

**IN THIS ISSUE:**

Glycerol: A New Source of Alternative Energy  
Consultant's Corner: Factors for Feeding Glycerol  
From the Maternity Pen: Rethinking Energy for Dry Cows  
Beyond Bypass: Managing Nutrient Variation  
Quality Corner

## Glycerol: A New Source of Alternative Energy

Affordable commodities for dairy rations are a moving target these days, with nutritionists and their clients increasingly looking to alternative feedstuffs to satisfy dietary requirements.

The proliferation of the biodiesel manufacturing industry in recent years has created an abundance of the co-product glycerol, which is commonly marketed as crude glycerin, with a glycerol content of approximately 80 percent. Purdue University professor of ruminant nutrition and physiology Shawn Donkin, PhD, has evaluated a wide range of aspects of feeding glycerol in lactating dairy rations.



"Glycerol has been examined for decades as an energy source to treat ketosis and, more recently, as a high-energy supplement to transition-cow rations," says Donkin. "Through that research, we learned that it is readily fermentable in the rumen, indicating that glycerol could serve as an excellent energy source for rumen microbes, resulting in direct contributions to energy and metabolizable protein for the cow."

Donkin and his colleagues set out to evaluate the value of glycerol as a replacement for corn grain in lactating rations. In their study, 60 lactating Holstein cows were adjusted to a basal diet for two weeks, and then assigned to feeding groups receiving 0, 5, 10 or 15 percent glycerol as a percentage of ration dry matter. The basal (0 glycerol) diet was balanced to meet or exceed NRC (2001) requirements and contained corn silage, alfalfa haylage, hay, dry-rolled corn, vitamins and minerals. In the glycerol-added rations, corn was replaced by an equivalent amount of food-grade glycerol and corn gluten feed at a glycerol-to-gluten ratio of 6.25:1.

Diets were offered once daily for ad libitum intake (5 to 10 percent weighbacks); feed refusals

were measured daily; and feed intake was determined by the difference. Cows were milked twice daily, and milk samples were collected weekly at two consecutive milkings. Fat, protein, lactose, total solids, milk urea nitrogen and somatic cells were measured.

The Purdue researchers found no collective difference in dry-matter intake, milk production, or components over the eight-week trial period. Donkin says an initial (seven-day) decrease in feed intake at the 15-percent-inclusion level indicates that feeding at this high level may call for a stepped-up approach to gradually introduce glycerol to the ration.

Other results from the study, summarized in Table 1, showed:

- A decrease in milk urea nitrogen in response to glycerol (suggesting improved use of dietary protein by rumen bacteria and reduced losses as ammonia).
- Cows fed the highest amount of glycerol gained the most weight during the feeding period.
- Cows fed 10 and 15 percent glycerol gained more weight than cows fed 5 percent or no glycerol.
- Weight gain for the control (no glycerol) and 5-percent-glycerol groups did not differ.

Using data from intake, production and bodyweight changes, the researchers calculated net energy of lactation (NEL) for each diet, with results of 0.70, 0.70, 0.71 and 0.72 + 0.02 Mcal/lb. Donkin says the consistency of these values indicates that glycerol can be substituted for corn without adjustments for energy content.

One caveat of the Purdue study is that it was conducted using food-grade glycerin with a glycerol content of 99.5 percent. Jonathan Townsend, DVM, PhD, technical services nutritionist for Land O'Lakes Purina Feeds, says the quality of commercially available crude glycerin is an important factor when considering the use of glycerol in a lactating TMR. "The two levels we really need to watch are methanol and mineral salts," advises Townsend. "Methanol content of crude glycerol should be no more than 0.5 percent." Sodium, potassium and phosphate should be monitored and accounted for in ration formulation, to avoid potential problems with dry-matter intake and impact on nutrient management plans.

Donkin says the nearly identical performance outcomes of glycerol compared to corn make it realistic choice as a potentially more affordable energy source. "We've seen in one year how much corn prices can swing," he states. "Our research shows that, in those times when feeding corn becomes cost-prohibitive, substituting glycerol could be a safe, reliable and affordable alternative."

## CONSULTANT'S CORNER

### Factors for Feeding Glycerol



*By Jonathan Townsend, DVM, PhD, Diplomate ABVP – Dairy, Land O'Lakes Purina Feed, Mason, Mich.*

I became familiar with glycerol when I was a ruminant nutrition graduate student, studying under Dr. Shawn Donkin at Purdue University. The results of his research were very interesting, and I was eager to use glycerol as a ration component when I returned to the field and resumed work with commercial herds.

The region I serve, which covers southern Michigan, northern Illinois and Indiana, and northwest Ohio, has recently gained reliable access to a processed feed additive that blends glycerol with cane molasses

at 15 to 20 percent glycerol. Most of my experience in feeding glycerol comes from using this blended product, which is fed at 1 to 2 percent of the ration dry matter, or approximately one-half to six-tenths pounds of glycerol per cow per day.

The blended product has worked very well in that, when balanced into the ration as a replacement for corn, it looks the same on paper, yet has been more affordable, at times strikingly so in the past year. Palatability is excellent. As a side benefit, adding a bit more moisture to a TMR helps to collect fines and stick the ration together, and improve dry matter intake.

While not succinctly proven, I think the fact that glycerol breaks down to propionate and butyrate as it is metabolized provides potential the added benefit of a glycogenic effect that could help minimize metabolic disease, particularly in fresh cows. We can lower starch levels a bit and make the adjustment to the lactating ration easier for transition cows. Based on Donkin's research, I do recommend a ramp-up program if glycerol is being used at the higher end of the feeding range of 10 to 15 percent DM.

If I were using crude glycerin from a new source, it would be important to test initial loads for a while to evaluate methanol levels, and collect a full nutritional profile that would include sodium, potassium and phosphorus levels. If the product proved to be consistent, testing frequency could be reduced over time.

As with any co-product, whether or not it is a realistic commodity option depends a great deal on the location of the dairy relative to the feed source; affordable transportation; and reliability of a consistent supply. If these factors are favorable, my advice is to take a closer look at glycerol. I think it can have considerable merit as an alternative carbohydrate source, under the right conditions, and with proper nutritional management.

## FROM THE MATERNITY PEN

### Rethinking Energy for Dry Cows

Considerable focus on the care of transition cows in the past two decades often has included promotion of a high-energy "steam-up" ration for cows late in the dry period. But University of Illinois professor of animal nutritional sciences Jim Drackley, PhD, notes that most research trials and field experience have failed to demonstrate that steam-up diets reliably and repeatedly improved milk production, body condition, reproduction or health after calving.

Drackley and his colleagues observed that allowing dry cows to consume more energy than required, even if they do not become noticeably overconditioned, results in responses that would be typical of overly fat cows. They theorize that, like humans, cows vary in the areas of their bodies where they accumulate fat, and some may store it internally. This may cause fatty liver, subclinical ketosis and other secondary problems with liver function.

As a dietary alternative for pre-fresh cows, Drackley's team and other researchers around the world have recently studied the impact of feeding lower-energy, high-bulk diets that still meet — but do not exceed — minimum energy requirements for pregnant cows. Drackley says that cereal straws, particularly wheat straw, are well-suited to dilute the energy density of higher-energy feedstuffs such as corn silage and alfalfa. The key is to promote aggressive dry-matter intake via a high-straw, low-energy (0.59-0.63 Mcal NEL/lb. DM) TMR in which the straw is thoroughly incorporated to ensure that it is not sorted off.

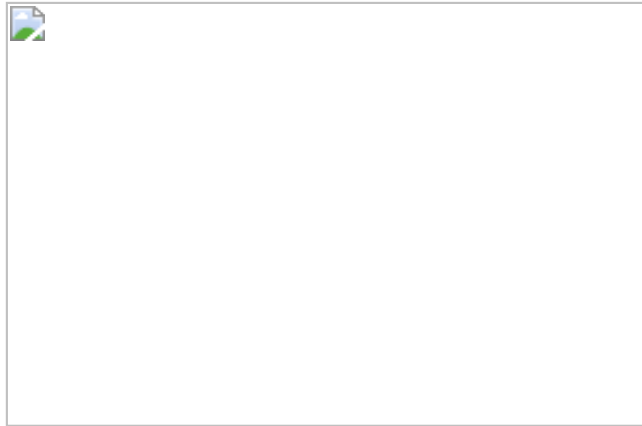
This dietary approach may lead to fewer DAs in fresh cows; decreased assisted calvings; and lower incidence of milk fever, retained placentas and ketosis. Evidence also points to improved reproduction and foot health.

[Read more](#) on the subject.

## BEYOND BYPASS

### Managing Nutrient Variation

In this era when every input on dairies must be carefully scrutinized, paying close attention to the consistency of feed inputs plays an important role in keeping performance and production on an even keel. Ohio State University professor of animal sciences Bill Weiss, PhD, says that if rations are highly variable, they must be over-supplemented to avoid deficiency, or production may suffer at times when the diet does not provide adequate nutrients.



For feeds with low expected variability — such as corn grain and soybean meal — NRC values (mean and standard deviation [SD]) are adequate for ration-balancing purposes. In fact, Weiss suggests that such "book values," which are derived from a large set of samples, may be more reliable than analyzing an individual sample of a feedstuff at hand. But feeds with greater content variability, such as corn silage, alfalfa, corn gluten feed, distillers grains and food processing byproducts, need more actual analysis. Weiss advises routinely sampling these feeds over time and continuously entering the data into a spreadsheet to calculate mean and SD. As data accumulate over time, the more accurate the mean and SD will become.

Feeds that are known to have great variability, but are secured at a bargain price, may be fed successfully if they are used at low inclusion rates. However, Weiss cautions that, if such feedstuffs are fed too aggressively, the costs associated with the increase in uncertainty regarding diet composition may quickly overwhelm any apparent savings in ingredient costs.

Finally, Weiss advises that variation in total rations can be significantly reduced by increasing the number of feedstuffs in the ration. He explains that the greatest reduction in variation occurs when going from one ingredient to two. But with the addition of even more ingredients, the overall probability that the ration's nutrient composition will be off-target continues to go down. Figure 1 shows the difference in variation comparing rations that contain one, two and three ingredients.

Read the [full text](#) of a paper containing an in-depth explanation of applying statistical principles to manage variation in rations, co-authored by Weiss and his colleague Normand St.-Pierre, PhD.

## QUALITY CORNER

West Central recognizes the need to continually monitor production processes and quality testing of the end product manufactured to ensure what is manufactured not only meets West Central's guarantee, but consistently meets the high quality and value added standards customers demand. As such, West Central typically takes a conservative approach regarding product claims and what the SoyPLUS<sup>®</sup> and SoyChlor<sup>®</sup> products can do. Keeping with West Central's tradition of research and development and peer reviewed, published documentation

of product performance, West Central regularly updates the nutrient values of SoyPLUS® and SoyChlor®, and management is constantly thinking about how to make those products better.

West Central recently updated its "tech" sheet for SoyPLUS to reflect changes in the nutrient values of last year's soybean crop. As test results were reviewed, and calculations were run in the different ration balancing software, it was clear the NE(1) values historically published were low and Dr. Jesse Goff updated those numbers. Goff points out that West Central had used the Dairy One energy calculations, which are not the same as the NRC values, so those changes were made. Look for updated tech sheets to arrive in the mail shortly, if they haven't already, and please update your ration balancing program to include these updated values.

Goff does caution to keep in mind that NE lactation is not a constant — it changes depending on what else is in the diet and the amount fed. And, as always, there is some interpretation to the numbers because you have to decide on the consistency of all feedstuffs in the diet as well as how you define "maintenance intake" and what is production intake. The important thing is to have a number so as to gauge the relative energy of feedstuffs.



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