



Dairy Pipeline

School of Animal Sciences

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Hay Ash Content: Lessons from the Coalfields

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For many years, the Powell River Project was a unique partnership among the state agencies of Virginia Tech and Virginia Cooperative Extension, and the private industry partner, Red River Coal Company.

Many different types of experiments were conducted on the Project's grounds, including on livestock. Goats were studied for weed and brush control, and there was a herd of cattle roaming the large flat steps created by the coal mine.

Over the years, Extension Veterinarian, Dr. Dee Whittier noted that cows at Powell River Project had a life expectancy about 2 years shorter than normal. The climate and elevation gave cattle a grazing advantage, but beginning at about age 6, mature cows would start to lose weight and finally die in what should have been the latter part of their prime.

Dee suspected Johne's Disease, but examinations of the cattle's gastric and intestinal systems found no evidence of any disease that would have been both life-threatening and widespread enough to be a definitive cause.

Dee uncovered the culprit when he examined the deceased cows' mouths. Without fail, each animal's

teeth were worn to the point they weren't able to eat enough to sustain themselves. But what caused the teeth of these animals to be prematurely worn down? The answer was dust. Each day, hundreds of trucks, loaders, and graders trammed past the cow pastures on their way to the mine or back to the mine office.

As they passed, the gravel roads produced clouds of dust that settled on the grass. The dust (mostly limestone rock dust) raised the ash content of the pasture so high, it literally sanded and ground the cattle's teeth down as they grazed!

You may be asking, "What does this have to do with me? I don't live near a surface mine." Or you might think, "I live on an unpaved road, but we don't have enough traffic to raise that level of dust."

What happened in the mountains of far Southwestern Virginia is important because many of the hay tools we use, especially if they are running out of adjustment, may be increasing the ash content of our hay crops to a level capable of prematurely starving our cattle just as effectively.

What is ash and where does it come from? When you get a hay sample back from the lab, the report will list a percentage value for the amount of ash in your hay. Ash includes the naturally occurring minerals in the plant: calcium, magnesium, potassium, phosphorus, etc. While these minerals are important, they add zero calories to the hay.

Dr. Dan Undersander, Extension Specialist in Agronomy, University of Wisconsin, has done extensive research on ash content and the relationship between ash level in forages and the proper adjustment of forage machinery. In grass, the amounts of those in-plant minerals are around 6%; alfalfa is a bit higher at 8%. Any amount higher than those figures in your sample is a measure of dirt contamination.

Ash content of forage samples from the UW Marshfield Lab (2005-2009) showed haylage samples averaged 10.7% ash with a maximum of 27%. Dry hay was slightly lower with an average of 9.4% ash and a high of 25.7%. You might think, “Those high levels of ash are from outlying poor managers.” Again, according to Dr. Undersander’s work, this is not the case. Ash content of forage samples entered in the 2009 World Dairy Expo contests showed maximum levels of ash in the Haylage, Dairy Hay, and Commercial Hay categories to be 15.6%, 15.2%, and 13.9%, respectively.

So how is this dirt finding its way into our animals’ feed? The honest answer is we are putting it there. Any time a tooth from a tetter, rake or baler pick-up strikes the ground, the result is some dirt contamination. We can also get dirt in our hay by mowing hay crops below the recommended setting of 4 inches.

Disc mower/conditioners running too low don’t have to strike the ground. The vacuum created by the blades that lift the crop and feed the rolls can and will suck dirt up along with the hay. One of the biggest culprits of high ash levels on the machinery side is the wheel rake. Due to their speed and ability to merge wide swaths of hay quickly, wheel rakes have made a huge comeback. Their issue is that they are ground-driven, so they cannot help but add ash to our hay. But be advised, just because you don’t use a wheel rake doesn’t make you immune to dirt contamination.

Raking seems to be the number one action that greatly affects ash content, and any rake set too low is going to increase contamination. For that matter, any tool set too low will increase ash content. “If dirt contamination can’t be totally eliminated, why worry about it? The short answer is.... Cash! We are in a record-setting high price cattle market.

Replacements are expensive; a decent calf is worth over \$2,000.

Why would you want to go out, burn diesel, wear out machinery, and spend precious time making hay that has less feed-value for your animals? How bad can it be? Let’s say you do a decent job, and you have a hay sample that tests 18% ash. You are feeding 1,200 pound cows hay from mid-November to April 10. That size animal will eat about 27 pounds of hay per day, and the above timeframe is 146 days; therefore, your cows are each consuming 3,942 pounds of hay per year. Assuming we are feeding them grass hay, 18% ash hay has 12% contamination. Twelve percent of 3,942 tells us that each year, you are feeding each cow over 470 pounds of dirt over each hay-feeding season. That’s 3 ¼ pounds of dirt a day! That means that 2-year-old heifer will be fed over a TON of dirt by the time she is 6, taking a toll on her teeth, gut, and overall performance. Think how much more productive she could have been if we replaced that dirt with protein, energy and fiber.

Now is the time to get your hay equipment ready to harvest hay, not dirt. Replace full sets of teeth, not individual teeth. New teeth are going to be longer than worn ones, so they will hit the ground while the rest of the teeth move hay. When you replace your rake or pickup teeth, put the worn ones up and label them. They will likely match the ones you lose next season.

From Crude Fat to Precision Feeding: The Role of High Oleic Soybeans in Dairy Nutrition

Authored by Gustavo Begalli, Ph.D. student with Kristy Daniels, Associate Professor—Animal Systems Biology, School of Animal Sciences, Virginia Tech; danielsk@vt.edu

For decades, fat supplementation in dairy cow diets was treated simply as an energy boost. Farmers added tallow and vegetable oils, and an upper limit of about 7% of total dietary fat (on a DM basis) was established for maintaining rumen health. In the 1980s, rumen-protected fatty acids gained popularity. These dietary fat sources were included

to help cows meet the high energy demands of increasing milk production without impacting rumen function. These fat-feeding tactics worked for many years, but were not ideal. Over the last 20 years, we've learned that individual fatty acids play specific roles within the cow: some stimulate milk fat synthesis, others suppress it; some help cows maintain body condition, while others have little effect. Feeding fat is no longer just about adding calories. It is about providing specific fatty acids at the right times to achieve desired outcomes. The objective of this article is to overview how fatty acid supplementation in dairy cows has evolved from crude fat feeding to precision fatty acid feeding. It also aims to highlight the role of high oleic soybeans as a desirable fatty acid source, while exploring their limitations and potential future applications.

Advancing Fatty Acid Nutrition Beyond Crude Fat

In 2021, researchers at Michigan State University evaluated the effects of supplementing mid-lactation dairy cows with palmitic, stearic, or oleic acids at 1.5% of diet dry matter. Palmitic acid supplementation consistently increased milk yield and milk fat yield by 5 - 10%. This directly enhanced the economic value of milk. Stearic acid, at the same inclusion level, was absorbed and provided energy, but it did not impact milk fat yield. Oleic acid supplementation did not affect milk yield or composition, but it improved feed efficiency and supported mobilization of body fat reserves. These effects helped cows maintain energy balance and reduce metabolic stress (Burch et al.).

These recent findings have contributed to advancements in dairy nutrition. Instead of a generic approach of feeding fat, nutritionists now use precision feeding, where fatty acid profiles can match the cow's stage of lactation and production goals. For instance, in early lactation, oleic acid helps cows recover body condition; at peak production, palmitic acid supports higher fat yields; and later in lactation, balanced fatty acid blends help maintain health and reproductive performance. These insights contributed to the recent popularity of feeding dairy cows high oleic soybeans, a suitable source of precision fatty acids.

High Oleic Soybeans Have Valuable Blend of Fatty Acids

Traditional soybeans are high in polyunsaturated fatty acids, particularly linoleic acid, which can sometimes reduce milk fat synthesis when fed to cows. Plant breeders using conventional genetic selection have developed soybean varieties with much higher oleic acid content. These varieties typically contain 70-80% oleic acid, compared to 20-25% in standard soybeans. This shift provides a more favorable fatty acid profile.

High oleic soybeans offer several documented advantages across many dairy nutrition studies. In 2024, a study from Michigan State University concluded that increasing high oleic soybeans up to 24% of dietary DM increased milk yield by 8.8 lb/d while decreasing dry matter intake by 1.5 lb/d. This effect led to an improvement in feed efficiency. (Bales et al.). Additionally, milk component yields were increased for cows supplemented with high oleic soybeans, which could be explained by an increase in energy availability due to increased dietary fatty acids. With so many benefits, are there any downsides when considering using high oleic soybeans?

Current Challenges and Outlook for High Oleic Soybeans

Availability and cost of high oleic soybean seed remain barriers, as these varieties are not yet widely grown. Farmers currently grow high oleic soybeans in 16 states across the U.S., with the highest concentration in Ohio and Indiana. Storage and processing capacities are additional bottlenecks. This is because high-oleic soybeans must be handled separately from conventional soybeans to maintain identity. Due to these challenges, dairy farmers may find it difficult to source consistent supplies, and feed mills must adapt to incorporate them efficiently. Plant breeders continue to refine soybean varieties to increase oleic content and improve agronomic performance, making them more accessible to farmers. Ongoing research is clarifying how oleic acid interacts with other fatty acids to identify blends that support efficient nutrient use while promoting both milk yield and cow health.

Conclusion

The evolution of fatty acid supplementation in dairy cow diets reflects a broader trend in agriculture, moving from crude inputs to precision nutrition and from quantity to quality. What began as simply adding calories has become a sophisticated system of adjusting fatty acid profiles to adjust cow health, milk production, and profitability. High oleic soybeans represent a viable option for achieving precision fatty acid feeding.

Upcoming Events

May 1, 2026

State Dairy Skillathon Contest

May 2, 2026

Virginia Spring Holstein Show

May 5, 2026

Optimizing Grazing with Strip Grazing and Daily Rotations (Free Webinar from the Intro to Managed Grazing Series)

May 12-13, 2026

VFGC Basic Grazing School, Madison

June 8-11, 2026

Virginia FFA Convention (Youth)

June 12th, 2026

Virginia Dairy Expo

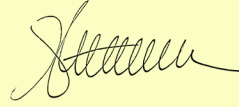
June Dairy Month & Poster Contest

If you are a person with a disability and require any auxiliary aids, services, or other accommodations for any Extension event, please discuss your accommodation needs with the Extension staff at your local Extension office at least 1 week prior to the event.

Additional Notes:

- The dairy extension group is working with VDH to assist in distributing PPE to dairy farms. Request a kit online at <https://shorturl.at/ethov> or contact your local extension agent. Requests will be filled as supplies allow.
- Your input could guide future programming! Please complete the short survey at <https://tinyurl.com/dairy-extension>.

For more information on Dairy Extension or to learn more about our current programs, visit us at VTDairy—Home of the Dairy Extension Program online at www.sas.vt.edu/extension/vtdairy.html



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