



USE FATTY ACID RESEARCH TO TAILOR YOUR COWS' RATIONS

When it comes to feeding fat in dairy cow rations, the whole ballgame has changed. A decade of research has demonstrated that not all fats are the same. Each fatty acid is unique and plays a specific role. Individual fatty acids affect digestibility, metabolism, energy partitioning and production responses. And cow response varies by stage of lactation, amount of milk produced and even the amount of forage in the diet. The same as individual amino acids have replaced crude protein in diet formulation; individual fatty acids are evolving into a precision feeding tool.

Researchers continue to investigate the nuances of individual fatty acids and cows' response to them. But existing data provides enough guidance that some nutritionists and dairy producers have already started applying it on farm and are seeing good results.

"The biggest change that producers and nutritionists need to understand is that a bag of fat is not a bag of fat," explains Adam Lock, associate professor of dairy cattle nutrition at Michigan State University. For a long time fat was seen as an easy way to add energy to the diet. However, the fat content and type of fatty acids contained in byproduct feeds is highly variable and can be problematic. But now, with the differences in cow response to individual fatty acids identified, rations can be tailored to meet cows' specific needs at different times within the production cycle.

"No one single diet is best for every lactating cow in your herd," says Lock. "The needs of the cow at 40 days in milk compared to the needs of the cow at 140 days in milk are not the same." In order to optimize cow health and productivity, rations should be tailored to meet cows' specific needs as they change throughout lactation. Feeding individual fatty acids can help you do just that.

POST PEAK MILK

New research in the November *Journal of Dairy Science* further defined which individual fatty acids work best for which cows. In de Souza et al. (2019), researchers created four blends of palmitic (C16:0) and oleic (*cis*-9 C18-1) acids from two commercially available products. The blends of

palmitic: oleic acids ranged from 80:10 to 60:30 and were supplemented at 1.5% of diet dry matter. All cows were post peak in milk production ~108 DIM at the start. Cows were grouped by milk production, low (99 lbs/day), medium (117 lbs/day) and high (132 lbs/day). Cows in the high group responded best to higher blends of oleic acid whereas cows in the low group responded best to higher levels of palmitic acid. Results include:

- Regardless of production level, increasing oleic acid did not affect dry matter intake, but it did increase fatty acid digestibility, body weight and body condition score change and tended to increase energy partitioning to body reserves in all cows.
- In high-producing cows, higher levels of oleic acid increased milk yield, fat corrected milk (FCM), energy corrected milk (ECM), protein yield, fat yield and lactose yield. Increases in de novo and preformed milk fatty acids were responsible for the increase in milk fat yield.
- In low-producing cows, higher levels of oleic acid in the ration decreased milk yield, FCM, ECM and milk fat yield. Decreases were seen in the amount of de novo and mixed milk fatty acids.
- Low-producing cows responded best to higher levels of palmitic acid.
- Increasing the amount of oleic acid fed linearly reduced FCM and ECM in low-producing cows. However, in high-producing cows as oleic acid increased FCM and ECM increased linearly.

These results build on previous research and further demonstrate that individual fatty acids do affect cows in different stages of lactation, with varying levels of milk production differently. "We continue to ask the questions, which fatty acids does the cow utilize best? What does she need to perform? Are there other nutrients she needs to get the most benefit from these individual fatty acids?" says Lock. Each new study provides more insight. But the

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research so far shows that feeding individual fatty acids to cows by their stage of lactation and milk production can be beneficial.

TRANSITION COWS

Immune response and inflammation are two competing components during the transition period, says Barry Bradford, professor of dairy science and management at Michigan State University. But new research indicates that individual fatty acids may be able to help strike a balance between the two within the cow. In addition to providing fuel, individual fatty acids also provide signals at the cellular level which can change the function of cells and organs (Bradford et al., 2016). Individual fatty acids can alter the physiology of transition cows in important ways.

Recent research has evaluated individual fatty acids during the transition period. In Piantoni et al. (2015) cows supplemented with a combination of palmitic and stearic acid during the first 30 DIM consumed more feed than non-supplemented cows. While loss of body condition in early lactation was diminished, milk production did not change. In de Souza & Lock (2019) supplementing cows with palmitic acid in the first 24 DIM significantly increased milk fat yield but also tended to increase body weight loss.

Another study by de Souza et al. (2018) supplemented cows with palmitic and oleic acid during the first 24 DIM. Supplemented cows had increased

DMI, reduced body weight loss and increased blood insulin levels. From 25 to 60 DIM all cows were fed the same lactation diet. Cows supplemented with fatty acids during the first 24 DIM had increased ECM and milk fat yield during the carryover period studied. As the amount of oleic acid included in the diet was increased, cow response improved.



"Dietary fatty acids do appear to have the potential to modulate partitioning of energy

between the mammary gland and other organs in early lactation," explains Bradford. Further research is needed, but based on current research oleic acid appears to hold the most promise for use in early lactation. Researchers are also evaluating omega-6 and omega-3 ratios as a possible pathway to decrease inflammation status of postpartum cows and enhance cows' immune system.

APPLYING ON FARM

Research with individual fatty acids has created a new avenue to tailor diets to meet cows' specific needs at different stages of lactation and at different levels of production. Palmitic, oleic and stearic acids are the individual fatty acids with the most research behind them. Current research indicates that cows receive the most benefit from supplementation with palmitic and oleic acids, says Lock. Stearic acid plays a role, but it is readily available as the end product of rumen metabolism of unsaturated fatty acids derived from other feedstuffs.

Research is on-going to further define how best to use fatty acids to supplement cows. Individual fatty acids can help address challenges on your farm, and help cows achieve their production potential. Just remember, not all fat is the same. Before buying any commercial fat product, ask for a fatty acid profile.

References available online at www.dairynutritionplus.com/enewsletter/nutrition-plus/2020-May.asp



FROM THE MATERNITY PEN

More on Hypocalcemia and Rumination Activity

Initial results from a study reported in the September issue of the Dairy Nutrition Plus newsletter showed that cows fed a negative DCAD diet (-9 mEq/kg DM) prepartum ate more, ruminated longer and had higher blood calcium levels than herd mates fed a positive DCAD diet (+196 mEq/kg DM). The full results of that study were released in the *Journal of Dairy Science* in March so more details are now available. Highlights from Goff et al. (2020) include:

- Cows that developed clinical hypocalcemia (milk fever) had very little or no detectable rumination activity for up to 36 hours.
- Cows with subclinical hypocalcemia spent less time ruminating on the first day of lactation than normocalcemic cows.
- Clinical hypocalcemic cows treated with intravenous calcium to restore blood calcium levels to normal only had a small increase in rumination which lasted just 2 to 6 hours.
- There was a strong correlation between blood calcium concentration at 12 hours after calving and rumination activity on the first and second days of lactation.
- Blood plasma calcium concentration has a continuous linear effect on rumination rate. The greater the decline in plasma calcium concentration, the greater the decline in rumination time.
- Cows fed the negative DCAD diet spent more time ruminating than cows fed the positive DCAD diet during the first 30 hours after calving.
- Cows fed the negative DCAD diet returned to 90% of their pre-calving rumination rate on day 4. That's a full day sooner than cows fed a positive DCAD diet that did not develop milk fever.

Although this study could not define the DCAD at which calcium homeostasis is optimal, the researchers do suggest that a diet DCAD that is just -9mEq/kg DM can positively affect the blood calcium and rumination status of periparturient cows. You can read the full study at <https://doi.org/10.3168/jds.2019-17581>

CONSULTANTS CORNER

Deliver Feed to Coincide with Peak Milk Synthesis

All life follows a rhythm. Seasonal rhythms occur on a 12-month cycle. Circadian rhythms are a 24-hour cycle. Migrating birds, the spring flush in milk production; your activity and alertness throughout the day, and differences between morning and evening milkings are all examples of the rhythms of life around us.



KEVIN HARVATINE
Penn State University

Cows have a daily circadian pattern of feed intake, which has a major impact on the rumen and availability of nutrients to the cow, explains Kevin Harvatine, associate professor of nutritional physiology, Penn State University. Cows eat 3 to 4 times more per hour during the day and early evening than they do during the night. In addition, cows have a daily pattern of milk synthesis. In a perfect world, the rhythm of intake and milk synthesis would be aligned, but management of cows, including the timing of feeding and milking may disrupt the synchrony of these rhythms. If the daily pattern of nutrient absorption is not aligned with the rhythm of milk synthesis, milk production is probably limited and body weight gain may occur.

Research shows that managing the photoperiod to provide 16 to 18 hours of light vs 8 to 10 hours of light leads to a 5 to 10% increase in milk yield without a change in milk composition (Dahl & Petitclerc, 2003). A short photoperiod during the dry period also increases milk yields in the subsequent lactation by stimulating mammary development (Auchtung et al., 2005). The cow utilizes the same basic signaling for both seasonal and circadian rhythms. This indicates that lighting and daily rhythms have a big impact on milk synthesis and is important to the mammary gland.

Quist et al. (2008) showed that milk yield and composition vary between milkings. While the synthesis of protein is fairly constant, milk yield is highest and milk fat concentration is the lowest at the morning milking, and milk yield drops and milk fat concentration increases as the day progresses.

Research by Rottman et al. (2014) showed that the daily rhythm or pattern of milk fat and milk yield synthesis could be altered by feeding four times a day instead of once a day. Milk fat yield was increased over 0.25 units across the day and also decreased the variation in milk fat concentration over the day by over 50%.

So how can you use this information? Harvatine recommends that you think of the rumen first. Can you feed more often to stabilize the amount of fermentable feed entering the rumen throughout the day? Feed delivery is a very strong stimulus to bring cows to the feed bunk. Feeding twice per day can be a big advantage if the feeding times are correctly selected. Feeding in the early morning before milking and between milking will increase intake during two periods that are normally lower in feed intake. Make sure feed is available (delivered fresh or pushed up) each time cows return from the parlor and monitor cow behavior to ensure optimal application on each farm.

He also shared an interesting example from the field. A dairy producer had two groups of high production cows being fed the same ration. However, one pen consistently had a lower milk fat content—a difference of 0.3 to 0.5 units—than the other. He moved 15 cows from one pen to the other, and their milk fat content increased to match the rest of the pen. The only difference between the two pens was the time of day cows were fed. The high group that was underperforming its peer group was not fed until 11:30 a.m. The other group was fed earlier in the morning. Milking and feeding order were switched so that feeding times were similar and soon the underperforming group was matching performance of the other high production group.

There is still more to learn on how best to match feeding, milking and lighting schedules, but considering these factors and the natural daily pattern of feed intake and milk synthesis provides an additional avenue to help maximize cow production and efficiency.



BEYOND BYPASS

Prepartum BCS Does Not Impact RPC Response

When it comes to feeding transition cows rumen-protected choline (RPC) recommendations have not been consistent. This has led to speculation that perhaps over-conditioned cows, those already predisposed to developing fatty liver, receive greater benefit from feeding RPC.

Researchers at the University of Florida conducted a study to answer this question. In Bollatti et al. (2020) researchers evaluated the effects of supplementing 192 transition cows with RPC from 21 days prepartum to 21 days postpartum. Supplemented cows received 12.9 grams/day of choline ion and control cows received 0. (Supplemented cows were fed 60 grams/day of a commercial RPC product that contained 28.8% choline chloride which supplied a daily dose of 12.9 grams of choline ion). Body condition score (BCS) and body weight were tracked throughout the study. At the beginning of the study, when cows entered the close-up group, the mean BCS was 3.51 for both control and supplemented groups with a BCS range of 2.69 to 4.25. Data on production and on metabolic responses were collected through 105 days in milk. Results showed that all cows supplemented with RPC—no matter what their BCS at the start of the study—increased their milk yield by 4 lbs/day. Yields of fat, lactose, energy corrected milk and fat corrected milk also were increased in all RPC-supplemented cows compared to non-supplemented cows. However, dry matter intake did not increase, and the production response was not at the expense of body weight or BCS. That means cows fed RPC were more efficient at converting feed into milk. Although over-conditioned cows were more apt to develop fatty liver and had higher levels of fat mobilization, when supplemented with RPC the over-conditioned cows had similar increases in milk yield and in milk components as cows with low or moderate BCS.

More research is needed to understand how choline improves nutrient utilization for milk synthesis. But one thing is clear; transition cows supplemented with RPC had improved yields of milk, milk components and increased efficiency of feed utilization in the first 105 days of milk irrespective of their BCS. You can read the full study at <https://doi.org/10.3168/jds.2019-17302>



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HAPPENINGS

Your Partner Through This

In times of uncertainty, reliability matters more than ever. As we all work through the impact of COVID-19 together, our team at Landus will continue to deliver what we've always promised: quality, consistency and supply chain reliability. As you navigate more changes than ever, know that our team remains committed to delivering unwavering consistency in our products to eliminate one less variable beyond your control. Our SoyPlus and SoyChlor manufacturing teams continue to practice social distancing and follow CDC guidelines to maintain a safe working environment for essential employees. Our quality management team has adapted their processes to continue monitoring quality controls safely. As our farmer-owners in Iowa shift into spring planting local teams are offering digital communication tools and contactless services to ensure an uninterrupted supply of locally-grown soybeans for our future. From seed to feed, our team is witnessing the resiliency of the ag industry amid this pandemic. The work you do to provide safe and nutritious food to our world matters. Our Landus family thanks you, and we remain open for business to serve you.