LALLEMAND
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Enzymes

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

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A Guide to Baking Enzymes

ENZYMES ARE USED as flour additives and dough conditioners to replace chemical ingredients and to perform other functions in a label-friendly way. Understanding their characteristics can help millers, ingredient suppliers, and bakers use enzymes more effectively.

TYPES OF ENZYMES

Amylases break down the starch in flour into dextrins and sugars. *Alpha*-amylase and *beta*-amylase occur naturally in wheat, but the natural level of *alpha*-amylase is usually too low and variable for optimal breadmaking.

Malt is used to standardize the *alpha*-amylase activity of most bread flour. Malted wheat or barley flour is added at the mill, or diastatic malt syrup can be added at the bakery.

Fungal amylase is also used to standardize the *alpha*-amylase activity of bread flour. Additional fungal amylase is used in dough conditioners to improve oven spring.

Other amylases are more temperature stable so that they work at later stages of baking. These intermediate stability, maltogenic, bacterial, and thermostable amylases are used primarily in antistaling products because they convert more of the starch into forms that resist firming.

Glucoamylase breaks down the dextrins generated by amylases into glucose sugar. Glucose is easier for yeast to ferment than maltose, and can be used to partially replace other sugars in the recipe.

Hemicellulase breaks down the hemicellulose or pentosans in wheat flour, rye flour, and fiber supplements. This releases bound water into the dough to improve machinability and loaf volume.

Lactase breaks down the lactose sugar in dairy products into glucose and galactose sugars. The glucose contributes to yeast fermentation, while the galactose contributes the same crumb color enhancement as lactose.

Protease breaks down the gluten protein in wheat flour. For breadmaking this can improve gas retention, but with a tradeoff for less tolerance. For cracker production this improves machinability, with gas retention not as important.

Lipoxygenase from soy flour oxidizes the fats in flour to form peroxides. The peroxides bleach the flour pigments, which results in a whiter crumb color.

Glucose oxidase oxidizes ascorbic acid to dehydro-ascorbic acid. The dehydro-ascorbic acid modifies the gluten protein by forming linkages that increase its strength.

GENERAL CHARACTERISTICS

Enzymes are large proteins that act as catalysts to speed up reactions without themselves being changed. They are produced by plants, animals, and microorganisms but are not living organisms themselves. Enzymes are highly active so that only small quantities are required, and highly specific so that a single enzyme usually catalyzes only a single reaction. Each enzyme has its own pH and temperature range, and the progress of its reaction depends on those conditions along with time and concentration.

Enzymes are named for the compounds they work on (carbohydrases, proteases, lipases) and the kinds of reactions they catalyze (hydrolases, oxidases). Most commercial enzymes are produced from microorganisms, so their genus and species is also an important way of identifying them.

Enzyme preparations are complex mixtures that normally contain more than one activity, but they are usually standardized and sold on the basis of a single activity measurement. Depending on the application, other "side activities" may also be relevant.

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BAKING ENZYMES

NAME	FUNCTION	APPLICATIONS
Malt flour	Breaks down starch, produces maltose sugar	Flour standardization
Fungal amylase	Breaks down starch, produces maltose sugar	Flour standardization, dough conditioners, sweetening
Bacterial amylase	Breaks down starch	Dough conditioners, antistaling
Thermostable amylase	Breaks down starch	Antistaling
Intermediate stability amylase	Breaks down starch	Antistaling
Maltogenic amylase	Breaks down starch, produces maltose sugar	Antistaling
Glucoamylase	Produces glucose sugar	Sweetening
Hemicellulase/ Pentosanase	Breaks down fiber, releases bound water	Dough conditioners
Fungal lactase	Breaks down lactose, produces glucose sugar	Sweetening
Fungal protease	Breaks down gluten	Flour standardization, dough conditioners, cracker production
Bacterial protease	Breaks down gluten	Cracker production
Bromelain	Breaks down gluten	Flour standardization
Lipoxygenase	Oxidizes fats, bleaches flour pigments	Crumb whitening
Glucose oxidase	Oxidizes ascorbic acid, modifies gluten	Dough conditioners

Regulatory Perspective:

U.S. AND CANADIAN REGULATIONS

In the U.S. most enzymes approved for food use by the FDA are considered GRAS (Generally Recognized As Safe) with a maximum use level consistent with GMP (Good Manufacturing Practice). The use and labeling of enzymes for specific applications in flour and baked goods is governed by Title 21 of the Code of Federal Regulations.

Malt and fungal *alpha*-amylase from *Aspergillus oryzae* are permitted to standardize wheat flour under 21 CFR 137.105. Malt must be labeled as "malted wheat," "malted wheat flour," or "malted barley flour" in both the flour and finished product. Fungal *alpha*-amylase may be labeled in the flour as "Fungal *alpha*-amylase," "Fungal α-amylase," "Enzyme," or "Enzyme added for improved baking." It may be labeled the same way in the finished product or exempted from labeling as a processing aid.

"Enzyme active preparations" are permitted for use in baked goods with specific standards of identity under 21 CFR 136.110 through 136.180. This includes regular, enriched, milk, raisin, and whole wheat bread, rolls, and buns.

Enzymes are exempted from ingredient labeling when they are used as "processing aids" under 21 CFR 101.100. The exemption applies when enzymes are added to a food for their technical or functional effect in the processing but are present in the finished food at insignificant levels and do not have any technical or functional effect in that food.

Enzymes are considered "natural" for label claims because they are obtained from natural plant, animal, and microbial sources.

In Canada, the use of enzyme preparations in bread and flour is provided for in Section B.16.100, Table V, of the Canadian Food and Drug Regulations. The maximum use level in bread or flour is Good Manufacturing Practice. In general the Canadian and U.S. approval criteria are similar, but the Canadian regulations allow a wider variety of enzymes as additives to be used in flour and fewer as ingredients in baked goods.

The regulations mentioned have been paraphrased. Only the regulations themselves as updated in the U.S. Federal Register *and* Canada Gazette *should be used for legal guidance.*

Bakezyme® Baking Enzymes

GIST-BROCADES is one of the world's leading enzyme producers, with a range of baking enzymes to solve baking problems.

Bakezyme® enzyme concentrates include several of the most common baking enzymes and are intended primarily for blend and mix manufacturers.

Essential®, Fermaid®, and Eagle® enzyme-based dough conditioners are ready-to-use products for specific wholesale baking applications. These products are blends of enzymes and other natural or conventional ingredients.

Gist-brocades enzymes are available throughout the U.S., Canada, and Mexico from its exclusive North American distributor, Lallemand and American Yeast Sales, backed with the same quality, delivery, and technical support.

ENZYME CONCENTRATES FOR BLEND AND MIX MANUFACTURERS

Bakezyme® P – Fungal amylase for general improvements in bread quality

Bakezyme® H – Fungal amylase for additional loaf volume and crumb softness and improved machinability in high-fiber doughs

Bakezyme® PS/Bakezyme® PFP – Fungal amylase/protease for improved bread quality made from strong flours

Bakezyme® AG – Fungal glucoamylase for sugar replacement in low-sugar doughs

Bakezyme® B – Bacterial protease for improved machinability and extensibility of biscuit and cracker doughs

ENZYME-BASED DOUGH CONDITIONERS FOR WHOLESALE BAKERS

Essential® PBR – Potassium bromate replacers for conventional and frozen doughs

Fermaid® – Potassium bromate replacers for conventional and frozen doughs

Eagle® CM – Potassium bromate replacer for continuous mix

Bakezyme® is a trademark of Royal Gist-brocades NV, Delft, Holland.

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Enzyme activity is measured using assay procedures that are usually different from application conditions and generally vary between enzyme suppliers. Addition levels and product comparisons should be based on baking trials, not activity specifications.

The shelf life and storage conditions for enzymes depend on their physical form. Liquids usually have the shortest shelf life and should be stored under refrigeration. Powders and tablets are usually stable for a year or more when stored at room temperature.

Because enzymes are proteins, skin contact and inhalation of dust or aerosols can cause allergic reactions in some sensitive individuals. Prolonged contact with concentrated proteases can also cause skin and eye irritation. Proper handling procedures should be provided on a Material Safety Data Sheet (MSDS). Additional information is provided in the brochure *Working Safely With Enzymes*, which is available from Lallemand or from the Enzyme Technical Association, 1575 Eye Street, N.W., Suite 800, Washington, D.C. 20005.

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