KEITH WELLER (K6010-15)

Inside a large animal calorimeter in Beltsville, Maryland, animal scientist Vic Wilkerson prepares a cow for a feeding test to determine the energy value of high-moisture, finely ground yellow corn.

Better Diets for Dairy Cows

Dairy cows have known it for some time: They make more milk or get fatter when their diet includes high-moisture, finely ground corn instead of dry, rolled corn. Now, Agricultural Research Service studies have shown this scientifically.

"If you change harvesting and processing methods, you can increase corn's energy value," says animal scientist Barbara Glenn.

Earlier studies at ARS' U.S. Dairy Forage Research Center in Madison, Wisconsin, found that high-moisture, finely ground corn ferments rapidly. Feeds that are rapidly fermented in the rumen and fully digested in the intestines provide more energy for the cow to use to produce milk.

But how much more, asked Glenn and former colleague Vic Wilkerson at the ARS Nutrient Conservation and Metabolism Laboratory in Beltsville, Maryland? Wilkerson is now with Land O' Lakes' Western Feed Division in Portland, Oregon.

At the Beltsville lab three decades ago, ARS scientists first measured the energy value of feedstuffs for milk production—known as net energy of lactation (NEL). Today the lab is still one of a handful worldwide equipped with calorimetry chambers for net energy measurements.

"Any time we get NEL data, it's very valuable. There's very little data published because of the cost of doing the studies," says Bill Weiss, associate professor of animal science at Ohio State University. Weiss is a member of a National Research Council subcommittee that is revising the nutrient requirements of dairy cattle, including energy values of feeds.

Feed consultants and dairy farmers rely on NRC's published values to formulate animal rations. But measured NEL values for new corn sources and types are rare; most values are estimated.

Dry corn might have been good enough in the past, but not for today's top milk producers. With many corn hybrids and storage and processing methods to pick from, says Glenn, "corn isn't just corn anymore."

Wilkerson and Glenn measured the energy value of diets containing high-moisture corn compared with dry corn. Glenn says high-moisture corn—cut early, while still moist, and then ensiled—is popular with dairy farmers in the North Central and Northeast regions.

The researchers also compared the effect of grinding corn versus rolling it. Small ground particles are reportedly more digestible and thus able to provide more energy, she says. The different corns were mixed with alfalfa, soybean meal, and a powdered mineral supplement.

Wilkerson calculated each corn's contribution to the energy value of whole diets. He wasn't surprised to find high-moisture corn provided 14 percent more energy than dry corn, instead of the 4 percent difference stated in the NRC handbook.

"Dairy farmers were getting fat cows when they substituted high-moisture corn for dry corn," he notes. "That suggested there was more energy available than what's shown in the handbook."

But farmers don't want fat cows any more than they want overly thin

ones, especially when they stop making milk. "If a cow's too fat or lean, she won't breed," says Wilkerson.

Farmers also don't want cows getting more nutrients than they need for optimum milk production. It inflates the feed bill. And excess nutrients either add body fat or exit the cow as potential pollutants.

But dairy farmers do want more milk. In the ARS study, cows produced 4-plus pounds more milk daily with high-moisture corn than dry corn—in the alfalfa-based diet. Processing also made a difference. Finely ground corn provided 5 percent more energy than the big chunks of rolled corn, increasing milk production by about 5 pounds a day, says Wilkerson.

Weiss says his committee will consider the data in revising the energy values for dairy feedstuffs, noting that the values may be higher than the committee will agree on. "All net energy values we use now are estimated on very old numbers."—By **Judy McBride,** ARS.

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JOE LARSON NRCS

Unshelled feed corn.

Testing for Natural Aflatoxin Inhibitors

In the United States, corn with more than 20 parts per billion (ppb) of aflatoxin—which is the equivalent of just 1 ounce in 3,125 tons—is not considered fit for feeding to animals that produce meat or milk for humans.

A known carcinogen, aflatoxin is the metabolic byproduct of *Aspergillus flavus* fungi. Grain with more than 5 ppb gets thumbs down for making food-grade corn products. And in the South and in areas where occasional drought stresses corn and increases *A. flavus* levels, farmers may lose opportunities to produce corn valued for export markets.

Finding natural compounds in corn that affect the toxin-producing machinery of *A. flavus* is a first step toward identifying corn genes that might be modified to make the microbe less harmful. The strategy could be joined with efforts to breed corn that discourages growth of the fungus.

Now, a faster, cheaper test is helping researchers detect genetically regulated compounds in corn that inhibit or promote the ability of *A. flavus* fungi to produce aflatoxin. ARS chemist Robert A. Norton developed the new procedure at the National Center for Agricultural Utilization Research in Peoria, Illinois.

"We can now realistically test a much wider range of compounds for toxin-producing activity—including lipids—using 1 milligram [thousandth of a gram] or less of the test compound," he says.

Norton purchases the compounds for testing, some of which cost up to hundreds of dollars per milligram, though most cost less. Despite the expense, Norton says that it's cheaper to buy the compounds than to tediously extract them from corn.

"And with the new testing method, we don't have to use as much of them," he says.

His procedure involves placing the test compound, along with about 29 microliters [millionths of a liter] of a nutrient medium and *A. flavus* spores, on a small disk. The disk is hung by a pin from a Teflon cap inside a bottle containing a small amount of water. After 5 days, researchers measure fungal growth on the disk. They use a small amount of solvent to extract aflatoxin from the fungus; high-performance liquid chromatography measures the amount. The method saves time, nutrient medium, and solvent.

Norton currently tests up to 200 samples per week. So far, he has pinpointed several aflatoxin-synthesis inhibitors, including carotenoids that impart yellow color to modern corn hybrids and a colorless benzoxazolinone compound. He also plans to test colorless anthocyanin-related compounds that could be bred into yellow corn.—By **Ben Hardin,** ARS.

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