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Flour Fundamentals



From the field to the final product, wheat quality counts.

Even before the freshly baked bread is pulled from the oven, a familiar, comforting aroma envelops you. It conjures memories of sitting at your grandmother's kitchen table waiting eagerly for a slice simply slathered with butter while it's still warm.

Yet, here at the Great Plains Analytical Laboratory (GPAL), located about 20 minutes north of downtown Kansas City, Missouri, these loaves have been baked to satisfy science, not hunger.

Lacey Schmidt, GPAL's cereal chemistry lab manager, removes the "pup" loaves from their diminutive pans. She measures

their height, then loads them in a laser scanner that records not only each loaf's volume but also its weight. Later, she'll assess their crumb structure and crust formation—along with texture, taste and overall sensory appeal. Similar analysis is conducted with other baked goods, such as cakes, cookies and tortillas, all to help food manufacturers optimize their formulations, improve product quality and ensure consistent performance across every batch.

Likewise, halfway across the country, on the banks of the Willamette River, in Portland, Oregon, similar testing occurs

At the Great Plains Analytical Laboratory in Kansas City, Missouri, "pup" loaves are baked to assess wheat and flour quality (left).

Mike Moran (below) is executive director of the Wheat Marketing Center in Portland, Oregon.



at the Wheat Marketing Center (WMC), where staff members assess characteristics of wheat and flour, and how those characteristics affect end products including noodles, crackers, cookies, sponge cakes and steam breads. While the two organizations have different overall missions, they share a common goal: continued improvement in the quality of all classes of U.S. wheat.

"It's really easy in a commodity environment to forget that this is food," says Mike Moran, WMC executive director. "Somebody is going to eat this, so how are we producing the best food available? What do millers and bakers need, and how are we providing the best flour to meet those needs around the world?"

> METRICS THAT MATTER

When discussing wheat quality, the numbers that mean the most to farmers, millers and bakers often differ. Farmers most often concern themselves with yield, test weight, moisture, protein and bushel price. Millers will be interested in these and others, such as flour yield, ash, wet gluten and falling number, while bakers will focus on results of dough rheology, or physical dough testing. This includes mixing properties as measured by a farinograph or alveograph, which predict dough yield, stability, elasticity and extensibility.

“Quality changes depending on what you’re making,” says Jayne Bock, WMC technical director. “High-quality wheat for bread-making is very different from high-quality wheat for cake-making. So, we need to think about it that way. There’s no ‘bad’ quality wheat, but are you targeting the right application?”

In the U.S., six classes of wheat—hard red winter, hard red spring, soft red winter, soft white, hard white and durum—are recognized, each having its own niche. While hard red winter varieties, for example, have qualities that make them more suitable for bread, soft red winter is more likely to be used to produce crackers and cookies.

Within a class of wheat, there are genetic differences among varieties planted by farmers, and the resulting qualities of the grain are further influenced by agronomic management and the environment.

“It’s a complex mix,” Moran says. “The trend right now is really amplified climate variability. Each year is very different than the year before.

So, how are we equipping farmers with varieties that are going to have greater resilience? And, what are the unique characteristics of wheat, and how do you match the right class or blend of classes to a specific product? That is really at the core of who we are.”

> THOROUGH TESTING

Each season, the labs at both GPAL and WMC analyze the composition of wheat samples from multiple classes collected from various regions of the country. That grain is then milled into flour, and end-product testing with simple recipes provides data that millers and bakers will ultimately use to inform decisions when moving from old crop to new crop.

“A lot of the data we’re providing helps the mills understand if there are adjustments they need to make when they’re milling the product to make sure they’re still meeting their customers’ needs,” Moran explains.

Some data inform purchase decisions. For example, grain test weights correlate to potential milling yield.

“It’s not a 1-to-1 correlation, but generally, the higher the test weight, the heavier the kernels, the more flour we would expect to get from those kernels,” Bock explains. “Flour milling is a tight-margin industry, so every additional tenth of a percentage of flour extraction they can get, the more money they can make.”

Protein is another key parameter. Bakers will desire flour with certain protein percentages for particular products, so millers will source wheat to hit those targets.

“If a bread maker wants a 10.5% protein flour, then a >



1. A laser is used at GPAL to measure the volume of freshly baked bread.
2. Lacey Schmidt and Todd Lowenstein (GPAL) evaluate texture and crumb structure of bread samples.
3. Schmidt uses a windowpane test to evaluate if bread dough has been sufficiently kneaded before fermentation begins.
4. Derek Wilson (GPAL) takes high-resolution images of bread slices using a C-Cell analyzer that provides objective data about baking quality.



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- 5. Liman Liu (WMC) places bread into a bamboo steamer basket.
- 6. Formulation and product development, such as for noodles, is one of the services offered to WMC clients.
- 7. Andrew Mense (WMC) combines ingredients for a batch of dough.
- 8. A flour slurry is prepared for a falling number test that measures the amount of any preharvest sprouting.



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millers is going to be looking for wheat that's 11.5 to 12%," says Tom Fontana, GPAL's general manager. "Some years, they'll be able to purchase hard red winter wheat out of Kansas that hits the mark. But, in years when growing conditions kept protein

levels down, maybe they need to go buy spring wheat out of North Dakota to blend in to get that protein up to where they want it."

Dough rheology also provides insights that affect bakery production. For instance, a particular flour may have excellent water absorption leading to higher dough yield, but if that flour requires a longer mix time, throughput can be reduced.

"Any adjustments you have to make at a bakery costs time and money, so bakers want to buy flour that's consistent every time," Schmidt explains. "That means the mill has to find the wheat that's consistent to their customer specifications each time."

> NO QUALITY COMPROMISE

Moran says a perception still exists today that wheat yield and quality are



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mutually exclusive, "but we're finding that's not necessarily true. You don't have to give up one to get the other. The more that we focus on both, it's going to be better for the farmer."

Annually, the Pacific Northwest Wheat Quality Council issues a list of preferred wheat varieties for the region based on quality rankings from most to least desirable. This emphasis on quality helps to differentiate U.S. wheat in world markets.

"You can really simplify a formula by buying the right wheat in the first place," Bock says. "You can buy cheaper wheat, but you're probably going to invest a lot more in specialty ingredients trying to get the formula to run properly. You'll save money in the long run, even if the wheat itself is more expensive. That's the message we're always sharing." ///