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G94-1229 Importance of Grain Quality, Nutrient Composition and Processing for Dairy Cattle

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Importance of Grain Quality, Nutrient Composition and Processing for Dairy Cattle

This NebGuide discusses grain quality and proper grain processing for most effective use by dairy cattle.

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Grain Quality Considerations for Dairy Cattle

Controlling the quality of grain is extremely important for dairy cattle because even small degrees of variability can lead to significant changes in performance. Some of the quality factors considered in grain grading that can influence feeding value are:

1. low test weight (reduces energy content by 5 to 10 percent),
2. damaged or broken kernels and foreign material,
3. sprout damage,
4. discoloration or heat damage,
5. mold, and
6. mproper moisture content.

NebGuide *G83-661, The Influence of Grain Grades and Off-Quality Grain on Its Feeding Value to Cattle*, details how these quality factors can influence cattle performance.

Other quality considerations particularly important to dairy cattle include:

- **Palatability.** Anything that reduces feed intake can seriously reduce milk yield. Major factors include moldy grain, finely ground grain and dustiness. Flaking or wet rolling using steam can help alleviate dust problems, although milk fat test may be depressed. Using molasses and small amounts of fat can also help reduce dustiness of grain mixes without lowering milk fat test.

- **Bulk.** Some degree of bulkiness is required in grain mixes fed separately from forage. Properly processing grains, such as coarse grinding or rolling, as well as using bulky grains like oats will usually improve grain palatability. Dairy cows prefer coarse-textured feeds; therefore, avoid fine-grinding grains if they will be fed alone. Grain texture is not so important when fed as part of a total mixed ration in combination with forages.

- **Particle size**. Adequate particle size of both forage and grain is necessary to maintain normal milk fat percentage and avoid rumen acidosis, off-feed problems, or lameness.

- **Nutrient composition and variation.** Variations in grain and forage nutrient content must be monitored routinely and rations formulated accordingly to optimize milk and milk solids production.

Feed Grains for Dairy Cattle

The major grains fed to dairy cattle in the U.S. are corn, sorghum, oats, wheat and barley. Research in the late 1960s indicated that all these grains supported the same level of milk production when fed in a pelleted grain mix. However, this research was conducted with a diet consisting of 55 percent alfalfa hay (dry basis) fed to cows past peak milk yield, with low feed intake. For today's high-producing herds, on-farm observations suggest that palatability of a grain mix is usually improved when no single grain makes up more than 80 percent of the concentrate mix.

Table I gives the nutrient composition of several feed grains and oilseeds commonly fed to dairy cattle. Perhaps of greatest importance for dairy feeding is the effect of grain type and processing on starch degradability in the rumen. Knowledge of starch degradation, combined with information about supplemental crude protein digestion rates, should allow combinations of grains and protein supplements to be formulated which will improve efficiency of nutrient use in the rumen to increase milk yield and secretion of milk components. Of great importance also is the negative effect of rapid starch digestion on fiber digestion in the rumen. To maintain normal milk fat tests, the negative effect of starchy grains on fiber digestion needs to be controlled. This raises the possibility of combining several starch sources with different fiber sources to maintain normal milk fat percentages.

Table I. Nutrient composition of common feed grains and oilseeds.

	Corn	Sorghum	Wheat	Oats	Barley	Soybeans	Cottonseed
	(% of Dry Matter)						
Crude protein	10.0	9.7	16.0	13.3	13.5	42.8	23.0
NE_L, Mcal/pound[1]	.89	.84	.89	.80	.88	.96	1.01
Fat	4.3	3.4	2.0	5.4	2.1	20.0	20.0
NDF[2]	9.0	18.0	14.0	32.0	19.0	14.0	44.0
Ca	.03	.04	.04	.07	.05	.49	.21
P	.29	.34	.42	.38	.38	.21	.64

Source: National Research Council (1989).

[1]NE_L = Net energy for lactation.

[2]NDF = Neutral detergent fiber.

Grain Processing for Dairy Cattle

Dairy cattle can use grains efficiently if the grain is broken, ground, rolled, or pelleted. Many kernels pass through the cow undigested if not processed. The dairy cow does not chew food well while eating, and kernels which escape rumination are likely to resist digestion and be excreted whole. Grain can be processed to varying degrees in order to manipulate starch degradability and subsequent animal performance.

The most common procedure for processing grains is grinding. Coarse grinding reduces dustiness and improves palatability more than fine grinding. Rolled grains are also very palatable but require more expensive machinery. Pelleting is easier to handle with augers, and increases the amount of concentrates that a cow can eat in a short time period (as when in a milking parlor). A dairy cow can consume about 1 to 1.5 pounds of grain per minute when pelleted, about .75 pounds per minute when cracked or coarsely ground, but only .50 pound per minute when the grain is finely ground. Milk fat percentage may be depressed by 0.1 to 0.2 percentage units, or more, when pelleted grains are fed. Cooking grains often causes severe milk fat depression, especially when high levels of grain are fed to early lactation cows.

Generally, feeding lactating cows high-grain rations (less than or equal to 60 percent grain, dry basis), especially heat-treated grains, or feeding all of their forage in ground, pelleted or cubed form results in low or erratic feed intake, acidosis, and lower milk fat test. Often, grain processing which results in more efficient gain in beef cattle will depress milk fat synthesis in dairy cattle.

Grain Feeding for Dairy Cattle

Corn. When dairy cows are fed whole, shelled corn as much as 18 to 35 percent of the grain passes through the digestive tract with little nutrient digestion occurring. For optimal utilization by mature dairy cows, corn grain should be ground to a medium degree of fineness. Only cracking the kernel will typically result in less than optimal nutrient digestion. F. B. Morrison, in his classic textbook, *Feeds and Feeding*, discusses research in which cows fed medium-ground corn digested 98 percent of the grain, whereas only 90 percent was digested for cracked corn. Worse still, whole corn was only 70 percent digested by the cows.

In contrast, whole shelled corn is chewed effectively by dairy calves and heifers until about 8 months of age. As much as 25 percent of shelled corn can escape mastication in adult dairy cows, compared with only 6 to 11 percent for calves and heifers.

Aside from being a high-starch, high-energy feed grain, the protein in corn is also relatively undegradable in the rumen than with other common grains. The ruminally undegradable or "escape" protein fraction for corn is about 50 percent of crude protein (CP). Sorghum protein has a similar escape value. By comparison, oats, wheat and barley all contain protein with only a 20 percent protein escape value.

This high escape value for corn protein makes it especially useful for dairy rations containing high quality alfalfa as the sole or major forage. Immature alfalfa contains over 20 percent CP, but only about 20 to 25 percent of the CP is ruminally undegradable. Because of alfalfa's high CP content, few protein supplements are needed. Therefore, in a diet containing 60 percent alfalfa, about 38 percent of the escape protein needs of the dairy cow are satisfied by corn grain.

Recent evidence suggests that when feeding high-protein silages (such as alfalfa), finely ground corn blended into the total mixed ration (TMR) results in higher milk production than coarsely ground corn.

This is presumably due to more efficient use of ammonia by ruminal microbes for microbial protein synthesis. More research in this area is warranted, but it may be that corn processing recommendations will vary substantially for grain fed in a TMR versus grain fed separately in a grain mix.

To allow for earlier harvest and reduced field losses, corn is sometimes harvested at higher moisture levels and ensiled. High-moisture shelled corn contains between 22 and 26 percent moisture, depending on storage structure. Generally, the corn will be rolled or coarsely ground prior to ensiling. The feeding value of high-moisture shelled corn for dairy cattle is typically equal to, or slightly better (0 to 3 percent) than, dry corn.

Sorghum. Sorghum grain is high in energy and starch content and often is less expensive than corn. Sorghum is adapted to hot, arid regions of the world. Steam flaking sorghum consistently improves digestibility of starch but also increases the risk of acidosis, off-feed problems and reduced milk fat test. Dry rolled sorghum is less digestible than steam flaked sorghum. The digestibility of steam flaked grain is related to bulk density of the flake -- lower bulk density provides starch that is more rapidly digested in the rumen. When compared with dry rolling, steam flaking sorghum grain significantly increases starch digestion in the rumen and milk protein percentage.

Research in Nebraska indicated that sorghum grain, when finely ground, supports milk yield and composition, dry matter intake and bodyweight similar to rolled corn for midlactation cows. Whether grain was fed separately from forage or as a part of a TMR had no effect on performance. Finely grinding sorghum improved efficiency of solids-corrected milk production relative to rolled grain sorghum for early lactation cows.

Wheat. Wheat should be coarsely rolled, ground or cracked because feeding the whole grain allows too many kernels to escape digestion. Do not fine-grind wheat because it will become pasty in consistency. Often, wheat works best in a grain mix when combined with bulky concentrates such as ground oats, bran, corn and cob meal, or soybean hulls. Dairy cows prefer coarse textured feeds, and addition of these bulky ingredients improves grain mix palatability and consumption rate. Wheat is approximately equal to corn in energy content but should be limited to one-third to one-half of the total grain mix. Wheat does contain higher CP and phosphorus levels than other common grains, so supplemental CP and phosphorus can be reduced in the diet.

Wheat is rapidly and extensively digested in the rumen, so when large amounts are fed, cows can become acidotic quickly and go off-feed. Proper feeding management is necessary to successfully feed high levels of wheat to dairy cattle: 1) use a total mixed ration, 2) allow 10 days to two weeks for gradual adaptation to the diet, and 3) use buffers such as sodium bicarbonate to minimize the effects of rapid starch digestion which will lower milk fat test.

Barley. Barley is an important component of dairy rations in many parts of the world despite its rapid rate of digestion in the rumen. This rapid starch digestion may dramatically lower rumen pH, cause digestive problems and low milk fat test. Therefore, diets must contain adequate fiber to use significant amounts of barley effectively in the concentrate mix. Performance is sometimes better when heavy-weight barleys are fed than lightweight barleys. Some research suggests that replacing a portion of the rapidly digested barley starch with more slowly digesting corn starch reduces the negative effect of starch on fiber digestion. However, convincing evidence of this idea is lacking.

When processing barley grain, a coarse grind is preferable to a fine grind because barley becomes very pasty when finely ground.

Summary

A wide variety of feed grains may be fed to dairy cattle as sources of starch, energy, and protein. However, these grains must be processed properly and fed with the correct levels of dietary forage to avoid off-feed problems, reduced milk yield, and low milk fat test. Only high quality grains, which have been tested for nutrient composition, should be used in formulating rations for lactating dairy cattle

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