LALLEMAND

BAKING UPDATE

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Bread Flavor

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

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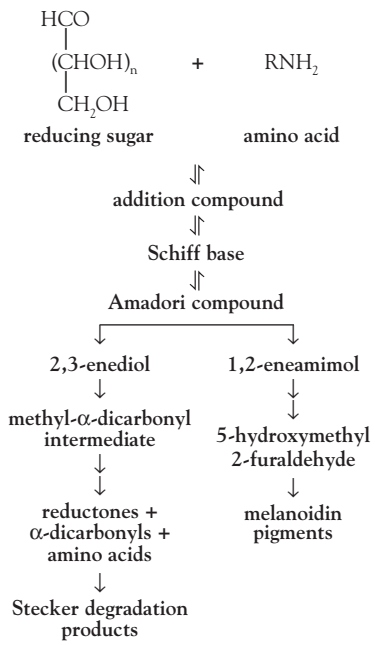
Maillard Browning Reaction

Crust coloring during baking results from caramelization of sugars, and from the Maillard reactions between reducing sugars and amino acids. Both require heat and are nonenzymatic, but Maillard reactions require less heat and are especially interesting because of the large number of end products that result from a small number of reactants.

Glucose, fructose, maltose, and lactose are common reducing sugars in bread. Sucrose is not a reducing sugar, but yeast or acid invert sucrose to produce glucose and fructose. Flour contains most of the common amino acids, and yeast fermentation increases the levels of free amino acids, including lysine, alanine, proline, and cystine.



Maillard reactions take place in stages, beginning with the combination of an aldehyde group (-CHO) from a reducing

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Bread Flavor

BREAD FLAVOR, along with appearance, is a key factor affecting consumer perceptions of quality and consistency. Understanding the way that ingredients and processing affect bread flavor can help bakers maintain uniformity, duplicate the appeal of traditional products, and develop more distinctive varieties.

Flavor perception is a complex phenomenon involving aroma, taste, and texture. Aroma refers to the volatile flavor components that are sensed by smell. Taste consists of the sweet, salt, sour, and bitter components that are sensed by tastebuds on the tongue and in the mouth. Besides these four traditional components there is a fifth component, umami, or enhanced intensity, that is also considered to be one of the basic tastes. Texture is the tactile sensation in the mouth that is perceived as chewing quality.

The desirable flavor of fresh white bread is usually described as a yeasty and wheaty aroma with a sweet, salty, and slightly sour taste. The crumb texture is soft and moist while the crust is crisp and dry. Variety breads have flavors that are distinctive or more pronounced, also depending on the ingredients and processing.

INGREDIENTS

Sugars are added as sucrose, glucose, lactose, and high fructose corn syrup, and are also contributed by enzymes acting on the starch in flour. The type of sugar affects its sweetening intensity, and its ability to participate in browning reactions.

Salt makes an important contribution to the desired flavor of bread, and without it white bread has a flat and unappealing taste. In particular, the perception of sweetness is enhanced by the amount of salt in the formula.

Yeast, in the form of a nonleavening yeast product or a yeast extract, has a flavor profile of its own, and can be used as a flavor enhancer in many food products including bread. Only when using very high levels of yeast (over 10 percent compressed yeast) the taste may become objectionable because of bitterness. Yeast fermentation affects bread flavor by transforming sugars (sweet) into carbon dioxide gas, ethanol (pungent), and smaller amounts of many other compounds, including acids, aldehydes, ketones, and other alcohols. Some of these fermentation products will further react during baking to produce a variety of new flavor components.

Flour contributes the characteristic flavor of white bread. Whole wheat, rye, soy, malt, and other specialty flours contribute their unique flavors to variety breads. Adding as little as 5 percent rye flour to white bread has an easily recognizable impact on the flavor.

Water absorption affects dough texture, which in turn affects flavor development. Slack doughs with high levels of unbound water, as in Italian ciabatta-type bread production, enhance crust color and flavor development during baking.

Acids are added as propionic acid, acetic acid (vinegar), and lactic acid and are also contributed by yeast and bacterial fermentation. Traditional sour dough methods use prolonged fermentation by lactic acid bacteria to produce the unique flavor of German rye bread, San Francisco sour dough, and French pain au levain. Organic acids are a component of the sour dough flavor, but adding them alone does not produce the same finished products.

Other ingredients contribute to the flavor of variety breads, including milk powder, fat (shortening, butter, oil) egg products, lecithin, seeds (sesame, poppy, caraway), fibers, spices, fruits, and nuts.

PROCESSING

Mixing develops the gluten protein in the flour, affecting gas retention and crumb texture. Bread produced by the continuous mix process has a finer, more uniform texture than bread produced by conventional mixing. Some consumers perceive the difference in texture as a lack of flavor, and this

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Bread Flavor *(Continued)*

perception may remain even when a flour brew or preferment step is used to increase the amount of fermentation aroma.

Fermentation takes place by the action of yeast and the bacteria which are normally associated with commercial yeast, malt, and flour. Fermentation produces organic acids which lower the pH and increase the TTA (total titratable acidity). It also produces alcohols, esters, ketones, and aldehydes that make up the slightly pungent flavor of freshly baked bread crumb. Fermentation time that is too long for water brews or flour brews increases the intensity of these flavor components to the point where they can become objectionable. Lowering the fermentation temperature allows longer fermentation times and produces a more appealing flavor.

Baking evaporates the moisture from the surface of the bread, allowing the temperature to rise above the boiling point of water and causing caramelization and Maillard reactions to occur. These nonenzymatic browning reactions transform sugars and amino acids as the crust develops. Crusty bread has more flavor than non-crusty bread because many of the Maillard reaction products migrate from the crust to the crumb where they bind to gelatinized starch. Baking at lower temperatures for longer times and adding steam at the start of the process enhance crust development. Steam changes the crust color from yellow-brown to dark brown-reddish by gelatinizing more of the starch so that it becomes dextrinized later in baking and is available for Maillard reactions.

Storage diminishes and changes the flavor of bread as some flavor components are lost faster than others. Sweet and salty tastes decrease with time, and the remaining sourness starts to become unpleasant. The desirable alcohol smell of yeast is lost, the wheaty odor is reduced, and the remaining doughy or starch aromas become unpleasant. The texture of the crumb becomes firmer and drier, while the texture of the crust becomes soft and leathery. Heating stale bread temporarily reverses some of the changes and releases aroma compounds that had been bound to starch.

Maillard Browning Reaction *(Continued)*

sugar with the amino group ($-NH_2$) of an amino acid to form a Schiff base intermediate. Schiff bases are unstable and they are quickly rearranged into what are known as Amadori compounds. Schiff bases and Amadori compounds are colorless, and the reactions that form them are reversible.

In the next stages, more than one hundred different components can be produced from Amadori compounds through various condensation, isomerization, polymerization, cyclization, and degradation reactions. The major pathway leads over the 1,2-eneamimol of the Amadori compound to 5-hydroxymethyl-2-furaldehyde into the formation of melanoidin pigments. A minor pathway leads over the 1,3-enediol and the methyl *alpha*-dicarbonyls intermediate to various C-methyl reductones and *alpha*-dicarbonyls. A third important branch of the Maillard reaction involves the Stecker degradation of *alpha*-amino acids into aldehydes.

The products of these various pathways range from colorless to intensely colored and many are volatile aroma compounds. They include heterocyclic compounds (mostly pyrazines), nonheterocyclic compounds (such as thiophenes, oxazoles or oxazolines), and pyranones, furanones, and related compounds.

Lallemand Flavor Products

LALLEMAND provides a complete line of yeast, yeast extracts, sour dough flavors, and starter cultures. The inactive yeast components in Lallemand's natural dough conditioners contribute flavor along with functionality and nutritional enrichment.

Essential® LCR 100 is a natural dough relaxer that can be used to replace chemical reducing agents such as L-cysteine and sulfites. It contains nonleavening *Saccharomyces cerevisiae* yeast components that also enhance yeasty flavor notes.

Fermaid® RELAX is a natural dough conditioner that can be used to reduce mixing requirements and improve dough extensibility. It contains autolyzed *Saccharomyces cerevisiae* yeast components that contribute a yeasty aroma.

Fermaid® T is a natural dough conditioner that functions as a unique dough relaxer and fat replacer, especially in regular and low-fat flour tortillas. It contains nonleavening but intact yeast cells with a high glutathione content and a pleasant yeasty aroma.

LBI 2163 is a general purpose savory flavor enhancer that increases salt perception in low-salt applications. It contains primary grown torula yeast and can be used to improve the taste of bread prepared with reduced levels of salt.

LBI 4060 is a dried sour dough product based on wheat flour. LBI 4060 is produced by carefully drying a ferment obtained by a traditional multistage fermentation and ripening process of wheat flour with selected lactic acid bacteria strains.

LBI 4080 is a dried German rye sour dough product, which can be used not only as a convenience product when producing rye breads, but also to improve the taste and flavor of regular white bread. LBI 4080 is produced by carefully drying a ferment obtained by a traditional multistage fermentation and ripening process of rye flour with selected lactic acid bacteria strains.

Lallemand Rye Flavor is a blend of food-approved acids with ground caraway spice and is used to enhance the flavor of rye bread. The combination of increased acidity and caraway flavor produces a "European"-style rye bread with increased customer appeal.

Lallemand Bakery Starter Cultures are blends of selected yeast and lactic acid bacteria strains and are used to produce traditional French "pain au levain" bread using a 24-hour sponge (poolish). Using Lallemand Bakery Starter Cultures instead of relying on the bacterial microflora of flour improves quality and consistency.

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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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