

# BAKING UPDATE

## Bromate Replacement

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



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### Lallemand Facilities

Lallemand Inc. is a privately held company producing yeast 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.

Through its subsidiaries, Lallemand Distribution and American Yeast Sales, Lallemand offers a full range of ingredients to the baking industry through a growing network of sales, technical service, and distribution locations.

#### American Yeast/Lallemand North American Sales and Distribution Headquarters

- Derry, New Hampshire


#### Technical Center

- Montréal, Québec

#### North American Yeast Production Facilities

- Montréal, Québec
- Baltimore, Maryland
- Bakersfield, California

#### North American Distribution Branches

- Atlanta, GA
- Jacksonville, FL
- Bakersfield, CA
- Montréal, Québec
- Baltimore, MD
- Phoenix, AZ
- Dallas, TX
- Toronto, Ontario
- Derry, NH 

### A Guide to Bromate Replacer Ingredients

**P**OTASSIUM BROMATE has been the oxidizing agent of choice for American bakers because of its slow action, good oven spring, and high tolerance. Current baking technology has been developed around the use of bromate, and its voluntary or mandatory elimination poses a major challenge.

Bromate works on the gluten in flour to increase its strength and produce larger, more uniform finished products. It can be mixed into flour, added with yeast food to the sponge or brew stage, or added separately at mixing. No matter when it is added, bromate's slow action means it works primarily during proofing and baking.


Most other oxidizing agents act faster than bromate, making them less versatile and effective. As a result, most bromate replacers have to use a combination of ingredients to control the amount and timing of oxidation. Here is a summary of ingredient pros and cons, with additional data given in the table below.

**Ascorbic acid** is a natural oxidizing agent that is probably the most widely used bromate replacer ingredient. It is label-

friendly but gives longer mix times, less oven spring, and firmer crumb than bromate.

**Chemical oxidizing agents** include ADA, iodate, and calcium peroxide. They can be used to enhance the effectiveness of ascorbic acid but are faster, stronger oxidizing agents. They are not label-friendly and have less tolerance than ascorbic acid.

**Enzymes** are natural ingredients that can be used with ascorbic acid to enhance oxidation and compensate for its shortcomings. They improve oven spring, soften crumb, and are label-friendly. Enzymes (especially fungal enzymes) are more tolerant than chemicals, but their variety of functions and characteristics can make evaluation more complex.

**Other ingredients** include dough relaxers like cysteine and multipurpose conditioners like DATEM. These ingredients have characteristics that make up for ascorbic acid's shortcomings but may also conflict with other dough conditioners and ingredients. 

### BROMATE AND REPLACER INGREDIENTS

COMPOUND	FUNCTION	CONSIDERATIONS
Potassium Bromate	Slow oxidizer	Used alone as the oxidative agent of choice
Ascorbic Acid	Intermediate oxidizer	Requires oxygen, so is less effective in continuous mix
Calcium Peroxide	Fast oxidizer	Usually used with ascorbic acid
ADA (Azodicarbonamide)	Fast oxidizer	Critical dosing with limited tolerance
Potassium and Calcium Iodate	Fast oxidizer	Critical dosing with limited tolerance
Oxidative Enzymes (lipoxygenase, glucose oxidase, sulfhydryl oxidase)	Form oxygen via hydrogen peroxide	Usually used with ascorbic acid
Carbohydrase Enzymes (fungal <i>alpha</i> -amylase, hemicellulase)	Act on starch and fiber during baking	Used with ascorbic acid to improve oven spring and freshness
Cysteine and Glutathione	Act on gluten during mixing to relax dough	Used with fast chemical oxidizers to shorten mix time and improve handling
Yeast Components	Natural source of glutathione and enzymes	Used with fast chemical oxidizers and with enzymes for an all-natural system

## International Perspective:

### BRITISH BROMATE REPLACEMENT EXPERIENCE

**B**romate approval in Great Britain was withdrawn in 1990 with about one year's advance notice. The experience is interesting from an American perspective because Britain's baking industry is similar to the U.S. and Canada. It includes a large production of white pan bread by wholesale bakeries using high-speed equipment.

Iodates are not approved in Great Britain, and the most common replacer has been ascorbic acid. The most common problems have been increased mix time, incomplete dough development, poor gas retention, increased cripple rates, and faster staling. Direct costs for dough conditioners have increased about twenty percent with the use of ascorbic acid and the additional need for antistaling agents (emulsifiers and enzymes). Indirect costs for reformulation and higher cripple rates have also increased.

Some of the British problems and costs are a result of the widespread use of the Chorleywood process. This process depends on mechanical dough development and takes place in the absence of air. Since air is required for ascorbic acid to work efficiently and iodates are not allowed, this application is especially challenging. The most similar American process is continuous mix, which also takes place in the absence of air and so presents some of the same problems.

## Essential® PBR

**T**HE ESSENTIAL® PBR line of bromate replacers was developed based on the European experience with bromate-free baking and the British experience with bromate replacement. The products are derived from European bread improvers, but were developed in American bakeries for American recipes and processes.

Essential® PBR uses ascorbic acid to replace the oxidative action of bromate, and a combination of enzymes and yeast components to make up for ascorbate's shortcomings. The oxidative enzymes in Essential® PBR make ascorbic acid more effective by regenerating its active form when it's needed—during proofing and baking. The carbohydrase enzymes also act during proofing and baking to restore normal oven spring, crumb texture, and softness. The nonleavening yeast components contribute glutathione to restore normal mix time, dough development, and handling during make-up.

Essential® PBR is effective because it replaces the major functions of bromate in a balanced way with high tolerance. It is more forgiving during breakdowns and process changes than chemical systems that rely on stronger oxidizers. And because its fungal enzymes are inactivated during baking, it cannot cause stickiness or gumminess in the finished product.

Essential® PBR is an economical bromate replacement alternative. It's priced competitively against less effective chemi-

cal products, and it offers the potential for additional savings in recipes where it replaces other dough conditioners.

Essential® PBR is label-friendly because it contains only natural ingredients and is used with natural ascorbic acid. Because it does not rely on chemical components that may come under regulatory scrutiny in the future, Essential® PBR offers a long-term solution that may also avoid future reformulation and labeling costs.

Essential® PBR formulations are available for most products and systems, including sponge and dough, flour brew, straight dough, and frozen dough.

#### Essential® PBR-200 DF

A multifunctional bromate replacement system containing dough-improving yeast components and fungal enzymes (to be used with ascorbic acid and/or ADA).


#### Essential® PBR-100

A bromate replacement system to be used when there is no need for mix time reduction (to be used with ascorbic acid and/or ADA).

#### Essential® PBR-30

A bulk version bromate replacement system for ease of scaling (to be used with ascorbic acid and/or ADA).


#### Essential® PBR-FD

A bromate replacement system specially formulated for frozen dough. 

## Dough Oxidation Chemistry

Flour proteins contain amino acids with reactive sulfhydryl groups. In the native or reduced state, the flour proteins exist as separate entities. During the oxidation process, pairs of sulfhydryls become linked together in disulfide bonds. Because each protein has several sulfhydryl groups, one protein can become linked to several other proteins resulting in the formation of a network of chemically bonded proteins.

This cross-linked network of protein molecules is the primary determinant of dough structure and rheology. The stretching and pulling that occurs during mixing is beneficial because it breaks some of the disulfide bonds so that they can be reformed during baking. The primary effect of bromate is probably to increase the number of cross-links, especially during baking.

The wheat variety, milling conditions, flour age, and baking process all affect dough oxidation chemistry. In general, low extraction older flours with sponge and dough processing require less oxidation. In general, high extraction younger flours with no-time dough processing require more. 

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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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