by Steve Martin

Master the co-product puzzle to lower ration costs

SOMETIMES they are called by-products and other times they are more correctly called co-products. In either case, these "leftovers" from the original intended use for primary grains are a big part of dairy diets.

While forages are routinely grown with cows as their primary goal, the majority of grains are harvested for people to use first. These leftovers include co-products from corn, soybeans, canola, and various small grains like wheat and barley. Since these ingredients are so important in the formulation of dairy diets, gaining a better understanding of where they come from and what factors determine their feeding value is a worthy effort.

The big three starches

Much of what we feed to people and to cows around the world starts with a simple corn kernel. Along with rice and wheat, these three high-starch ingredients supply as much as 50% of the world's calories. Potatoes, cassava, other tubers, and roots round out the key starch sources for human's dietary energy. They vary in content, but several are in excess of 50% starch.

Let's use corn as our first example. Corn grain is between 70% and 75% starch. When this starch is removed for human use, the remaining 50% is almost exclusively used for animal feed. Among the key feed products in this group are corn gluten feed, corn gluten meal, hominy, corn bran, and distillers grains. All of these co-products are higher in protein, fat, fiber, and minerals than corn grain due simply to concentration after the removal of starch.

In the corn starch removal process, several pathways can be followed, resulting in differing levels of the remaining nutrients. When making ethanol, for example, nearly all of the starch is removed through fermentation. Thus, fiber, fat, and protein are more highly concentrated.

Meanwhile, when corn is used to produce high-fructose corn syrup for sweetening soft drinks and other processed foods, the starch is not completely removed. Thus, the protein is not as highly concentrated, but meaningful starch remains that brings great nutritional value to the feed.

The feeding value of the remaining fat, fiber, and protein should be considered. The fat in corn is unsaturated 18:2 fatty acids that are great for feeding heifers but a real risk for butterfat synthesis in a milk cow.

The protein quality in all corn products has been mostly considered poor due to lower levels of lysine. However, corn protein is reasonably high in methionine and some other essential amino acids. If these amino acids survive rumen activity due to normal heating during the various corn processing steps, there can be real value to the animal.

As for fiber, corn fiber is highly digested in the rumen. All of this makes the parts and pieces of corn a pretty solid way to supply nutrients to dairy animals. Again, the primary caution relates to the 18:2 fatty acids.

When we contrast the nonstarch components of corn to that in wheat and other small grains, we see some differences. First, any starch left in a by-product like wheat midds tends to be more rapidly fermentable in the rumen, and this fact must be considered in formulation. Also, the fiber in these small grains after processing is less digestible than fiber from corn. In feeds like brewers grain, this fiber may actually contribute some limited roughage value but lacks overall high digestibility potential.

Though distillers grains receive the most attention for 18:2 fatty acid risk as mentioned above, wheat and barley by-products, such as wheat midds and brewers grain, also have a notable concentration of these risky fats. These must be considered in lactating ration formulation.

Watching for high sulfur and potential toxin levels in all of these grain-type by-products is also important. Frequent testing for nutrients and antinutrients is advisable when feeding by-products.

Oil extracted from oilseed, including soybeans, canola, cottonseed, and peanuts, is the other primary category of by-products. It's the only other group that's truly deserving of the term co-products. These ingredients are the various meals left after oil extraction.

The processing of these seeds for cooking oil and biodiesel production leaves high-protein ingredients that can be used for both human and animal feed. Soybean protein, in particular, has significant importance in human nutrition. Most meals from the other oilseeds are primarily used for animal feed.

With fat levels in some raw oilseeds in excess of 40%, the moderate protein levels in the primary grain become high-protein ingredients. Unless further processing is employed, a significant amount of this protein is available in the rumen and this contributes greatly to the rumen degradable protein needs of a dairy cow.

Each of these feed ingredients has well-described amino acid values, and depending on some processing details, a significant amount of essential amino acids can be delivered to the small intestine. Soybean and canola meal are the feed rate leaders in this sector and contribute significantly to dairy rations.

Though these oilseed meals are primarily fed for their protein supply, the amount of and the digestibility of their fiber also must be considered. Looking at the extremes here, soybean meal contains highly digestible soybean hull fiber whereas cottonseed meal contains very poorly digestible and bulky cottonseed hull fiber. Though soy hulls and cottonseed hulls are both considered hulls, their digestibility and roughage value couldn't be more different. This fact has a significant impact on the inclusion of these two ingredients as protein suppliers in lactation rations.

The high-fiber group

The last word here relates to more details on the higher-fiber by-products. The previously mentioned seed hulls are two examples of very different roughage/fiber by-products. Other ingredients here are peanut hulls, almond hulls, rice hulls, and even leftovers from the cotton industry referred to literally as trash.

The beauty of these hull-type ingredients is that they are mostly pure and singular in their composition. Some by-products like gin trash, cotton burrs, and beet tailings are lower in cost but also somewhat problematic due to their variable combinations of different parts of the plant and an abundance of dirt. Frequent testing is encouraged to be sure we know what we are feeding.

Run the numbers

Some of the greatest creativity in feeding cows comes in the thoughtful use of by-products. Truly understanding the parts and pieces of everything from corn kernels to cotton seeds will help us to be sure they are fed correctly.

A careful approach to maximizing the feed rates of these ingredients likely will be key in reducing feed costs when producing milk. This effort will require more lab testing and perhaps other inconveniences than simply feeding primary grains.

As with all opportunities, care should be taken so that one doesn't go too far feeding by-products to reduce cost. The use of a strong formulation model, a Penn State Particle Separator, and good cow sense will ensure success.

Cows are designed to consume roughage. We must always keep this front of mind while adding highly concentrated primary grains and lower-cost by-products to supply needed nutrients and manage costs.

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