



NATBIO
PUTTING NATURE FIRST



BAKING & CONFECTIONARY

PRODUCTS FOR THE FOOD INDUSTRY | NATURE BIOCHEM

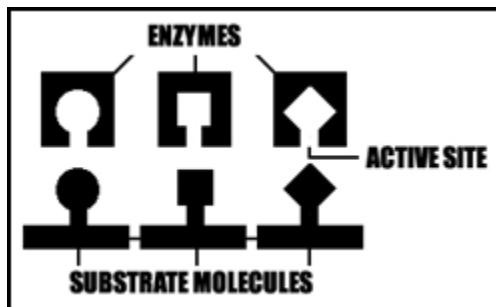
Enzymes

What are enzymes?

Enzymes are proteins which catalyse, or speed up, biological reactions. Enzymes usually have an -ase suffix, eg. lactase, protease, amylase and so on.

Biological reactions are the reactions that occur in living things. For example, when we eat food we need to digest it. Without enzymes in our bodies, digestion could take weeks instead of a matter of hours. Enzymes are specific for a certain reaction, for example, the enzyme lactase will only work in reactions where the chemical lactose is present.

This diagram explains what happens:



Each enzyme, for example lactase, has an active site where the substrate molecules bind to the enzyme. Each enzyme's active site has the right "shape" for a certain substrate molecule but no other. This is like a jigsaw puzzle where only certain pieces fit together.

Enzymes also have temperatures and pH levels which are optimum for them. The whole process looks like this:

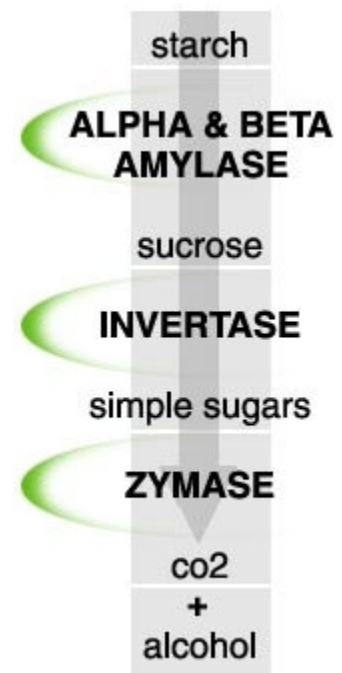
Enzymes in Breadmaking

Several enzyme catalysed reactions occur during breadmaking. First, starch has to be broken down into sugar. The sugar then has to be broken down into simple sugars to allow yeast to react with these sugars during the process called fermentation (rising).

Starch is made up of many glucose units joined together but yeast can't digest starch unless it is broken down into glucose units.

Enzyme digestion of starch can occur in two main ways by damaging starch mechanically, or by gelatinising it.

Damaged starch sounds as if it has been ruined for baking, but this is not true. It simply means that some starch granules have been crushed, broken or chipped during the milling process. In fact, some starch damage is highly desirable in bread flour and 6% damage (of the total quantity of starch present) is considered about right.



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 bread making.

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 maltogenic, bacterial, and thermostable amylases are used primarily in anti-staling 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 hemicelluloses 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 bread making 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 dehydroascorbic acid modifies the gluten protein by forming linkages that increase its strength.

| 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, | Dough conditioners |

Several enzymes are required in dough to convert starch into simple sugars that yeast can feed on. This is a complex process and involves the enzymes alpha and beta amylase. If these enzymes are present they can digest starch and provide the sugars for yeast fermentation.

Starch exists in two different forms - an unbranched chain form called amylose and a branched form called amylopectin. Enzymes that digest starch are called amylases. There are two important enzymes that digest these types of starch alpha-amylase and beta-amylase.



Alpha-amylase

Dough must contain some alpha-amylase to digest the amylopectin part of starch, but if dough contains too much of this enzyme it can completely liquify starch.

Alpha-amylase attacks starch practically anywhere along its chains, producing smaller chains of various lengths. These chains can contain one unit (glucose), two units (maltose) or larger units called dextrans that contain many glucose units. In a dough, beta-amylase can then digest these dextrans into maltose.

Beta-amylase

Cereal grains and flour always have an adequate supply of beta-amylase that can digest amylose completely into sugars. Beta-amylase attacks amylose chains and breaks them into molecules of maltose. Maltose is a disaccharide containing two glucose molecules.

Beta-amylase will also start digesting amylopectin from one end of the molecule but it cannot break the branches so digestion stops whenever it comes to a branch. Therefore, beta-amylase digestion of starch results in a mixture of maltose and larger dextrans. Yeast produces the enzyme maltase to break maltose into glucose molecules that it can ferment.

Once the starch has been broken down into these simple sugars, other enzymes in yeast act upon simple sugars to produce alcohol and carbon dioxide in the bread making step called fermentation. Sucrose (sugar) can't be fermented directly by the yeast enzyme, zymase. One of yeast's other enzymes, invertase, must first digest sucrose into glucose and fructose. The yeast enzyme, zymase, then ferments these sugars.

Types of Bread

There are three main kinds of bread in the world:

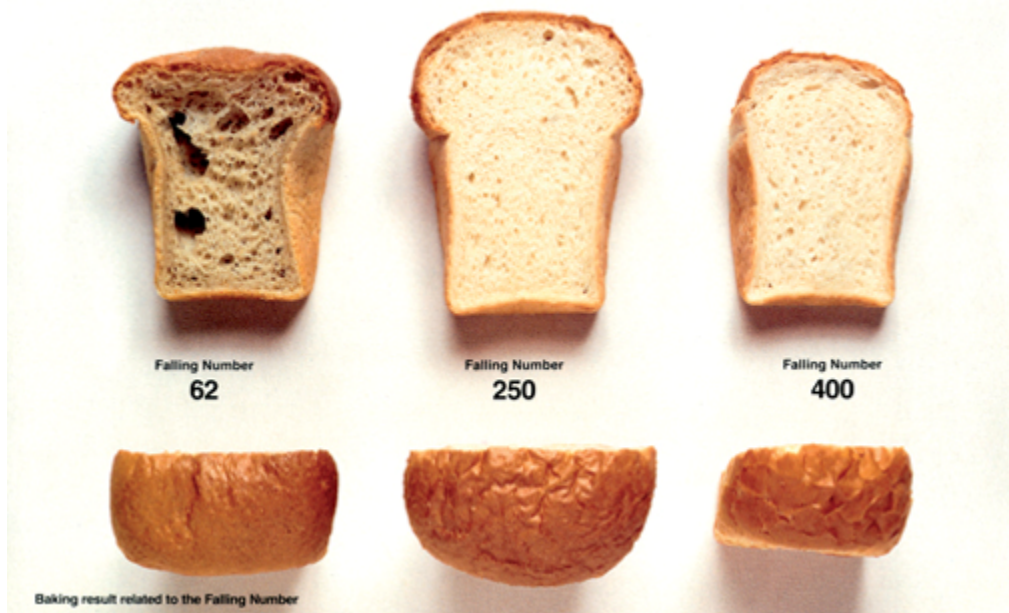
- those that rise highest and so have to be baked in pans,
- those with a medium volume, like rye and French breads
- those that hardly rise at all and consequently are called flatbreads.

Breadmaking involves the following basic steps:

- Mixing ingredients
- Rising (fermentation)
- Kneading
- Second Rising
- Baking
- Cooling



Falling Number in flour milling and baking



A certain amount of alpha-amylase is necessary for proper baking to occur. The alpha-amylase breaks down starches to provide sugars to help fuel the fermentation process. The amount of enzyme present can have a direct bearing upon the quality of bread produced. When the alpha-amylase activity is right, a high volume bread with firm and soft texture is achieved (FN = 250 in picture). If the activity is too high, a sticky bread crumb and low volume may result (FN = 62 in picture). If the activity is too low, a dry bread crumb with diminished volume may result (FN = 400 in picture). The FN value has an inverse relationship with the alpha-amylase activity meaning the higher the alpha-amylase activity the lower the FN value, and vice-versa.

Millers may use the FN value to produce products with desired or specific FN values. They may blend flours of various FN values to produce a product with a specific amylase activity. Malt can be added to adjust the value in a similar manner.

The exact FN number value desired will be dependent on the type of product to be produced. Breads flours will have different FN values than those of cracker flours. Bakers may use the FN to dictate to their suppliers the type of product they require for their specific endproduct. Bakers also have the option of manipulating their flours in the same manner as the miller. But by requiring the miller to supply a specific product, a baker can receive a consistent product and would not have to adjust this particular aspect of the baking process. Quality control personnel can use the FN value as a quality control tool to help assure the consistency of both incoming and outgoing products. It provides another important tool for savings of time and money.

Cake and Confectionery

Cakes are distinguished from breads in that they are usually sweet, with many other ingredients besides flour. Flour, fat, raising agents, eggs, sugar and fruit are the most common ingredients but other ingredients are limited only by the ingenuity of the baker.

Cakes fall into two basic categories: those made with fat, and the sponge types made without fat. The exception of the sponge type is the Genoese sponge which combines both types.

Mixing is a very important aspect of successful cake making. There are several methods and all have the same aims:

- to blend the ingredients into a smooth, even batter
- to beat the maximum amount of air into the batter
- to form a batter that will hold the air until it is baked ie be stable
- to develop a desirable visual texture, volume and mouth-feel texture in the baked product
- Some of the most commonly used mixing methods include 'whisking' or 'whipping', 'creaming', and the 'all in' method.

Overall, for anyone baking cakes, experience is the best teacher. The problem of under or over mixing is always present and understanding mixing is the key to successful cake making.

Some key points to ensure successful cake-making include:

- Always use the correct size tin, or ensure that the cake batter fills the tin to half its depth so that the cake will rise, but not over the top.
- Test the cake frequently near the recommended baking time to see if it is baked.
- Prepare the tin ahead of mixing by lining or greasing with butter and sprinkling with flour.
- Set the oven to the correct temperature before mixing.
- Assemble all the necessary ingredients. Remember that butter, margarine and eggs should be at room temperature (20°C) before use.



ENZYME PRODUCTS FOR FLOUR AND BREAD IMPROVER PREMIX BLENDS:

NzyBake FA – Fungal amylase for improvement in shelf life and baking volume.

NzyBake FH – Fungal hemi-cellulase for improvement in fermentation tolerance and crumb structure.

NzyBake BH – Bacterial hemi-cellulase for improved dough characteristics and gas retention.

NzyBake GO – Glucose oxidase for improved rheological properties and strong gluten matrix.

NzyBake LP - Fungal lipase for dough stability and shelf life. Also helps in crumb softness.

NzyBake PLP – Phospholipase used as an emulsifier replacer that gives effects equal to DATEM & SSL.

NzyBake FP – Fungal Protease used to opening up gluten network.

NzyBake BP – Bacterial Protease used to break down gluten network for wafers, crackers, biscuits.

NzyBake GA – Fungal Glucoamylase for improvement in browning and softness.

NzyBake AS – Anti-Staling enzyme for improvement in shelf life during storage.

ENZYME PRODUCTS FOR CAKES AND MUFFINS:

NzyCake PLC – Phospholipase for improvement in cake structure and shelf life. Contributes to softness that lasts. Improves overall quality of pound cakes, sponge cakes and muffins.

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