 50-percent flour preferment where yeast activity peaks at about one hour, pH levels off after about 2.5 hours, and TTA continues to increase beyond three hours. If the optimum fermentation activity for this product was at two hours, the optimum TTA would be 6.5. This TTA value can be used to standardize the results with other preferments even if time and temperatures vary.

### EFFECT OF TIME ON PREFERMENT CHARACTERISTICS




50% flour preferment with 1% sugar added.
Yeast activity measured in dough with 14% sugar.

## Working with Preferments *(Continued)*

varying the same time, temperature, and ingredient factors that affect yeast activation.

### DOUGH DEVELOPMENT

Dough development in the preferment is important because it affects the mixing, consistency, and gas retention of the final dough that in turn affect the volume, texture, and overall quality of the finished product. It is not known exactly how the preferment affects dough development, but several factors are involved. Water in the preferment hydrates the starch and gluten, alcohol changes the liquid/solid/gas interfaces, carbon dioxide bubbles work the dough, and enzymes from yeast react with the gluten.

Dough development in the final dough depends on mixing, the oxidation system, and the preferment. The amount of dough development in the preferment depends mostly on time, pH, and the amount of flour—the longer the time, the lower the pH, and the more flour, the greater the dough development. The dough development contribution in water-brew systems is minimal and increases with the amount of flour present in flour-brew and sponge systems. Dough development is usually controlled by varying the preferment time. It can also be decreased by adding salt to reduce the fermentation rate and lessen the amount of gluten hydration.

### OPTIMIZATION

Optimizing the preferment for a given breadmaking system can require trade-offs because fermentation affects gas production, flavor contribution, and dough development at the same time but not in the same way. In practice, dough development is usually the most important variable to optimize, taking precedence over the others.

Optimizing dough development means matching gas retention to gas production in the proofed dough when it is put into the oven. A well-developed dough is dry, pliable, and retains gas well to produce a large volume with a fine grain. Underdeveloped dough is tough, rubbery, and lacks the extensibility needed to retain gas well. Overdeveloped dough is wet, stringy, and lacks the strength needed to retain gas well.

Here are some recommendations for optimizing preferments, with an emphasis on the factors that affect dough development:

- ***Time and temperature.*** To increase dough development, increase preferment time and temperature. To decrease dough development, decrease preferment time and temperature. A minimum of 30 to 60 minutes is enough for yeast activation. Generally, a longer prefermentation time contributes to better flavor.
- ***Ingredients.*** To increase dough development, remove salt and add flour, yeast, yeast food, and sugar. To decrease dough development, add salt and reduce flour, yeast, yeast food, and sugar. Use acid yeast food only if the water is alkaline. More flour in the preferment usually contributes to better flavor.
- ***Yeast addition point.*** Adding yeast to the preferment increases yeast activation, flavor contribution, and dough development. Adding yeast, or "spiking," at the dough side shortens the final proof time, which decreases flavor contribution and dough development.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