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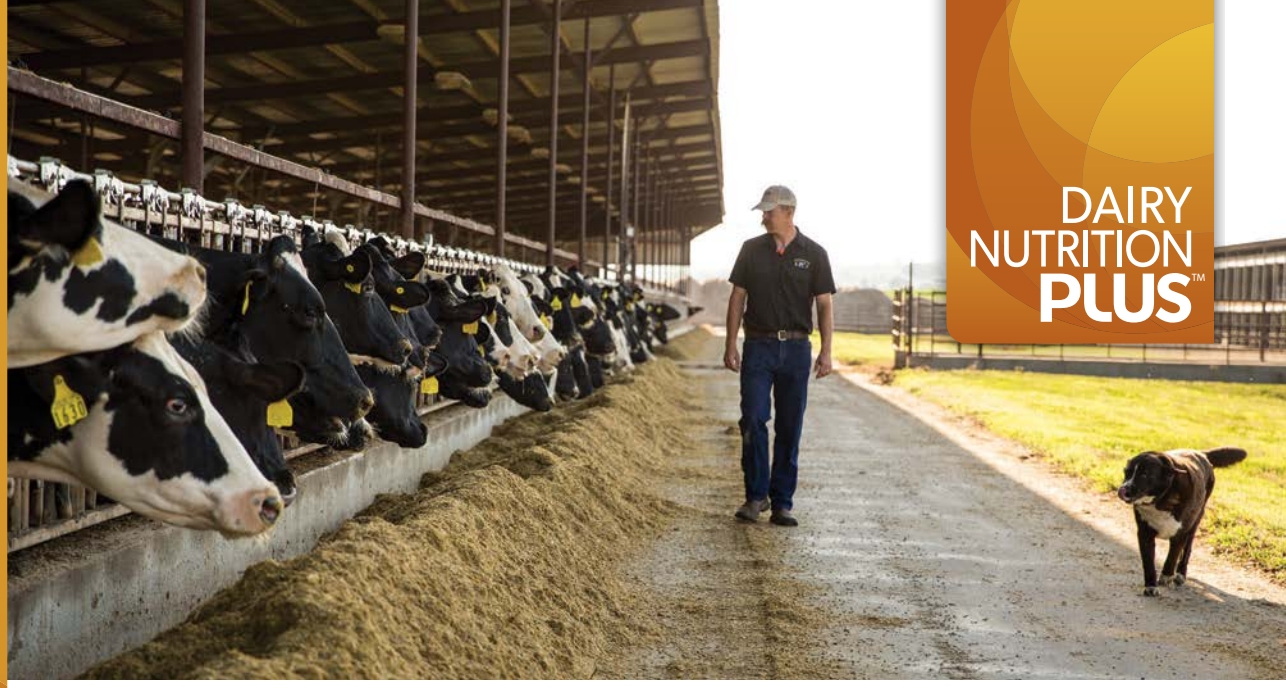

DAIRY NUTRITION PLUS™

# INDIVIDUAL FATTY ACIDS WILL LEAD TO MORE PRECISION FEEDING

When it comes to fat supplementation, new research has created a whole new ballgame. All fats supply energy to the diet. But individual fatty acids also affect digestibility, metabolism, energy partitioning and production responses in dairy cows. Timing of supplementation, stage of lactation and even the amount of forage in the diet all affect how cows respond.

This is an exciting time in dairy nutrition, says Adam Lock, associate professor of dairy cattle nutrition at Michigan State University. Research shows that not all fats are the same. Just as amino acids have replaced crude protein in diet formulation, individual fatty acids will replace dietary fat and supplemental fat in diet formulation.

About 10 years ago palmitic supplements became widely available in the United States. Nutritionists were asking if it was the same as other fats they were feeding. At the time, prevailing thought was that one saturated fatty acid would be similar to another saturated fatty acid. That they all behaved the same.

"Then we started looking into the research and found that might not be the case. We also looked at research with omega-3 and omega-6 in humans and soon realized that not all fatty acids were the same," explains Lock. "That led us down a new path of scientific discovery." Today, research clearly shows that not all fats are the same. Each fatty acid is unique and plays a specific role.

## UNDERSTANDING FATTY ACIDS

All of the fats traditionally fed are byproducts of other industries. None were developed with the specific needs of the dairy cow in mind. But because fats have a higher energy density than carbohydrates and proteins, it makes sense to feed them to provide extra energy.

Fresh cows in a negative energy balance and high-producing cows need a lot of energy. Adding energy-dense fats to the diet boosts the overall energy in the diet without requiring the cow to eat more. But too much fat in the diet can have negative consequences, too.

That's where the new research comes in to play. "We are trying to utilize existing products in different ways. We are not just looking at fat as an energy source, but as part of precision feeding to meet cows' needs," says Lock. In their research his team blends three or four commercial fats to create specific fatty acid profiles to best match the cows' needs. Palmitic acid (C16:0) and oleic acid (cis-9 C18:1) show the most promise so far. They have also studied stearic acid (C18:0) and plan to examine omega-3 and omega-6 fatty acids in the future.

## THE RESEARCH

Scientific discovery is generally a series of small, incremental steps. Researchers have examined the effects of fatty acids individually, and in different combinations and ratios on digestibility, energy partitioning, milk yield, component yield and changes in body condition. What they have discovered is that stage of lactation, amount of forage in the diet and even different fatty acid profiles all lead to unique responses in the cow.

In de Souza et al., 2016, individual cow data from 10 studies that fed palmitic acid supplements to post-peak dairy cows was analyzed. Milk fat yield and energy corrected milk (ECM) increased linearly with increasing palmitic supplementation. NDF digestibility also improved with supplementation but dry matter intake (DMI) did not change. Another study by Piantoni et al., 2015b, found that a combination of palmitic and stearic acids increased NDF digestibility in low forage diets but not in high forage diets.

In de Souza et al., 2018, when palmitic acid was fed in combination with oleic acid, it increased the energy allocated to body reserves. And when fed in combination with stearic acid (C18:0), it decreased nutrient digestibility.

Research with post-peak cows producing <95 lbs/day of milk supplemented with palmitic acid partitioned more energy toward milk production. But higher producing cows did not. Instead, cows producing 120 lbs/day or more of milk partitioned more energy toward milk production when supplemented with palmitic and oleic acids (de Souza and Lock, 2017a). This may suggest that palmitic and oleic acids are able to alter energy partitioning between the mammary gland and adipose tissue.

In a follow up study the timing of palmitic acid supplementation on performance of early lactation cows (1 to 24 days in milk) was examined. Compared to non-supplemented cows there was no difference in DMI or milk yield. However, cows supplemented with palmitic

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## INDIVIDUAL FATTY ACIDS WILL LEAD TO MORE PRECISION FEEDING

acid produced more ECM, about 10 lbs/day consistently over time. Supplemented cows also lost more body weight, ~50 lbs. In comparison, cows fed palmitic acid from 25 to 67 days in milk had increased milk yield, 7 lbs/day; increased ECM, 10.1 lbs/day; and lost about 22 lbs more body weight than non-supplemented cows (de Souza and Lock, 2017b).

And at this summer's American Dairy Science Association meeting, several abstracts by Michigan State researchers demonstrated that altering the dietary ratio of palmitic to oleic acids; and stearic acid to oleic acid changes how cows respond. Production responses, DMI, milk yield and ECM of high-producing cows improved with more oleic acid in the diet while lower-producing cows responded better to more palmitic acid in the diet. In the second study with differing ratios of stearic to oleic acids, compared to non-supplemented cows, all cows that received the fatty acid supplements had increased milk yield, ECM, fat yield and preformed fatty acids in the milk, but nutrient digestion was improved with the higher level of oleic acid supplements.

Fatty acids affect reproduction, too. Research at the University of Florida with omega-3 fatty acids showed that feeding very long-chain fatty acids improved first-service or overall pregnancy rates in six studies.

### LOOKING FORWARD

The data speaks for itself, says Lock. Research has demonstrated that individual fatty acids have a direct effect on several metabolic processes. Feedback from dairy nutritionists and producers that have started focusing on fatty acid profiles in their nutrition programs is positive. But there is still more to learn.

Fatty acids are present in all feeds. Forages contain about 2 to 3% fatty acids, and diets are often 50% forage. That means to feed a precise fatty acid profile, you must pay attention to all sources of fatty acids in the diet.

New research will continue to delineate fatty acids' effects on lactating dairy cows so that the ideal combinations of fatty acids to feed cows under specific physiological conditions and for specific purposes can be identified.

Not all fats are the same. And if someone wants to sell you a fat supplement, your first question should be, "What is the product's fatty acid profile?"

## HAPPENINGS

### *Exclusive Webinar: Understanding Dietary Calcium Requirements of the Prepartum Dairy Cow*

You're invited! Join our webinar December 11, 2018, to learn more about the dietary calcium needs of pre-fresh dairy cows. We'll take a thorough look at what the research shows us to date and address some common misinterpretations of the research that may be causing confusion. Our team will address a variety of questions commonly heard in the field, including:

- What are the metabolic calcium requirements of the prepartum cow?
- How do metabolically acidified cows metabolize calcium differently than metabolically alkalotic cows, and why does that matter?
- Is there justification for extremely high calcium in the diet?
- Does source of calcium matter?

Go to blog.dairynutritionplus.com and register today to join the discussion.

## FROM THE MATERNITY PEN

### *Reduce Cows' Odds for Uterine Disease*

Uterine disease occurs in nearly 50% of all dairy cows after calving. Affected cows often experience reduced reproductive performance, reduced milk production, increased risk for culling and shorter productive lifespans. The cost is significant.

Retained fetal membranes, metritis, endometritis and pyometra are the most common. Research has identified metabolic stress, which leads to disrupted immune function, as a common denominator across uterine diseases, explains Fabio Lima, assistant professor of veterinary clinical medicine at the University of Illinois. Metabolic stress during the transition period compromises the immune system's ability to recognize fetal membranes and pathogens thereby making the cow more susceptible to uterine disease. Use the following management strategies to minimize the risk of metabolic stress.

### NUTRITION

Feed the close-up diet for three to four weeks. In a one group system, feed the dry diet for six weeks. Feed to meet but not exceed energy requirements. Cows should calve with a body condition score between 3.0 and 3.5. Strive for at least 3% leftover feed. Provide dry cows with at least 1,000 IU of vitamin E per day (up to 2,000 IU per day) and 0.3 ppm of selenium. Cows need 30 inches of bunk space (or four cows for every five headlocks) and at least 4 inches of waterer space with two water sources per pen. Feed close-up cows a negative DCAD diet to prevent hypocalcemia.

### COW COMFORT

Aim for a stall stocking density of ≤ 85% or 120 sq. ft. of bedded pack/cow. Build the maternity pen to accommodate 130 to 140% of average monthly calvings. Allow cows <24 hours to adapt to maternity pen. House heifers separately from mature cows. Minimize group changes. And use heat abatement strategies for all cows when the temperature humidity index is 68 or higher.

### OTHER FACTORS

Use immunizations to prevent infectious diseases. Consider using sexed semen and/or calving ease bulls, and train personnel to know when and how to assist with delivery. Monitor cows for signs of disease and treat if indicated. Make sure employees have the training needed to monitor just fresh cows. Consider new technologies such as rumination monitors which can help find sick cows sooner.

## CONSULTANTS CORNER

### *Gut Health Key to Immune Function*

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When it comes to immune system function, most people don't think about the gastrointestinal tract, but they should. The gastrointestinal tract is the largest organ of the immune system. It serves as a physical and chemical barrier to prevent intrusion of foreign substances or organisms into the body.

Most people think of digestion and absorption of nutrients as the primary role of the gastrointestinal tract. But the gut also serves as the first line of defense against pathogens and toxins, too. The gut's mucus layer, tight junction proteins and chemical signaling pathways protect against potential invaders. Anything that impacts gut health can also impact the gut's ability to carry out all of its roles. Reduced animal performance and immune dysfunction can and do happen when gut health is compromised.

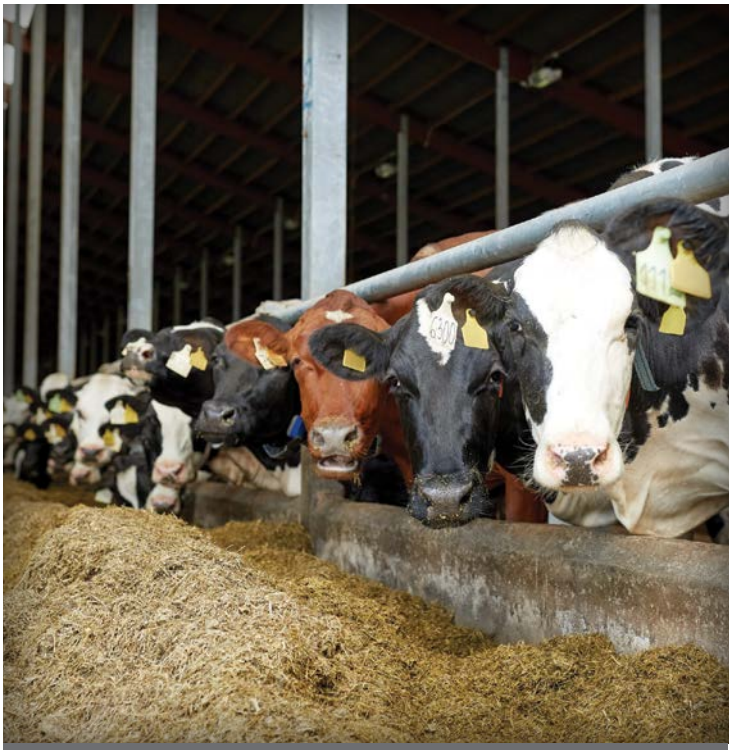
Several factors can negatively impact gut health. But stress and reduced feed intake are the most common culprits. Stressful events such as heat stress, calving, pen moves, restricted feed intake from overcrowding or too much time spent away from the bunk can all negatively affect the gastrointestinal tract. Work by Kvidera et al., (2017a) demonstrated that feed restriction in dairy cows compromises gut integrity. Increasing feed restriction resulted in changes to the intestinal epithelium which reduced the size of the villi. This change could negatively impact digestion and absorption as well as lead to loss of the effectiveness of the gut's barrier function.

The gut is a dynamic system. Dysfunction can occur within a few hours of undergoing stress or feed restriction. Depending on the severity of the stress, normal gut function may be restored within a few days. During this period of dysfunction animal performance is subpar and may remain low even after the stress factor or event has been overcome.

At this point there is no clear diagnosis for gut barrier dysfunction. Yet we know it occurs. Animals that suffer from dysfunctional gut barrier can present a myriad of signs all of which affect animal performance. But more importantly, there is a cascade of physiological changes that occur when gut integrity is compromised and these changes allow bacteria or toxins to get into the gastrointestinal tract. When this happens, the body mounts an immune response which diverts energy away from milk production and/or animal growth to immune function.

Research by Kvidera et al., (2017b) estimated that the activated immune system uses about 2.2 lbs of glucose in a 12-hour period. In terms of milk production, that amount of glucose would be enough to synthesize about 33 lbs of milk. In terms of protein production, the 2.2 lbs of glucose is enough to synthesize about 410 grams of protein. In addition, both tight junctions and mucins are proteins. The body may also divert amino acids from other functions to help restore gut integrity. Energy and protein used to restore gut health are not available for production functions. That's why subpar rates of gain, lower than expected feed efficiency and cows not milking as expected can all be signs of gut barrier dysfunction.

While research has used acute stimulus to study gut barrier dysfunction, it is reasonable to think that less intense situations which are commonly present on farm can impair gut health. Feed restriction of any form—overstocking, not in the pen to eat, empty bunks, social stress from pen moves, calving or heat stress—can all negatively impact gut health. And when repeated frequently, the cumulative stressors can lead to gut dysfunction. Feeding to meet animals' dietary needs is just the starting point. Management and feeding practices should also promote and support gut health and integrity. More research is needed to better understand and develop a diagnosis for gut barrier dysfunction. But based on current knowledge, producers need to be aware of and use management and feeding strategies to avoid the problem.



# BEYOND BYPASS

### *Feeding RPC Improves Liver Function*

Transition cows that experience negative energy balance are more apt to develop fatty liver and the negative consequences on health, milk production and reproduction that go with it. Excess fats can start accumulating in the liver in as little as 24 hours after feed intake dips before calving.

New research in the July *Journal of Dairy Science* looked to solve that problem by feeding rumen protected choline (RPC). Marcos Zenobi, PhD candidate, and Charles Staples, professor of dairy science at the University of Florida, sought to determine the optimal amount of RPC to feed in order to reduce the accumulation of triacylglycerol (TAG) in the liver of pregnant dairy cows, thereby lowering their risk for fatty liver.

In the study, 77 non-lactating, pregnant cows were fed the same diet ad libitum for 5 days. On days 6 to 14 cows received a restricted diet, about 32% of their net energy requirements, in order to simulate the negative energy balance commonly seen in early-lactation cows. RPC supplementation ranged from 0 to 25.8 grams/day of choline ions. Methionine intake was held constant in order to isolate the effect of RPC.

Feeding RPC ions, up to 25.8 grams/day, improved the liver's ability to break down and export fats. Researchers saw a 37% decline in the amount of TAG accumulation in the liver compared to non-RPC supplemented cows. Feeding RPC ions also increased the concentration of hepatic glycogen which decreased the hepatic ratio of TAG to glycogen by 51%. Research from Drackley et al., 1992, showed that when the hepatic ratio of TAG to glycogen exceeds 1.5 to 2.0, the risk of ketosis increases. In this experiment, all cows fed RPC ions had ratios lower than 1.2. Positive benefits from feeding RPC started with just 6.5 grams/day of choline ions and increased with amounts up to 25.8 grams/day. Concentration of TAG in blood plasma was increased in cows fed RPC, possibly indicating improved absorption of dietary fat due to RPC supplementation.

To read the full study: https://doi.org/10.3168/jds.2017-13973

LANDUS COOPERATIVE

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## QUALITY CORNER

### *Not All pH Test Strips Are Created Equal*

Accuracy is important, especially when it comes to pH test strips. Incorporating a DCAD management program for close-up dairy cows is a simple, proven way to improve transition cow health and increase profitability. Measuring urine pH is the simplest on-farm tool to help ensure you are managing your DCAD program the way you intend to.

This was the subject of a presentation at the 2015 ADSA Annual Meeting. Abstract #M3, *Evaluation of pH test strips for accuracy in determining pH of cow urine,* (J. Dairy Sci. 98: (Suppl. 2), page 8) looked at nine different commercial brands of pH strips. Only one brand got it right the majority of the time.

Producers must be aware of the variations in accuracy among commercially available brands of pH test strips as they rely on urine pH to measure the effect of feeding anionic supplements in their pre-fresh transition cow program. Other accurate brands do exist, but it's important to test those strips against a calibrated pH meter or ask your SoyChlor sales manager about their recommended brand.

For additional information about understanding urine pH testing in your DCAD management program, watch our recent webinar at https://www.youtube.com/watch?v=XpU6ZaX1sno