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LALLEMAND

BAKING UPDATE

Flour Quality

Practical technology from Lallemand Inc.

How Flour Affects Bread Quality

FLOUR PERFORMANCE depends on its composition, which in turn depends on wheat characteristics and milling. The quality of bread flour is determined by its ability to produce a consistent finished product with these characteristics:

- High loaf volume
- Symmetrical loaf shape
- Attractive and even crust color
- Fine and uniform crumb structure
- Smooth texture
- Light crumb color
- High absorption (moisture content)
- Tolerance to processing variations
- Tolerance to ingredient variations

WHEAT AND MILLING CHARACTERISTICS

Wheat classes are based on the hardness, color, and growing season of the wheat varieties. Hard wheats have a higher protein content than soft wheats and are used mostly for yeast-raised products. Soft wheats are used mostly for chemically leavened products. Durum wheats are a type of hard wheat used mostly for pasta products. Color refers to the red, white, or amber appearance of the bran on the outside of the kernel. Winter wheat is planted in the fall and harvested in early summer. Spring wheat is planted in the spring and harvested in late summer.

Growing conditions interact with the wheat variety to affect its quality. High soil fertility and low moisture during the growing season give higher wheat protein. Low soil fertility and high moisture give lower wheat protein. High moisture during harvest negatively affects quality, as sprouting may occur thereby increasing the amylase enzyme level.

Wheat grades are based on government standards. The grade standards include bushel weight, heat damage, foreign matter, broken kernels, and presence of wheat from other classes.

Milling separates the bran and germ fractions from the endosperm, which is used to make flour, and reduces endosperm particles to the correct size. A series of separation and sizing steps converts one hundred pounds of wheat into about seventy-five pounds of various flour types. Patent flour is made from the purest endosperm fraction with the lowest bran content. Clear flour is made from less pure fractions and has higher protein and bran content. Straight flour contains all the flour fractions and has a protein and bran content that falls in between the other two.

Flour treatment includes bleaching, maturing, malting, and enriching. Bleaching removes yellow endosperm pigments using oxidizing agents like benzoyl peroxide. Chemical maturing improves flour strength and tolerance using oxidizing agents like potassium bromate, ascorbic acid, or azodicarbonamide. Standardizing amylase activity in flour is accomplished by adding malted wheat or barley flour or fungal *alpha*-amylase. Enriching replaces a portion of the nutrients lost during milling and in the United States includes thiamine, riboflavin, niacin, iron, and (optionally) calcium.

Flour age and storage are important because fresh flour without chemical maturing lacks the strength and tolerance for breadmaking. Flour with chemical maturing may perform well when very fresh, but not for the five to twenty-one days after milling while it is respiring or "sweating." Flour is normally stable over a long period of time when stored properly but can deteriorate when exposed to extremes of temperature and humidity.

FLOUR COMPOSITION

Ash is the mineral residue remaining after organic matter has been incinerated. Wheat bran contains more minerals than does endosperm, so ash content roughly correlates with flour type. Typical ash levels are 0.4 to 0.45 percent for patent flours, 0.45 to 0.5 percent for straight flours, and approximately 0.6 percent for clear flours.

Continued

This issue was produced in consultation with B. L. D'Appolonia, Professor Emeritus, Department of Cereal Science, North Dakota State University, Fargo, ND 58105.

COMMON TYPES OF WHEAT AND FLOUR

WHEAT CLASS	FLOUR TYPE	PROTEIN RANGE	APPLICATIONS
Hard red spring	Clear	13.0–15.0%	Specialty breads
	High gluten	13.5–14.5%	Specialty breads
	Whole wheat	14.0–16.0%	Specialty breads
Hard red winter	Patent	11.0–13.0%	White pan bread
	Straight	10.0–11.0%	All purpose
HRS/HRW blends	Patent	11.0–13.0%	White pan bread
	Whole wheat	13.5–15.0%	Specialty breads
Hard white (winter)	Patent	11.0–13.0%	White pan bread
Soft red winter	Patent	7.0–9.0%	Cakes
	Clear	8.0–10.0%	Cookies, crackers, muffins, pastries
HRW/SRW blends	Straight	10.0–11.0%	All purpose
Soft white	Patent	7.0–9.0%	Sponge cakes
	Clear	8.0–10.0%	Flat breads, noodles, pastries
Durum	Semolina	12.0–14.0%	Pasta

How Flour Affects Bread Quality *(Continued)*

Color can be evaluated visually or with instruments. It is influenced by the yellow endosperm pigments, bran particles, and foreign material. Flour color has a direct effect on crumb color and combines with crumb structure to influence crumb "brightness." Bleached bread flour is characterized by a typical white creamy color.

Protein quantity is calculated from the nitrogen content determined by the Kjeldahl method or NIR instrument. It is affected primarily by wheat growing conditions. The protein content of flour is usually about 1 percent less than the wheat from which it was milled and is about 1 percent lower for patent flour than it is for clear. Typical flour protein levels for bread products range from 11 to 15 percent.

Protein quality is measured indirectly by dough-testing devices such as the Farinograph. It is affected primarily by wheat variety, which determines the characteristics of the glutenin and gliadin fractions of gluten, which make up about 85 percent of the flour protein. Typical Farinograph stability times for bread flours are 8 to 12 minutes.

Damaged starch is created during milling. Higher damaged starch levels increase absorption and the amount of yeast fermentation. Percentage of damaged starch in flour is determined as grams of starch susceptible to hydrolysis by *alpha*-amylase per 100 grams of flour on a 14 percent moisture base. Typical damaged starch levels in bread flours are 5 to 10 percent.

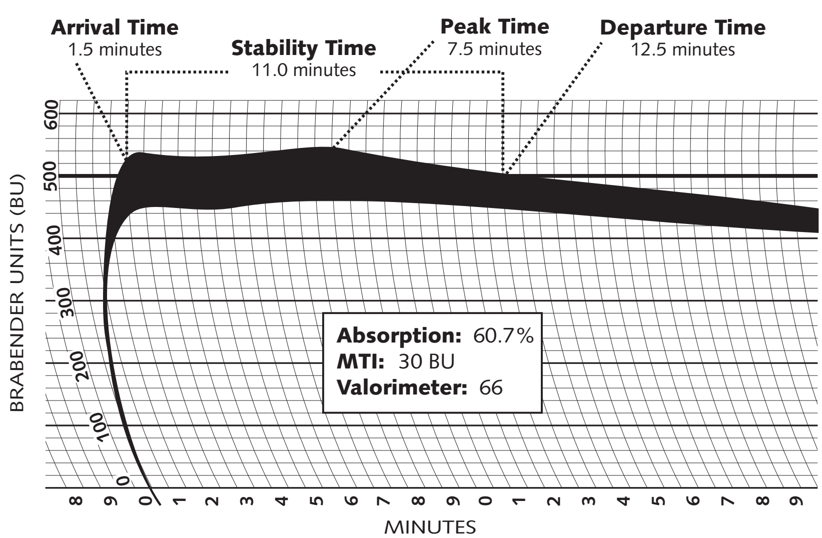
Absorption is measured by the Farinograph as an indication of the flour's ability to hold water while maintaining its consistency. High protein and damaged starch levels give high absorption, which is good for baking performance because it increases the finished product yield and improves shelf life. Typical absorption levels for bread flours are 58 to 66 percent.

Amylase enzyme activity is measured by viscosity tests like the Brabender Amylograph. It is influenced by wheat growing conditions and malting at the mill and is most important in straight lean doughs, where it affects the amount of yeast fermentation. Typical Amylograph values for malted bread flour are 450 to 550 Brabender Units.

Farinograph

A FARINOGRAPH CURVE provides useful information for bakers striving to produce consistent products with flour of variable quality. The Farinograph is used to determine flour strength and to predict processing characteristics like water absorption and mixing time.

The instrument works by measuring the resistance to mixing of a flour and water dough. The resistance is recorded as a curve as the flour becomes developed and eventually breaks down. The shape of the curve indicates the strength of the flour. A narrow curve that drops off rapidly indicates a weak flour, whereas a wider, more level curve indicates a stronger flour. The relative strengths of successive lots of flour can be judged by simply examining the shape of the Farinograph curves or by comparing the measurements labeled on the example below.



Arrival Time The time required for the curve to reach the 500 Brabender Unit (BU) line. Indicates the rate of hydration of the flour.

Peak Time The time required for the flour to reach full development. Gives an indication of optimum mixing time in the bakery.

Departure Time The time at which the curve leaves the 500 BU line.

Stability Time The interval between the arrival time and the departure time. Also referred to as "tolerance" of the flour to over- and under-mixing. A higher value means the flour is more tolerant.

Absorption The percentage of water required to center the curve on the 500 BU line at the maximum consistency of the dough (peak). Due to formula and processing differences, this may not be true absorption in the bakery.

MTI (mixing tolerance index) The difference in BU from the top of the curve at peak time to the top of the curve five minutes after the peak is reached. A higher value means the flour breaks down faster after reaching full development.

Valorimeter An empirical quality score derived from a template. Higher values indicate a stronger flour.

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Lallemand Baking Update is produced by Lallemand Inc. to provide bakers with a source of practical technology for solving problems. You can find the latest issues online at www.lallemandbaking.com.

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